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11n RT3070 USB

Test Report

Approvals		Date
Checked by	Arvin/Vincent/Jason	2008/6/3
Verified by	Gary	2008/6/6
Approved by	LS	2008/6/6

"THIS REPORT PROVIDES A SAMPLE UNIT MEASUREMENT, WHICH IS NOT SUITABLE AND IS PROHIBITED TO BE USED TO SETUP MFG CRITERIA…"

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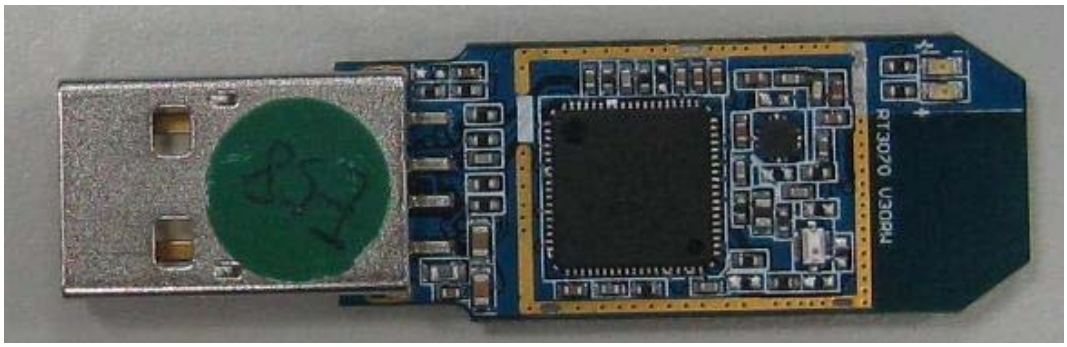
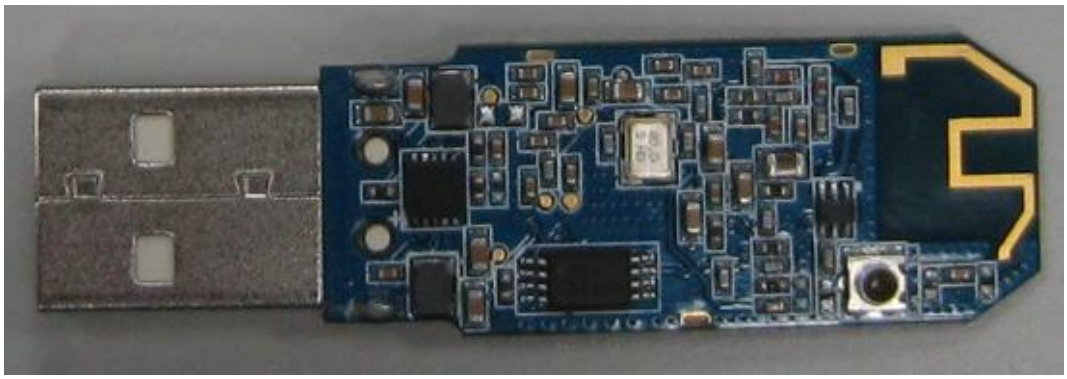
➢ DUT information

DUT Information			
H/W			
MAC/BBP: RT3070		**RF: RT3070**	**Interface: USB**
External LNA: NA		**PA: 2.4GHz** **RTC6681**	**PA+LNA: NA**
Front end Type:	**TX: 1**	**Other:**	
	RX: 1		
S/W			
Driver Version: QA RT3070 V1.0.0.1		**Utility Version:** **not ready**	
Other Parameter: ☐Default ☐ _____			

Chipset Information		Board Information
Type	**MAC/BBP/ Transceiver**	
Part Number	RT3070L	V30RW-1X1
Lot Number	PA89270E0	
Date Code	0821STE	

DUT Figure





1. Basic RF Testing

1.1. Transmit Spectrum Mask

- **Purpose**

  To verify the transmitter spectrum of the Device Under Test (DUT) is below conformance limit.

