AMPAK

AP6356

AMPAK Technology, Inc.
Advanced Module Packing & Testing

1. Current consumption measurement

1.1 Product current consumption

Requirement

To measure average current consumption in different status and voltage rail

Condition : Continue TX, Continue RX

Results

❖ 2.4GHz:

Test Mode	DUT Status	Supply Voltage	Test Data
802.11b 1Mbps	Continue TX	3.3V	**310**
	Continue RX	3.3V	**64**
802.11b 11Mbps	Continue TX	3.3V	**321**
	Continue RX	3.3V	**64**
802.11g 6Mbps	Continue TX	3.3V	**318**
	Continue RX	3.3V	**64**
802.11g 54Mbps	Continue TX	3.3V	**295**
	Continue RX	3.3V	**64**
802.11gn MCS0	Continue TX HT20	3.3V	**314**
	Continue RX HT20	3.3V	**63**
	Continue TX HT40	3.3V	**341**
	Continue RX HT40	3.3V	**75**
802.11gn MCS7	Continue TX HT20	3.3V	**279**
	Continue RX HT20	3.3V	**64**
	Continue TX HT40	3.3V	**297**
	Continue RX HT40	3.3V	**77**
802.11gn MCS15	Continue TX HT20	3.3V	**491**
	Continue RX HT20	3.3V	**86**
	Continue TX HT40	3.3V	**509**
	Continue RX HT40	3.3V	**110**

(Unit: mA)

❖ 5GHz:

Test Mode	DUT Status	Supply Voltage	Test Data
802.11a 6Mbps	Continue TX	3.3V	313
	Continue RX	3.3V	78
802.11a 54Mbps	Continue TX	3.3V	273
	Continue RX	3.3V	78
802.11an MCS0	Continue TX HT20	3.3V	303
	Continue RX HT20	3.3V	78
	Continue TX HT40	3.3V	337
	Continue RX HT40	3.3V	92
802.11an MCS7	Continue TX HT20	3.3V	266
	Continue RX HT20	3.3V	77
	Continue TX HT40	3.3V	286
	Continue RX HT40	3.3V	92
802.11an MCS15	Continue TX HT20	3.3V	445
	Continue RX HT20	3.3V	104
	Continue TX HT40	3.3V	470
	Continue RX HT40	3.3V	130
802.11AC MCS0	Continue TX HT20	3.3V	309
	Continue RX HT20	3.3V	78
	Continue TX HT40	3.3V	337
	Continue RX HT40	3.3V	92
	Continue TX HT80	3.3V	368
	Continue RX HT80	3.3V	116
802.11AC MCS8	Continue TX HT20	3.3V	535
	Continue RX HT20	3.3V	104
	Continue TX HT40	3.3V	558
	Continue RX HT40	3.3V	129
	Continue TX HT80	3.3V	285
	Continue RX HT80	3.3V	116
802.11AC MCS9	Continue TX HT20	3.3V	537
	Continue RX HT20	3.3V	105
	Continue TX HT40	3.3V	572
	Continue RX HT40	3.3V	130
	Continue TX HT80	3.3V	473
	Continue RX HT80	3.3V	178

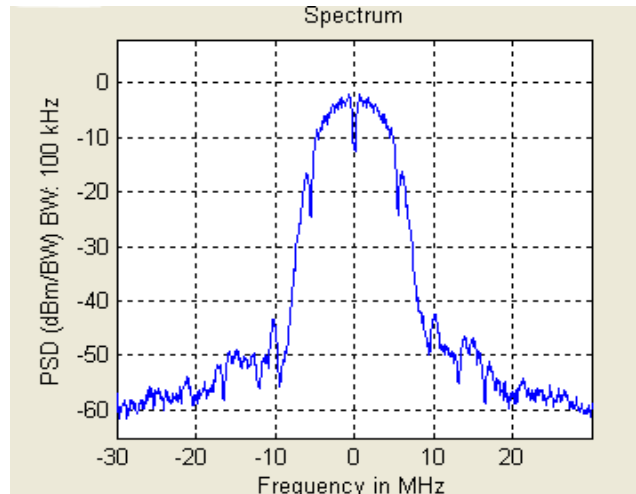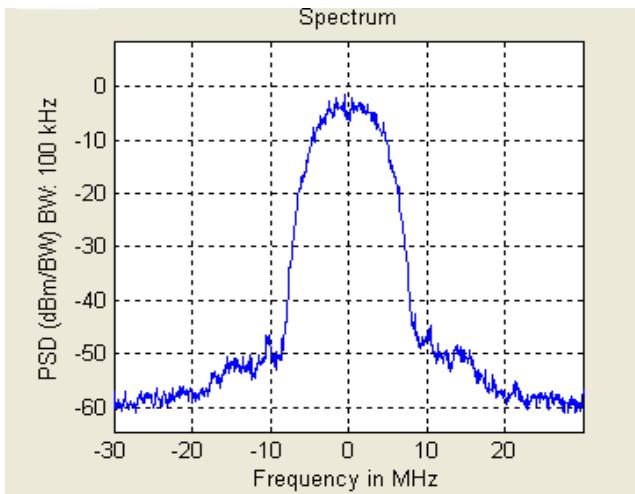# 2 Wi-Fi Spectrum Mask Test

2.1 802.11b mode

Requirement

※ The first side lobe of output pattern must be less than –30dBm.