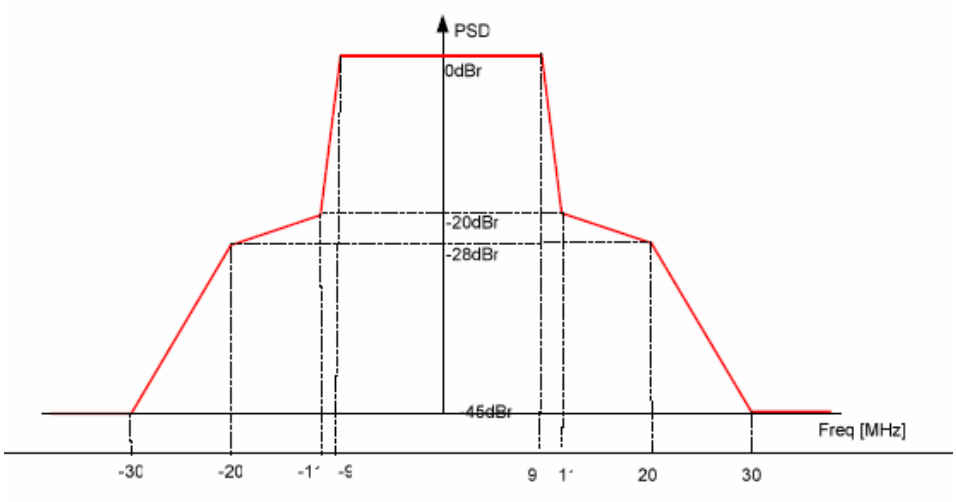


Figure 1- 1 Transmit spectrum mask limitation for 11n 20MHz

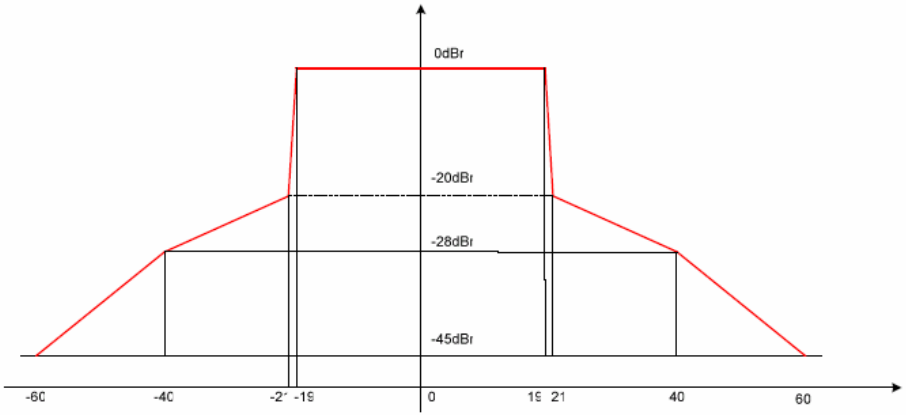


Figure 1- 2 Transmit Spectrum Mask Limitation for 11n 40MHz

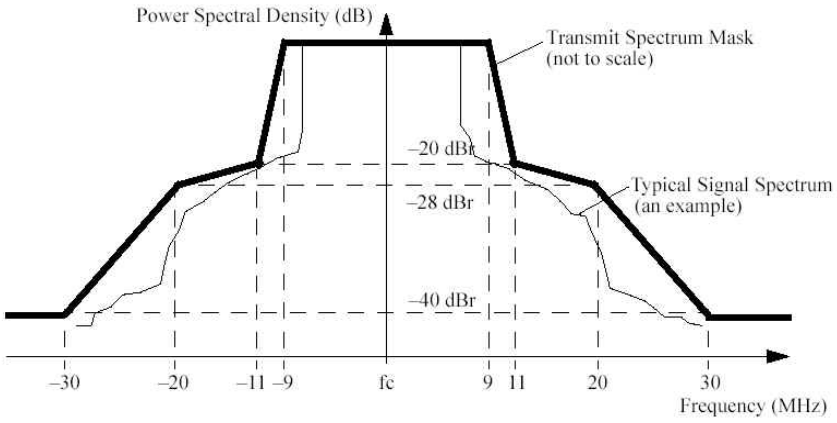


Figure 1- 3 Transmit spectrum mask limitation for 11g

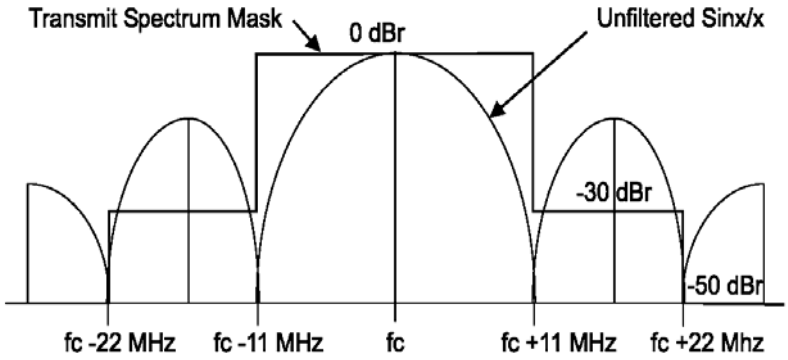


Figure 1- 4 Transmit spectrum mask limitation for 11b

- **Equipment**
  1. Spectrum Analyzer
  2. QA test.
- **Test Environment**

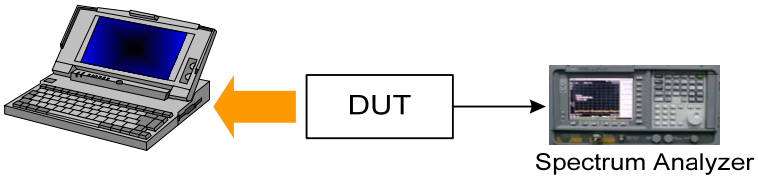


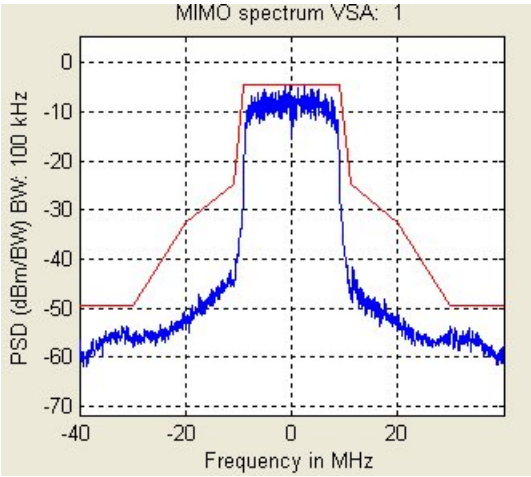
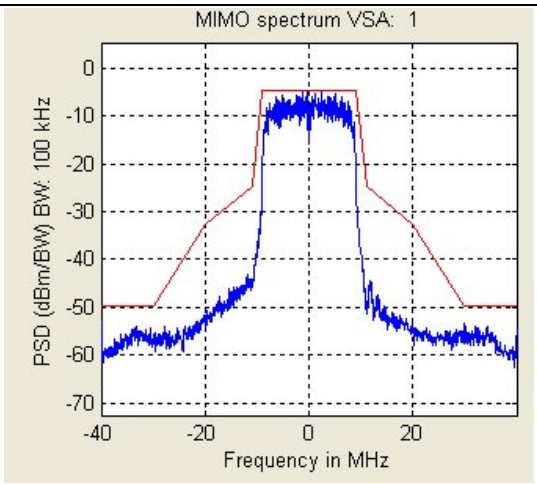
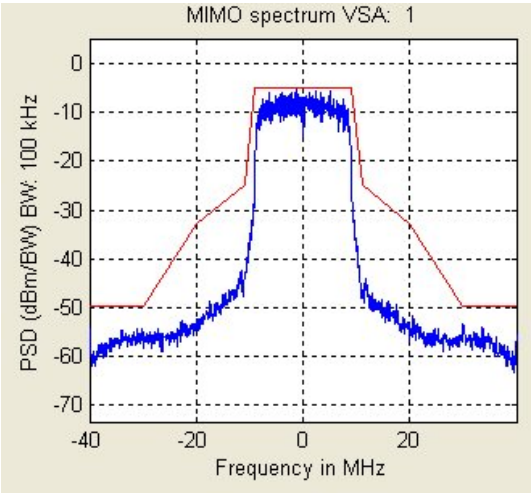
Figure 1- 5 Transmit Spectrum Mask Test Setup

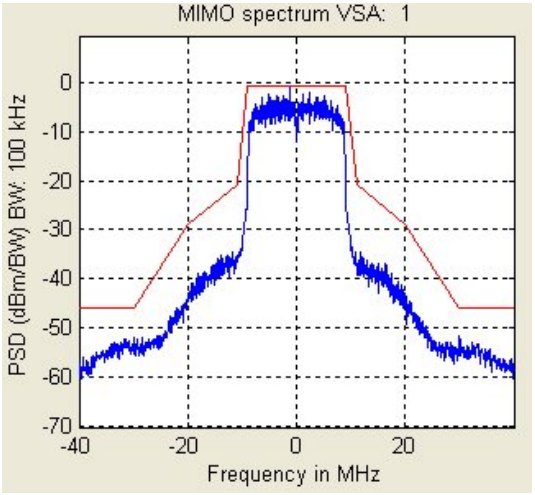
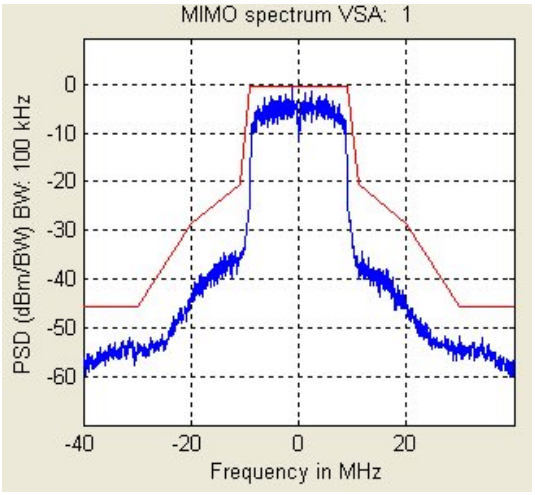
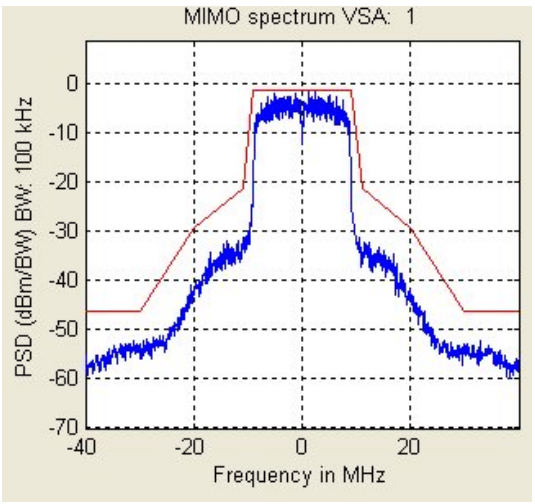
- **Procedure**
  1. Configure the hardware setup as Figure 1-5.
  2. Select test channel and set “Conti. Tx” from the QA test utility.
  3. Record the transmit spectrum mask from Spectrum Analyzer.
- **Pass Criteria**
  1. For transmitted spectral mask for 11n 20MHz shall be less than –45dBr for fc–30MHz<f<fc+30MHz.
  2. For transmitted spectral mask for 11n 40MHz shall be less than –45dBr for fc–60MHz<f<fc+60MHz.
  3. For transmitted spectral mask for 11g shall be less than –40dBr for fc–30MHz<f<fc+30MHz.
  4. For transmitted spectral mask for 11b shall be less than –50dBr for fc–22MHz<f<fc+22MHz.

➢ **Test Result**

The output spectrum test results were shown in Table 1-1, 1-2, 1-3 & 1-4.

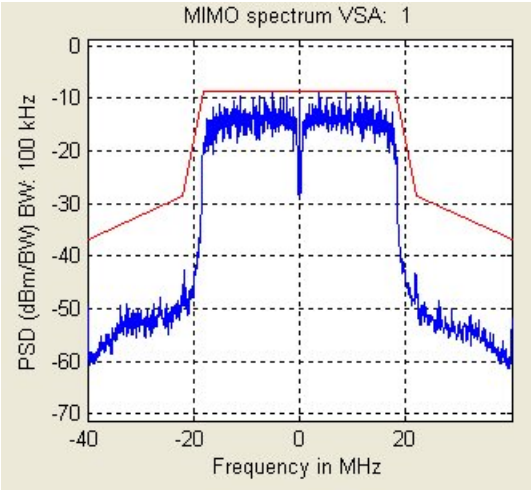
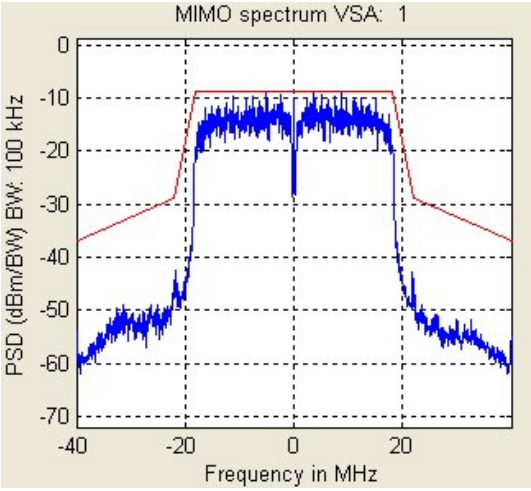
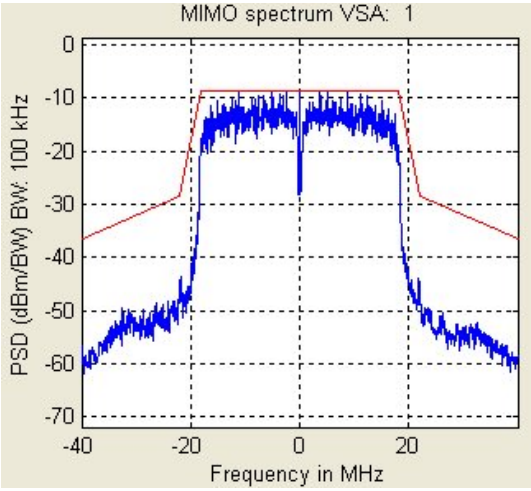
Table 1- 1 11n 20MHz mode output spectrum test results

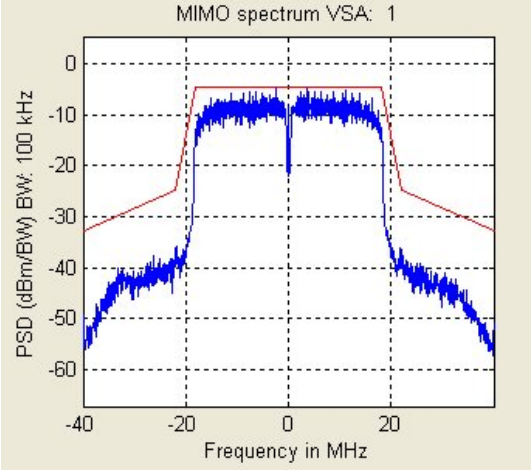
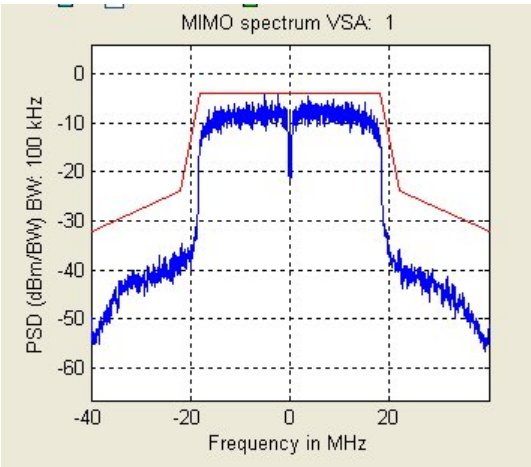
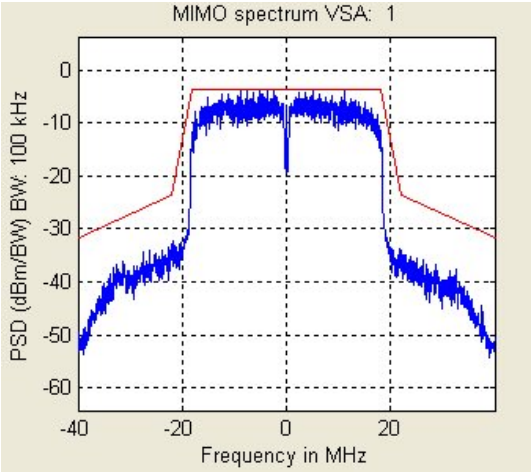
Channel	Test Records on Spectrum Analyzer	Result
CH 1 MCS7		**Pass**
CH 7 MCS7		**Pass**
CH 13 MCS7		**Pass**

CH 1 MCS0		**Pass**
CH 7 MCS0		**Pass**
CH 13 MCS0		**Pass**

* Cable Lose = 3dB

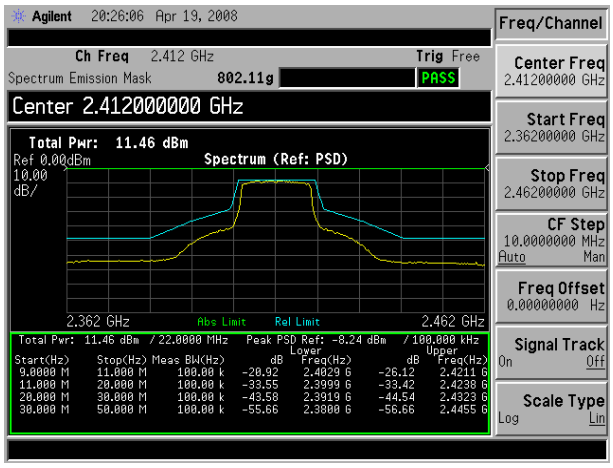
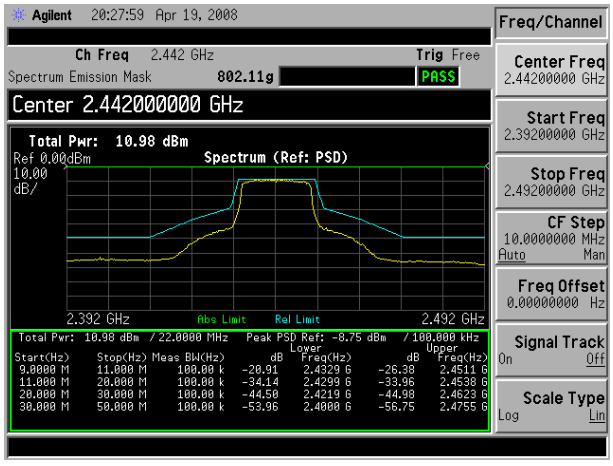
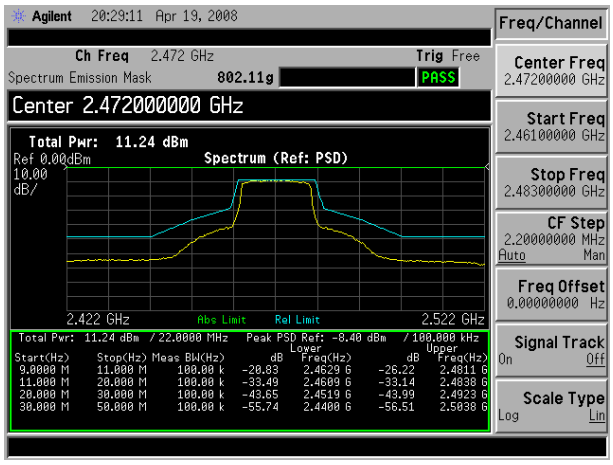
Table 1- 2 11n 40MHz mode output spectrum test results