※ The second side lobe of output pattern must be less than –50dBm.
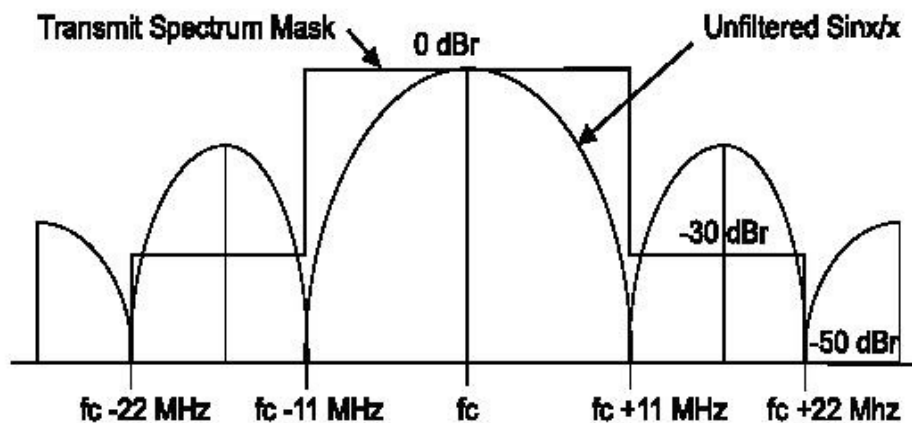
Method

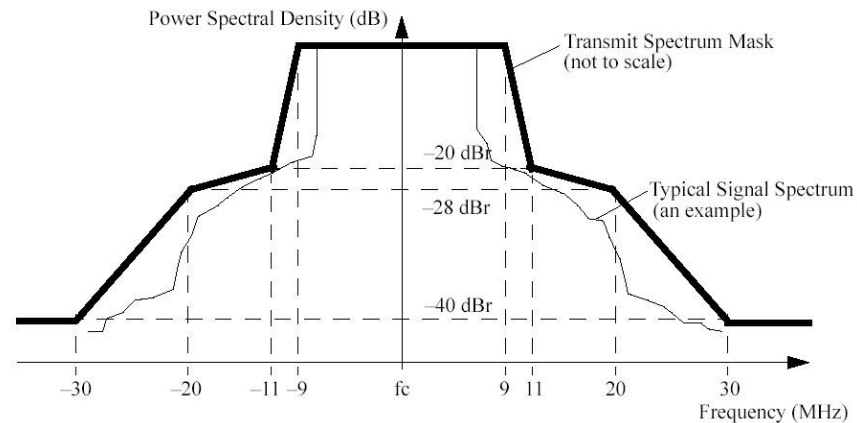Let DUT continue transmit 802.11b package. To set Spectrum Analyzer under max hold condition, measuring magnitude of 1st and 2nd sidelobe.

2GHz TX Spectrum Mask

Chain0, CH7, 11b, 1M	Chain0, CH7, 11b, 11M
Centeral Frequency: 2442MHz Spectrum Mask: Pass	Centeral Frequency: 2442MHz Spectrum Mask: Pass

2.2 802.11g mode

Requirement

※ The spectrum mask must under –20dBr@11MHz.