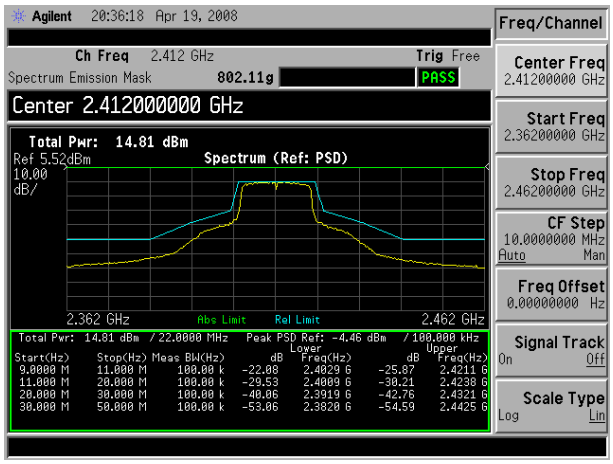
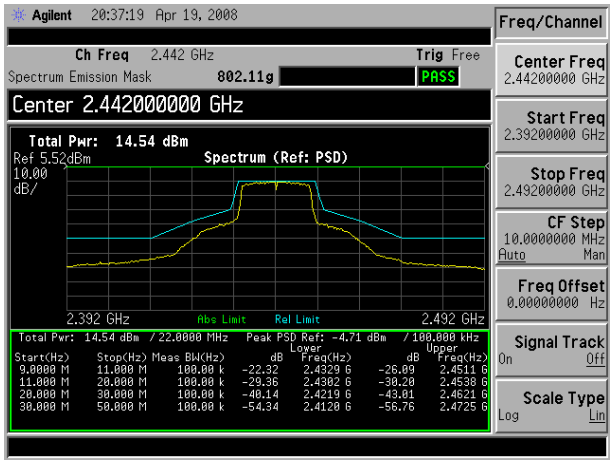
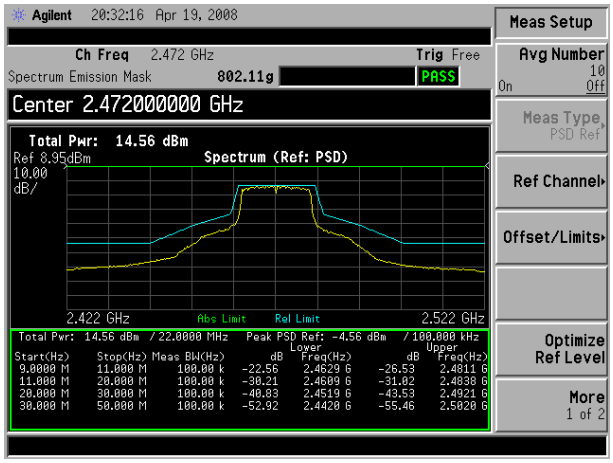
Channel	Test Records on Spectrum Analyzer	Result
CH 3 MCS7		**Pass**
CH 6 MCS7		**Pass**
CH 9 MCS7		**Pass**

CH 3 MCS0		**Pass**
CH 6 MCS0		**Pass**
CH 9 MCS0		**Pass**

* Cable Lose = 3dB

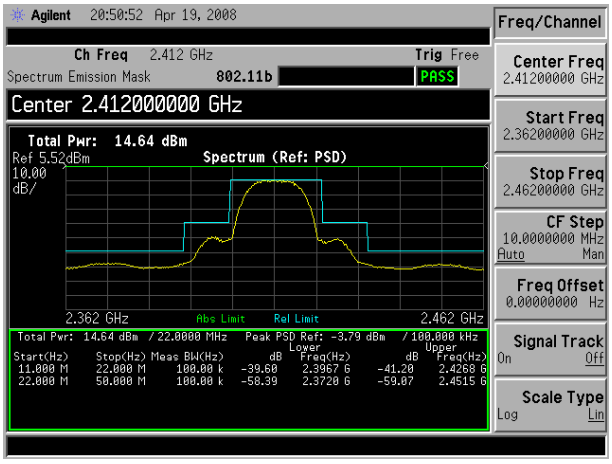
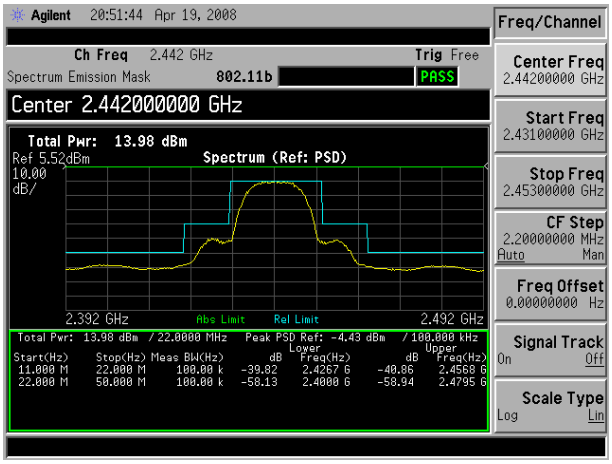
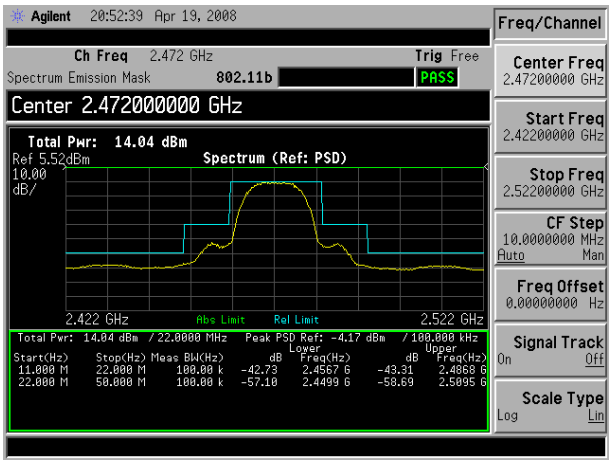
Table 1- 3 11g mode output spectrum test results