※ The spectrum mask must under –28dBr@20MHz.
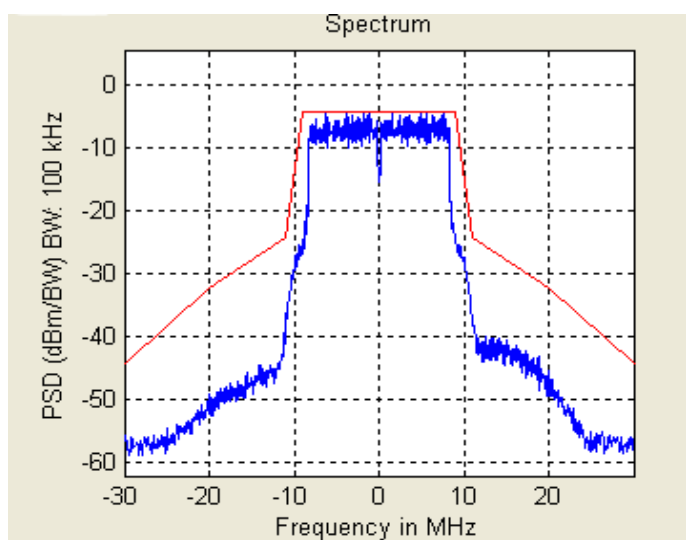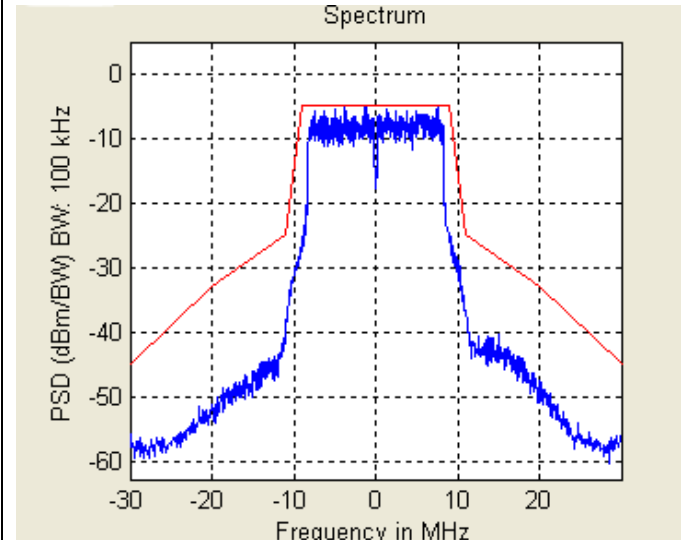
※ The spectrum mask must under –40dBr@30MHz.

Method

Let DUT continue transmit 802.11a/g packages. To Set Spectrum Analyzer under max hold condition. Measuring magnitude on △f@ 9MHz, 11MHz, 20MHz and 30MHz.

Results

2GHz TX Spectrum Mask

Chain0, CH7, 11g, 6M	Chain0, CH7, 11g, 54M
Central Frequency: 2442MHz Spectrum Mask: Pass	Central Frequency:2442MHz Spectrum Mask: Pass

2.3 802.11a mode

Requirement

※ The spectrum mask must under –20dBr@11MHz.

※ The spectrum mask must under –28dBr@20MHz.

※ The spectrum mask must under –40dBr@30MHz.

Method

Let DUT continue transmit 802.11a/g packages. To Set Spectrum Analyzer under max hold condition. Measuring magnitude on △f@ 9MHz, 11MHz, 20MHz and 30MHz.
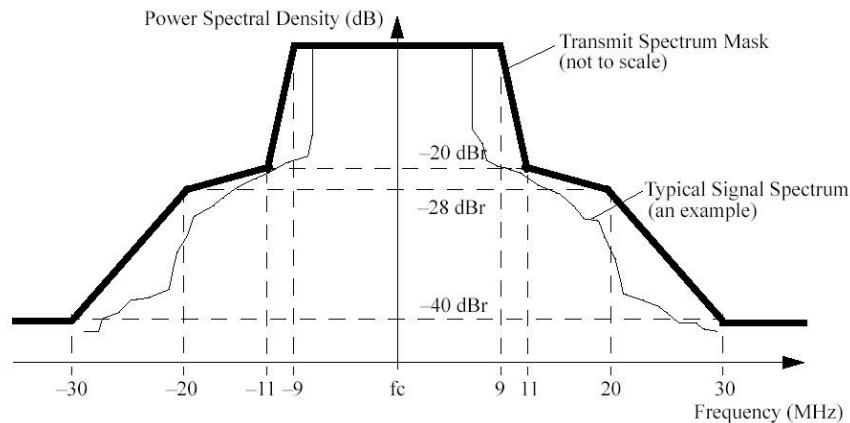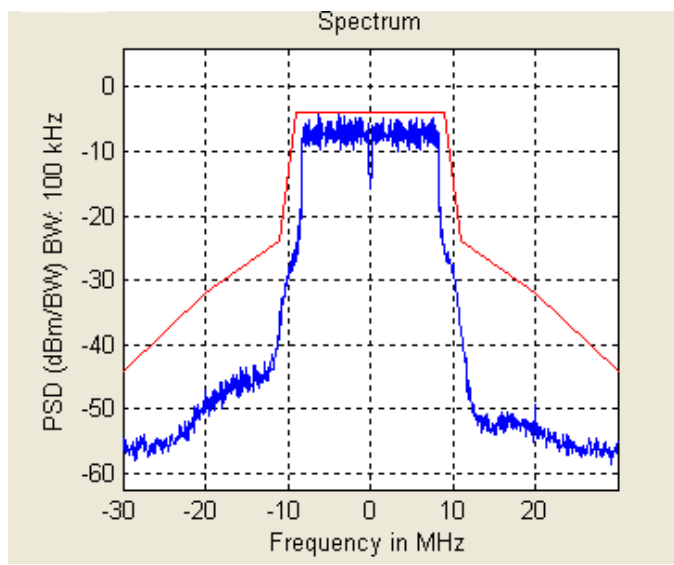
Results

5GHz TX Spectrum Mask

Chain0, CH108, 11a, 6M	Chain0, CH108, 11a, 54M
Central Frequency:5540MHz Spectrum Mask: Pass	Central Frequency:5540MHz Spectrum Mask: Pass

2.4 802.11n mode

<u>Requirement</u>

20M

※ The spectrum mask must under –20dBr@11MHz.

※ The spectrum mask must under –28dBr@20MHz.

※ The spectrum mask must under –40dBr@30MHz.

40M

※ The spectrum mask must under –20dBr@21MHz.

※ The spectrum mask must under –28dBr@40MHz.
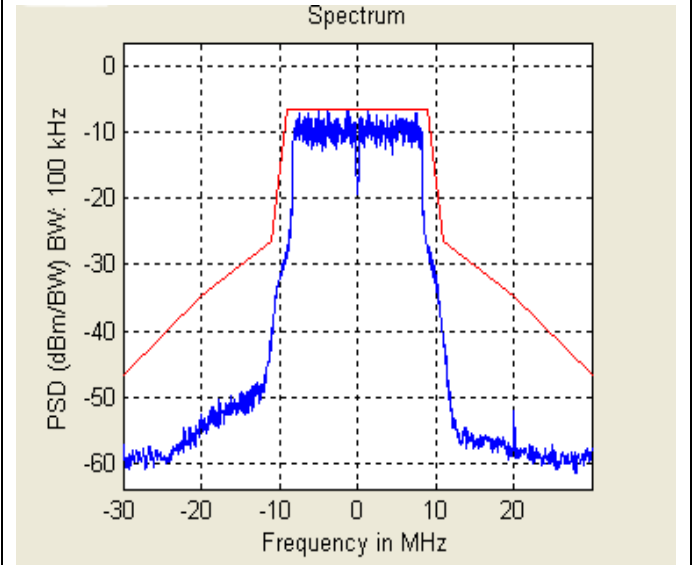
※ The spectrum mask must under –45dBr@60MHz.
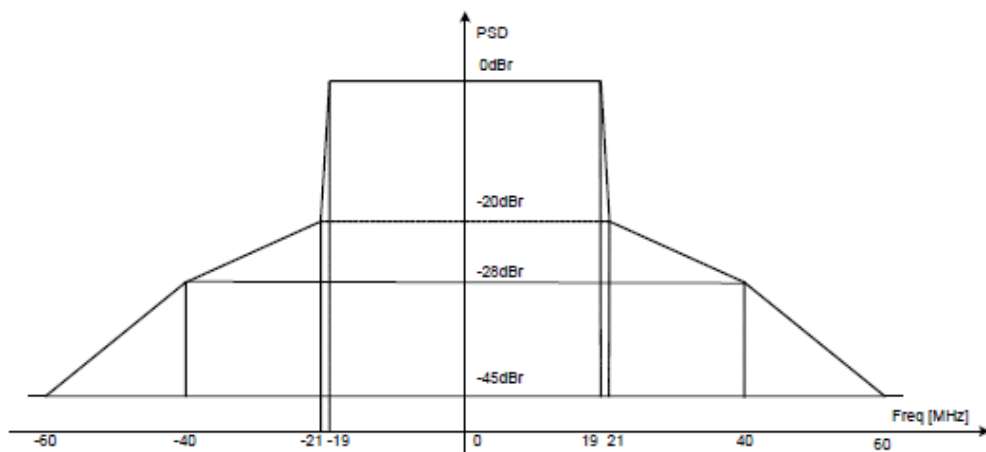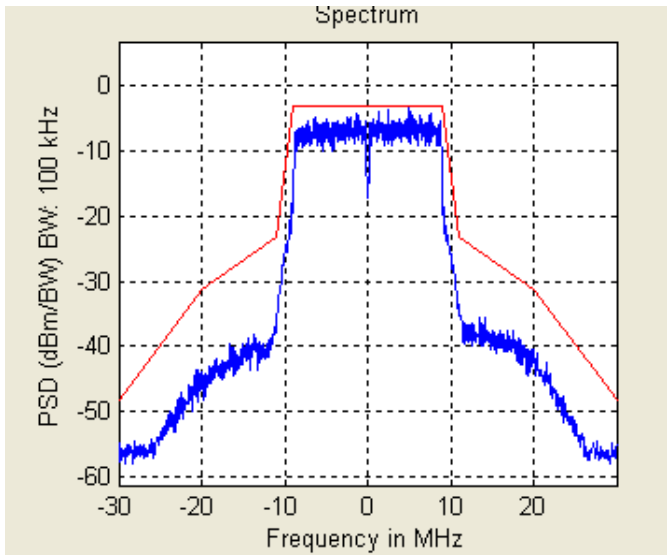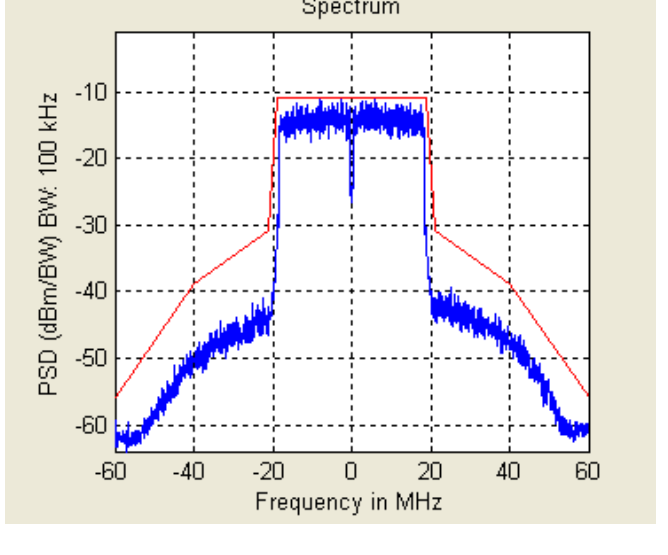
<u>Method</u>
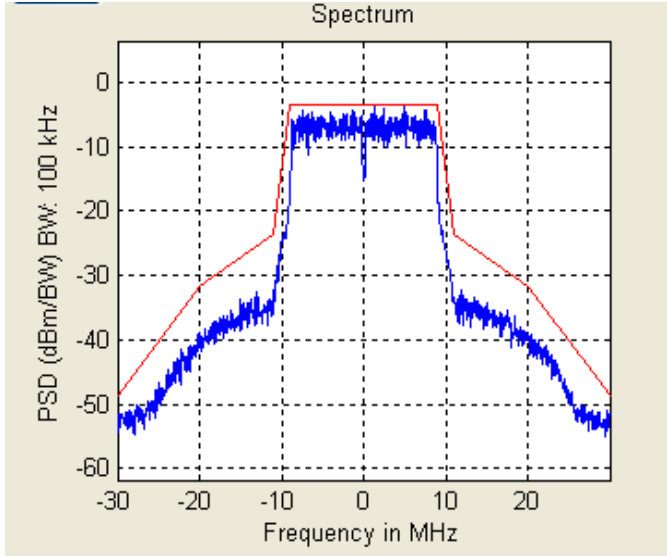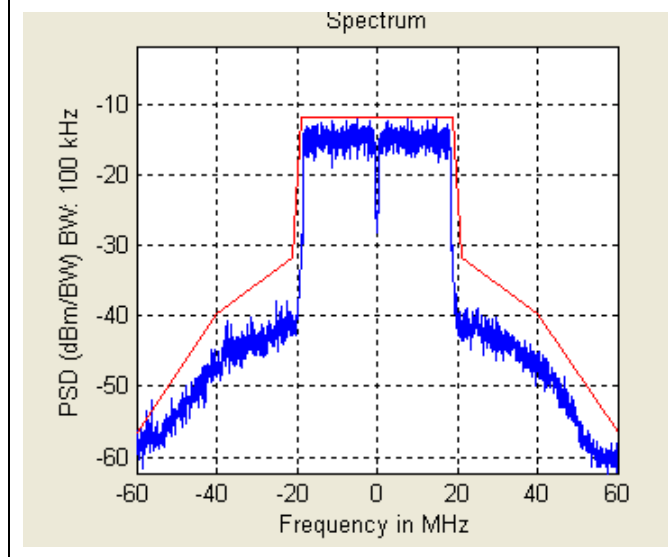
Let DUT continue transmit 802.11n packages. To Set Spectrum Analyzer under max hold condition. Measuring magnitude on △f@ 9MHz, 11MHz, 20MHz and 30MHz.