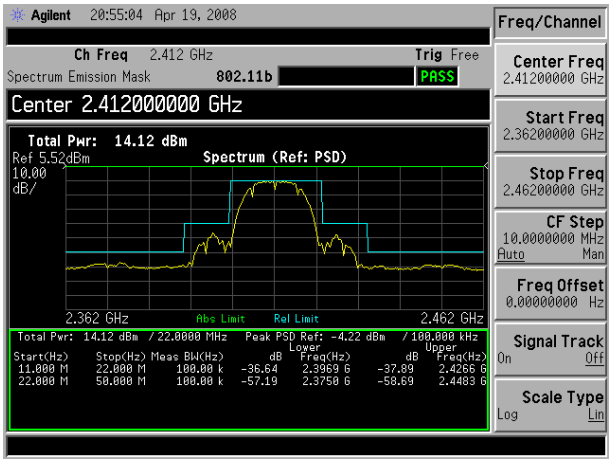
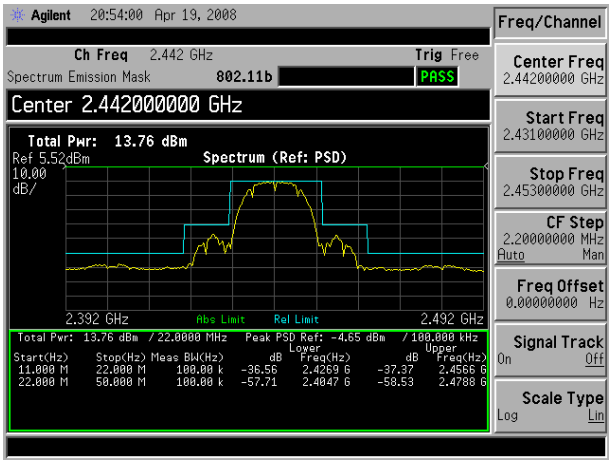
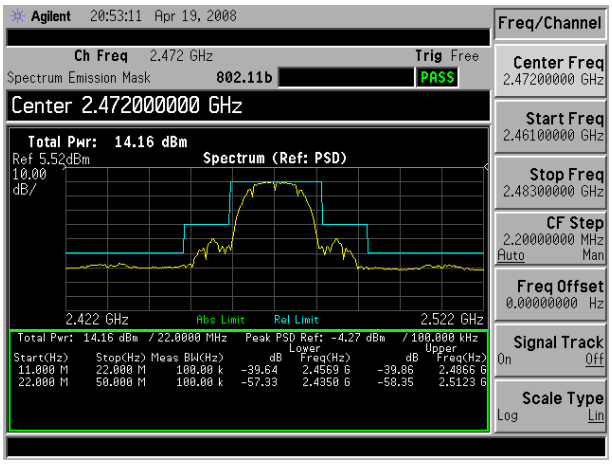
Channel	Test Records on Spectrum Analyzer	Result
CH 1 54Mbps		**Pass**
CH 7 54Mbps		**Pass**
CH 13 54Mbps		**Pass**

Channel	Test Records on Spectrum Analyzer	Result
CH 1 6Mbps		**Pass**
CH 7 6Mbps		**Pass**
CH 13 6Mbps		**Pass**

* Cable Lose = 3dB

Table 1- 4 11b mode output spectrum test results

Channel	Test Records on Spectrum Analyzer	Result
CH 1 11Mbps		**Pass**
CH 7 11Mbps		**Pass**
CH 13 11Mbps		**Pass**

Channel	Test Records on Spectrum Analyzer	Result
CH 1 1Mbps		**Pass**
CH 7 1Mbps		**Pass**
CH 13 1Mbps		**Pass**

* Cable Lose = 3dB

1.2. Transmitter Power

- **Purpose**

  The test is to measure the Device Under Test (DUT) transmitter output power.

- **Equipment**

  1. Spectrum Analyzer
  2. QA test

- **Test Environment**

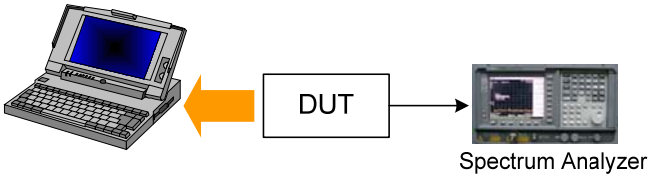


Figure 1- 6 Transmitter power test setup

- **Procedure**

  1. Spectrum analyzer setup: RBW 100KHz, VBW 100KHz.
  2. Select test channel and set “Conti. Tx” from the QA test utility.
  3. Record the output power from spectrum analyzer.
  4. Repeat sequence 3 and 4 to measure TX power for other channels and operation modes.

- **Pass Criteria**

  1. For 11n 20MHz as following table and based on the transmitted spectral mask less than –45dBr for fc–30MHz<f<fc+30MHz.
  2. For 11n 40MHz as following table and based on the transmitted spectral mask less than –45dBr for fc–60MHz<f<fc+60MHz.
  3. For 11g as following table and based on the transmitted spectral mask less than –40dBr for fc–30MHz<f<fc+30MHz.
  4. For 11b as following table and based on the transmitted spectral mask less than –50dBr for fc–22MHz<f<fc+22MHz.

➢ **Test Result: Unit in dBm**

Table 1- 5 Transmitter power test results @ 25℃

11b mode:

Mode	Rate	Ch 1	Ch 17	Ch 13
11b CCK	1Mbps	16.7	16.9	17.1
	2Mbps	17.0	17.1	16.9
	5.5Mbps	16.6	16.9	16.9
	11Mbps	16.9	17.3	17.1

11g mode:

Mode	Rate	Ch 1	Ch 7	Ch 13
11g OFDM	6Mbps	16.7	16.9	17.0
	18Mbps	17.3	17.3	17.1
	36Mbps	15.6	15.8	15.8
	54Mbps	13.9	14.0	13.9

11n 20MHz mode:

Mode	Rate	Ch 1	Ch 7	Ch 13
11n 20MHz	MCS0	16.6	16.8	16.9
	MCS3	17.2	17.3	17.1
	MCS5	15.3	15.5	15.5
	MCS7	13.3	13.6	13.6

11n 40MHz mode:

Mode	Rate	Ch 3	Ch 6	Ch 9
11n 40MHz	MCS0	16.7	17.1	17.7
	MCS3	17.5	17.6	17.8
	MCS5	15.8	16.3	16.2
	MCS7	13.2	13.7	14.2

1.3. Transmit Spectrum Flatness

- **Purpose**

  To verify the transmit spectrum flatness of the Device Under Test (DUT).

  For 802.11a/g the average energy of the constellations in each of spectral lines –16..-1 and +1..+16 will deviate no more than +/- 2dB from their average energy.

  For 802.11n 40MHz mode, the average energy of the constellations in each of spectral lines –42..-2 and +2..+42 will deviate no more than +/- 2dB from their average energy.

- **Equipment**

  1. Spectrum analyzer
  2. QA test.

- **Test Environment**

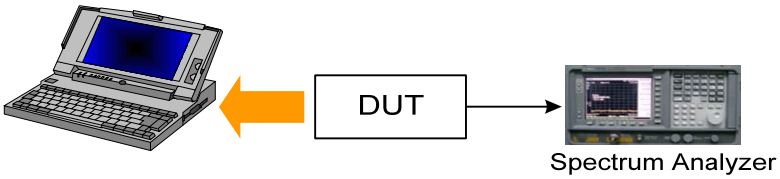


Figure 1- 7 Transmit spectrum flatness test setup

- **Procedure**

  1. Spectrum analyzer setup: RBW 100KHz, VBW 100KHz.
  2. Select test channel and set “continuous TX” from the QA test utility.
  3. Determine the pass/fail status of the output spectrum observed from the Spectrum analyzer.
  4. Repeat the test sequence 2 to 3.
  5. Measurement for data rate 54Mbps for 802.11a/g and MCS15 for 802.11n.