<u>Results</u>

2GHz TX Spectrum Mask
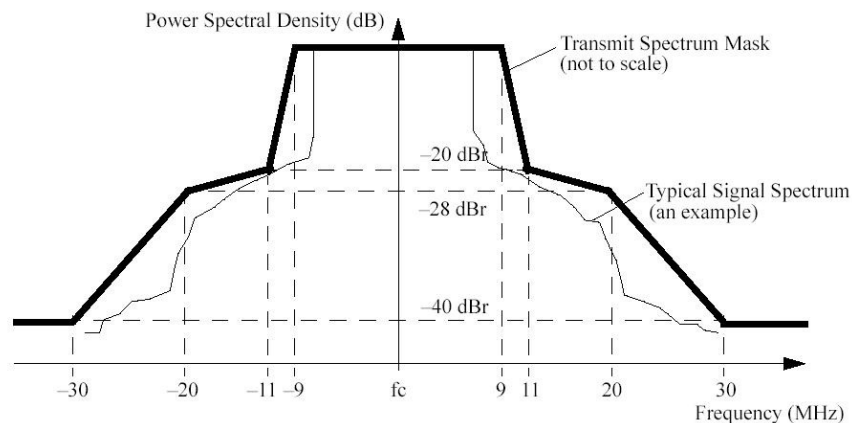
Chain0, CH7, 11n, HT-20, MCS0	Chain0, CH7, 11n, HT-40, MCS0
Central Frequency: 2442MHz Spectrum Mask: Pass	Central Frequency: 2442MHz Spectrum Mask: Pass

5GHz TX Spectrum Mask

Chain0, CH108, 11n, HT-20, MCS0	Chain0, CH108, 11n, HT-40, MCS0
Central Frequency: 5540MHz Spectrum Mask: Pass	Central Frequency: 5540MHz Spectrum Mask: Pass

2.5 802.11AC mode

Requirement

20M

※ The spectrum mask must under -20dBr@11MHz.

※ The spectrum mask must under –28dBr@20MHz.

※ The spectrum mask must under –40dBr@30MHz.

40M
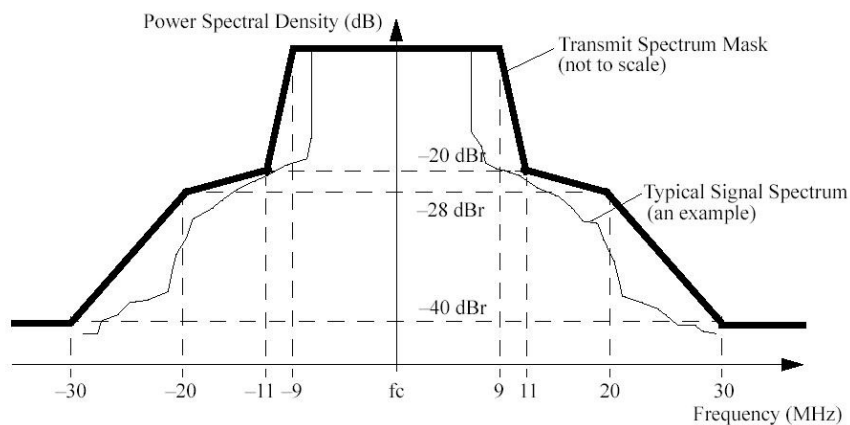
※ The spectrum mask must under –20dBr@21MHz.

※ The spectrum mask must under –28dBr@40MHz.

※ The spectrum mask must under –45dBr@60MHz.
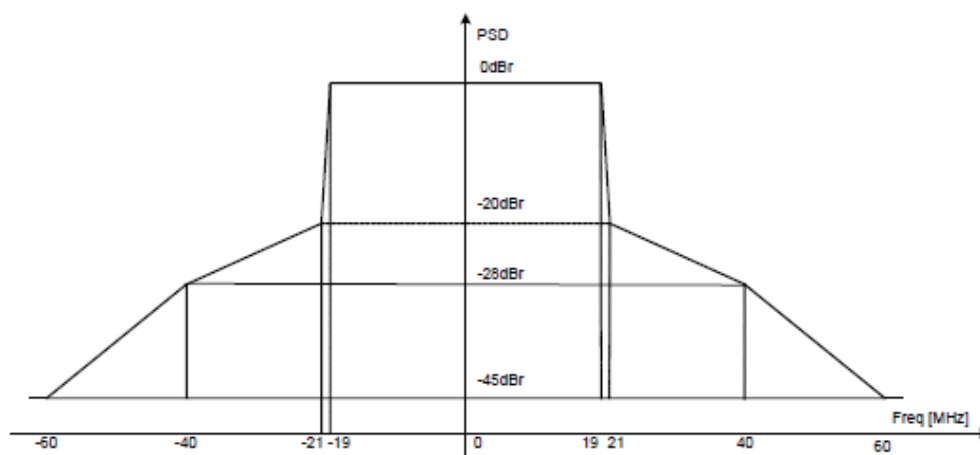
80M

※ The spectrum mask must under –20dBr@41MHz.

※ The spectrum mask must under –28dBr@80MHz.

※ The spectrum mask must under –40dBr@120MHz.
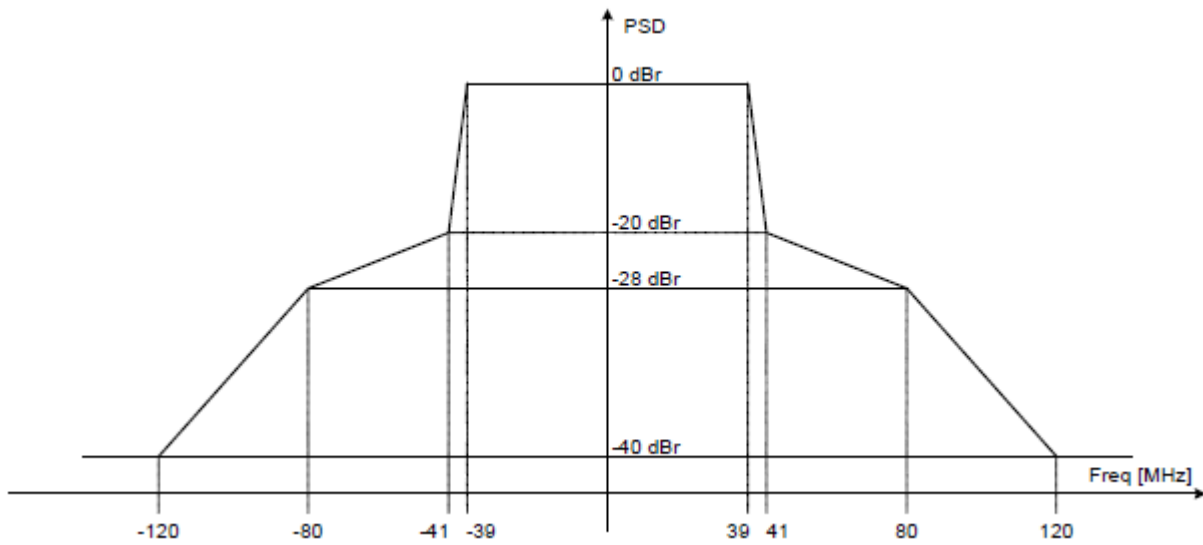
Chain0, CH108, 11ac, HT-20, MCS0	Chain0, CH108, 11ac, HT-40, MCS0
Centeral Frequency: 5540MHz Spectrum Mask: Pass	Centeral Frequency: 5540MHz Spectrum Mask: Pass