- **Pass Criteria**

  The transmitted spectral flatness should be with in +2/- 4dB.

➢ Test Result

Table 1- 6 802.11g transmit spectrum flatness test results

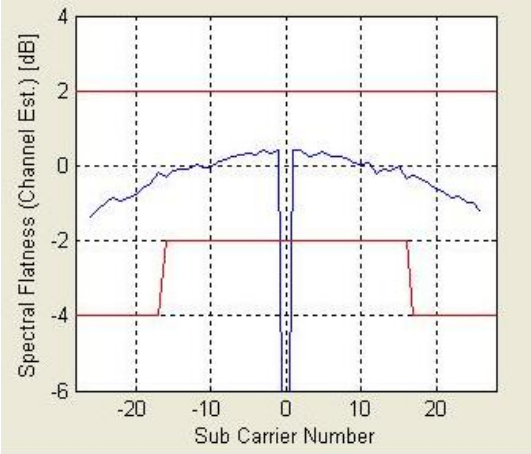
Channel	Test Records on Spectrum Analyzer	Result
CH 7		**Pass**

Table 1- 7 802.11n 20MHz transmit spectrum flatness test results

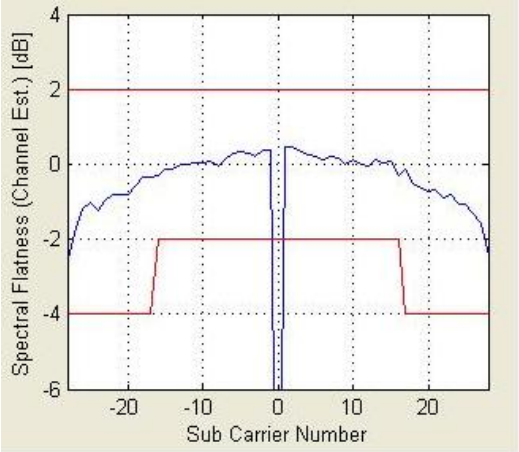
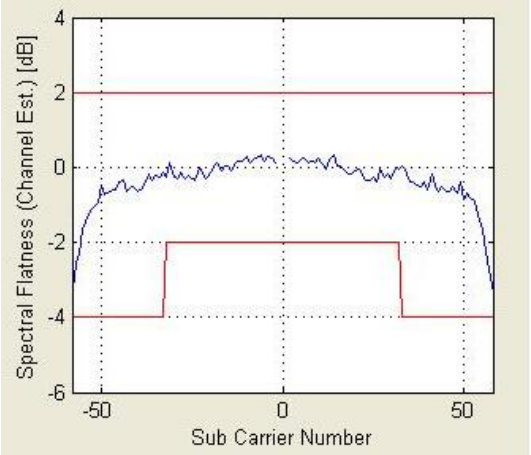
Channel	Test Records on Spectrum Analyzer	Result
CH 7		**Pass**

Table 1- 8 802.11n 40MHz transmit spectrum flatness test results

Channel	Test Records on Spectrum Analyzer	Result
CH 7		**Pass**

1.4. EVM

- **Purpose**

  The test is to measure the EVM of the DUT.

  The transmit modulation accuracy is measured using error vector magnitude (EVM). EVM is the magnitude of the phase difference as a function of time between an ideal reference signal and the measured transmitted signal.

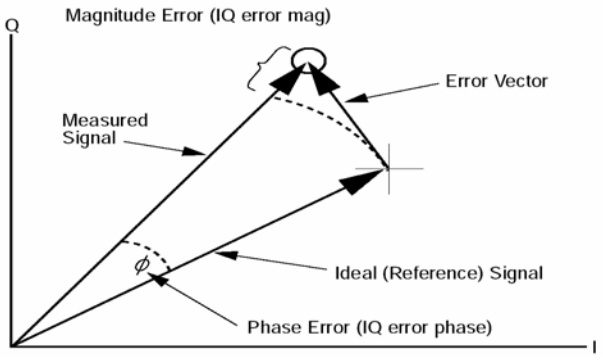


Figure 1- 8 EVM elements

Error vector magnitude (EVM) and related quantities

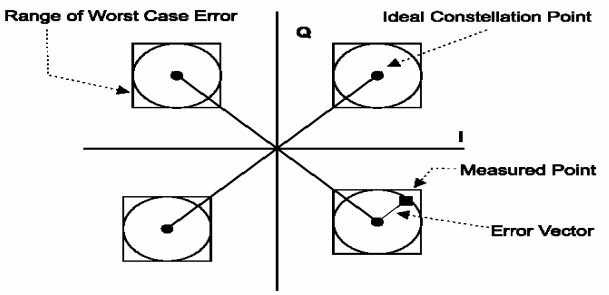


Figure 1- 9 Modulation accuracy measurement example

- **Equipment**

  1. Vector Signal Analyzer
  2. QA test.

- **Test Environment**

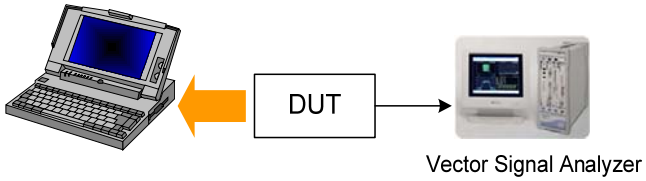


Figure 1- 10 EVM test setup

- **Procedure**

  1. Connect DUT RF out to vector signal analyzer.
  2. Use QA test utility to control DUT send packet.

3. Measure the DUT's EVM from vector signal analyzer.

➢ **Test Result:**

Table 1- 9 EVM test results

11b mode: unit in %

Mode	Rate	Ch 1	Ch 7	Ch 13
11b CCK	1Mbps	4.1	3.8	4.0
	2Mbps	4.1	3.9	4.0
	5.5Mbps	4.2	4..3	4.3
	11Mbps	4.2	3.9	4.2

11g mode: unit in dB

Mode	Rate	Ch 1	Ch 7	Ch 13
11g OFDM	6Mbps	-26.3	-26.7	-25.3
	18Mbps	-25.5	-26.2	-25.4
	36Mbps	-29.8	-30.6	-29.1
	54Mbps	-31.5	-31.6	-32.0

11n 20MHz mode: unit in dB

Mode	Rate	Ch 1	Ch 7	Ch 13
11n 20MHz	MCS0	-24.9	-25.5	-23.4
	MCS3	-26.2	-26.8	-26.2
	MCS5	-29.4	-29.6	-29.3
	MCS7	-31.3	-31.8	-31.2

11n 40MHz mode: unit in dB

Mode	Rate	Ch 3	Ch 6	Ch 9
11n 40MHz	MCS0	-26.7	-26.2	-24.8
	MCS3	-26.0	-25.5	-24.4
	MCS5	-28.7	-27.8	-27.0
	MCS7	-30.0	-29.8	-29.9

1.5. Transmit Center Frequency Tolerance

- **Purpose**

  To verify the transmitter (DUT) central frequency offset is within the specified limits.

- **Equipment**

  1. Spectrum analyzer
  2. QA test.

- **Test Environment**

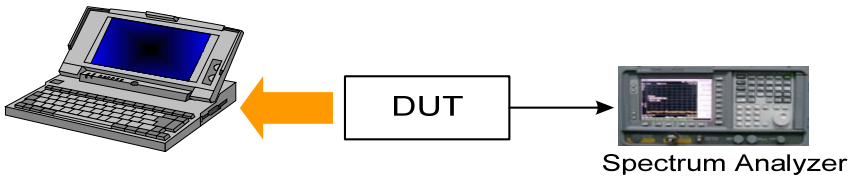


Figure 1- 11 Transmit center frequency tolerance test setup

- **Procedure**

  1. Select channel and click carrier test (without modulation) from the QA test utility.
  2. Measure and record frequency tolerance from the Spectrum analyzer.
  3. Repeat the test sequence 1 to 2 for other channels measurement.

- **Pass Criteria**

  The transmitted center frequency tolerance shall be ±20 ppm maximum.

- **Test Result: temperature @ 25℃**

Table 1- 10 11g Transmit Center Frequency Tolerance Test Result

Channel	CH7
Result (ppm)	2.25
Frequency Tolerance	5.5KHz
Pass/Fail	Pass

Table 1- 11 11n Transmit Center Frequency Tolerance Test Result

Channel	CH7
Result (ppm)	2.17
Frequency Tolerance	5.3KHz
Pass/Fail	Pass

1.6. Carrier Suppression

- **Purpose**

  The test is to verify RF carrier suppression of the DUT.

  802.11b:

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

  802.11g:

  The leakage of the center frequency component shall not exceed -15 dB relative to overall transmitted power or, equivalently, +2 dB relative to the average energy of the rest of the sub-carriers.

  802.11n:

  - **For all 20 MHz modes of transmission**

  The leakage of the center frequency component shall not exceed -15 dB relative to overall transmitted power or, equivalently, +2 dB relative to the average energy of the rest of the sub-carriers.

  - **For all 40 MHz modes of transmission**

  The center frequency leakage shall not exceed -18 dB relative to overall transmitted power, or, equivalently, +2 dB relative to the average energy of the rest of the sub-carriers.

- **Equipment**

  1. Spectrum analyzer
  2. QA test.

- **Test Environment**

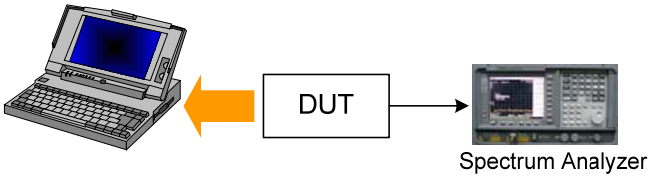


Figure 1- 12 Carrier Suppression

- **Procedure**

  1. DUT generate frame by the QA test that send the RF signal to spectrum analyzer.
  2. Determine the pass/fail status of the output spectrum observed from the Spectrum analyzer.
  3. Repeat the test sequence 1 to 2 for other channels.

- **Pass Criteria**

  - Delta > 15dB for b, g & 11n 20MHz
  - Delta > 18dB for 11n 40MHz

➢ Test Result

Table 1- 12 11n 20MHz Carrier suppression test results

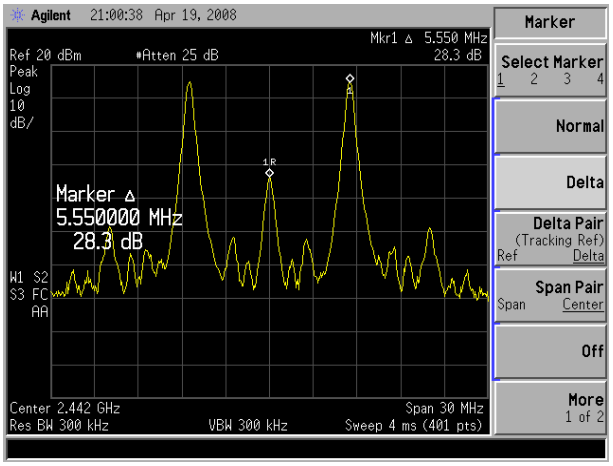
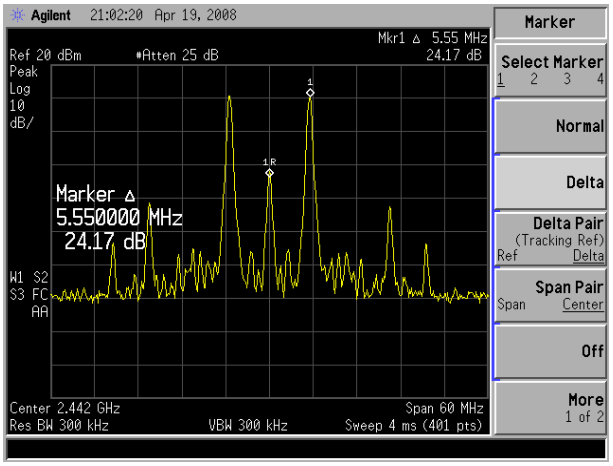
Channel	Test Records on Spectrum Analyzer	Result
CH 7		28.3dB

Table 1- 13 11n 40MHz Carrier suppression test results

Channel	Test Records on Spectrum Analyzer	Result
CH 7		24.17dB

1.7. Transmit Power on Ramp and Power Down Ramp Time

- **Purpose**

  To verify the power-on and power–down ramp time of the Device Under Test (DUT) are within the conformance limits.

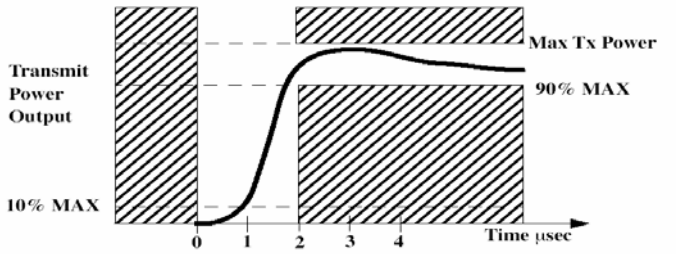


Figure 1- 13 Transmit power-on ramp

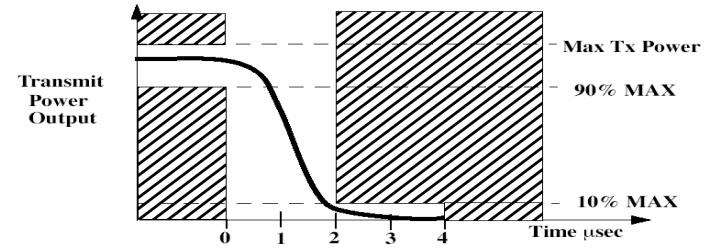


Figure 1- 14 Transmit power-down ramp

- **Equipment**

  1. Vector Signal Analyzer
  2. QA test.

- **Test Environment**

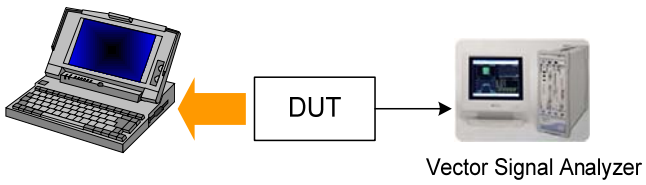


Figure 1- 15 Transmit Power Ramp Test Setup

- **Procedure**

  1. DUT generate frame by test utility which send the RF signal to vector signal analyzer.
  2. VSA setup on the time domain.
  3. Measure the results from vector signal analyzer.
  4. Repeat the test sequence 1 to 3 for other channels.

- **Pass Criteria**

  1. The transmitting power-on ramp for 10% to 90% of maximum power m shall be no greater than 2 µs.
  2. The transmitting power-down ramp for 90% to 10% of maximum power shall be no

greater than 2 µs.

- **Test Result**

Table 1- 14 11g transmitting power-on ramp test result

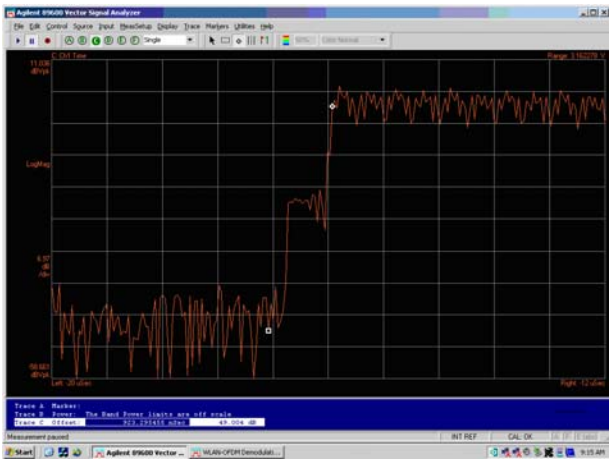
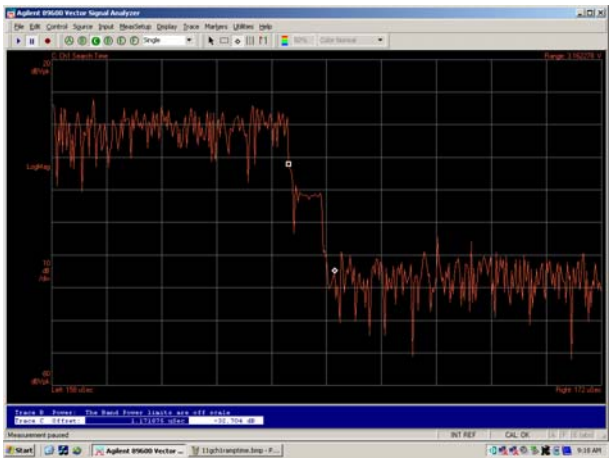
Channel	Test Records on Vector Signal Analyzer	Result
CH 7		923.29ns

Table 1- 15 11g transmitting power-down ramp test result

Channel	Test Records on Vector Signal Analyzer	Result
CH 7		1.17us

1.8. Receiver Sensitivity

➢ **Purpose**

To verify receiver minimum input level of the DUT.

➢ **Equipment**

1. Vector Signal Generator
2. QA test

➢ **Test Environment**

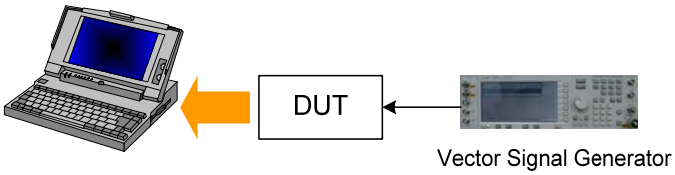


Figure 1- 16 Receiver Sensitivity Test Setup

➢ **Procedure**

1. Set VSG to generate PSDU length as following:
   - 1024 octets for 11b/g measurement
   - 4096 octets for 11n measurement.
2. Reduce VSG output power until the following FER is occurred.
   - 10% for 802.11n
   - 8% for 802.11g/b

➢ **Pass Criteria for 802.11n**

Modulation Coding	Rate (R)	Adjacent channel rejection (dB)	Alternate adjacent channel rejection (dB)	Minimum sensitivity (dBm) (20 MHz channel spacing)	Minimum sensitivity (dBm) (40 MHz channel spacing)
BPSK	1/2	16	32	-80	-77
QPSK	1/2	13	29	-77	-74
QPSK	3/4	11	27	-75	-72
16-QAM	1/2	8	24	-72	-69
16-QAM	3/4	4	20	-68	-65
64-QAM	2/3	0	16	-64	-61
64-QAM	3/4	-1	15	-63	-60
64-QAM	5/6	-2	14	-63	-59

➢ Test Result

Table 1- 16 Receiver sensitivity test results

11b mode: 1RX

Rate		Result (dBm)		
		CH1	CH11	CH13
11b	1M	-91	-91	-91
	2M	-91	-91	-91
	5.5M	-90	-90	-90
	11M	-88	-88	-88

11g mode: 1X

Rate		Result (dBm)		
		CH1	CH11	CH13
11g	6M	-89	-88	-88
	9M	-88	-87	-87
	12M	-86	-85	-85
	18M	-83	-83	-83
	24M	-81	-81	-80
	36M	-78	-78	-77
	48M	-74	-73	-73
	54M	-72	-72	-72

11n 20MHz mode: 1X

Rate		Result (dBm)		
		CH1	CH7	CH13
11n 20MHz	MCS0	-87	-87	-86
	MCS1	-85	-84	-84
	MCS2	-82	-82	-81
	MCS3	-80	-80	-79
	MCS4	-77	-76	-76
	MCS5	-72	-72	-72
	MCS6	-71	-70	-70
	MCS7	-69	-69	-68

11n 40MHz mode: 1RX

Rate		Result (dBm)		
		CH3	CH6	CH9
11n 40MHz	MCS0	-83	-83	-83
	MCS1	-81	-81	-81
	MCS2	-78	-78	-78
	MCS3	-76	-76	-76
	MCS4	-72	-72	-72
	MCS5	-69	-69	-68
	MCS6	-67	-66	-66
	MCS7	-64	-63	-63

1.9. Receiver Maximum Input Level

- **Purpose**

  To verify receiver maximum input level of the DUT.

- **Test Equipment**

  1. Vector Signal Generator
  2. QA test

- **Test Environment**

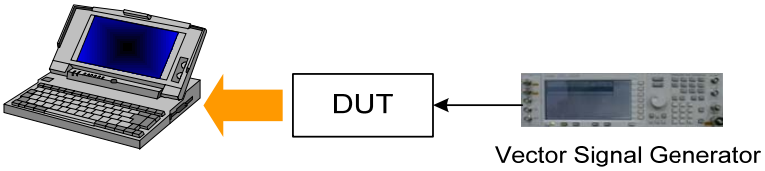


Figure 1- 17 Receiver maximum Input Level test Setup

- **Procedure**

  1. Set VSG to generate PSDU length as following:

Standard	PSDU Length (bytes)	FER (%)	Rate (Mbit/s)	Required max input level
802.11	1024	8	1, 2	-4 dBm
802.11b	1024	8	11, 5.5	-10 dBm
802.11g	1000	10	6, 9, 12, 18, 24, 36, 48, 54	-20 dBm
802.11a	1000	10	6, 9, 12, 18, 24, 36, 48, 54	-30 dBm
802.11n	1000	10	for any baseband modulation	-30 dBm

  2. Raising the VSG output power until the FER value listed in above table is occurred.

➢ Test Result

Table 1- 17 receiver maximum input level test results

Rate	Pass Criteria (dBm)	Output Power (dBm)			Result
		CH1	CH7	CH11	
1M	> -4	0	0	0	**Pass**
11M	>-10	0	0	0	**Pass**
6M	>-20	0	0	0	**Pass**
54M	>-20	-4	-4	-3	**Pass**
MCS0	>-30	-1	0	0	**Pass**
MCS7	>-30	-20	-20	-19	**Pass**

2. Power consumption

Table 2- 1 Power consumption

Mode	Status	Current (mA) @5V	Note
QA	Idle	89	
	RX	117	54Mbps,CH1
		117	MCS15, 20MHz,CH1
		137	MCS15, 40 MHz,CH3
	TX	173	11Mbps @ 17dBm,CH1
		155	54Mbps @ 13.9dBm, 11g,CH1
		155	MCS7, 20MHz,14dB,CH1
		166	MCS7, 40MHz,CH7
OS	LINK(S0)	102(20M)/120(40M)	
	RX	113	20MHz
		144	40 MHz
	TX	148	20MHz
		152	40 MHz
	SUSPEND	2	
	UNCONFIGURED	59	
	POWER SAVE MODE	52	DTIM=100ms
		47	DTIM=300ms
	RADIO OFF	52	