Chain0, CH108, 11ac, HT-80, MCS0
Centeral Frequency: 5540MHz
Spectrum Mask: Pass
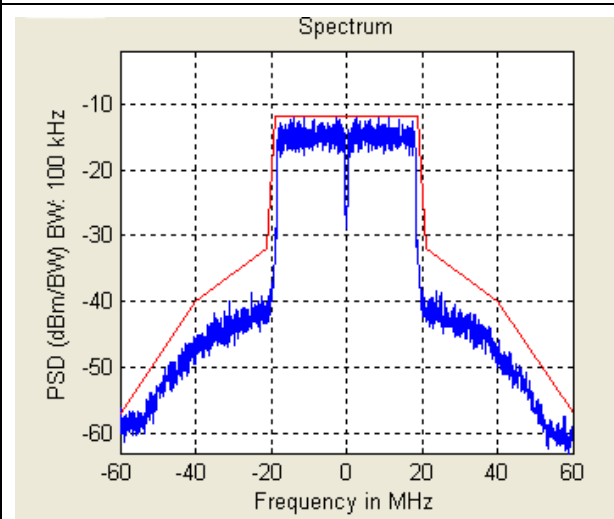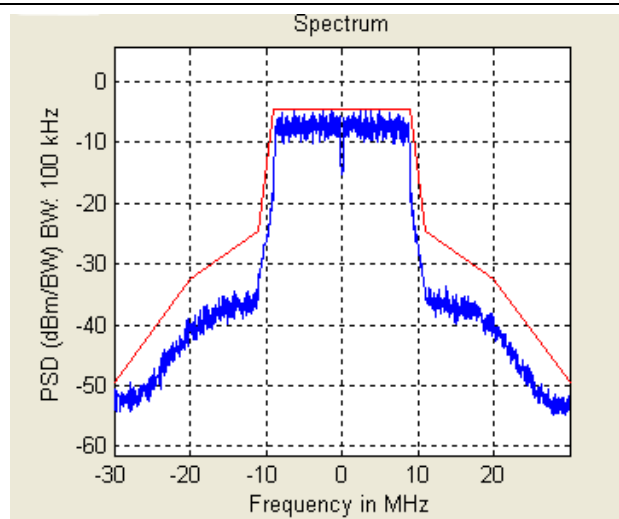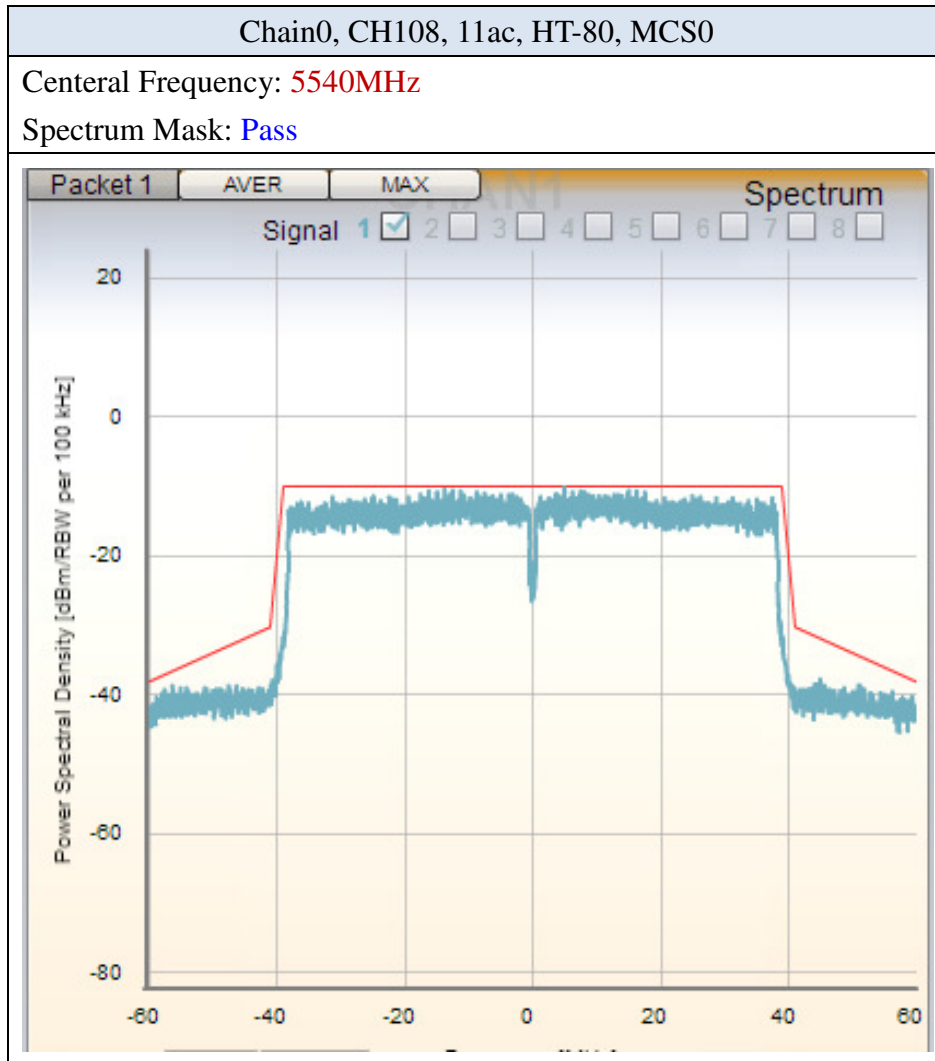
3. Wi-Fi Frequency Accuracy

<u>Requirement</u>

※ RF center frequency accuracy <+/-20 PPM

<u>Method</u>

Peak search the RF LO output power and make a mark, calculate its frequency accuracy.

<u>Results</u>

Test Item	Spec	Test Data
Frequency Accuracy	+/-20 PPM	**3.7.**

(Unit: ppm)

4 Wi-Fi TX Output Power and Modulation Quality Test (EVM)

Requirement

TX Output Power

❖ 2.4GHz:

802.11b/11M : 16 +/- 1.5 dBm

802.11g/54M : 15 +/- 1.5 dBm

802.11n/mcs7 : 14 +/- 1.5 dBm

❖ 5GHz:

802.11a/54M : 13 +/- 1.5 dBm

802.11n/mcs7 : 12 +/- 1.5 dBm

802.11ac/mcs9: 10 +/-1.5 dBm

TX Modulation Quality Test (EVM)

802.11b：EVM error < 35%rms (-9dB)

802.11a/g：EVM error < 5.5%rms (-25dB)

802.11n HT20/HT40：EVM error < 3.9%rms (-28dB)

Method

Let DUT continue transmit packages and measuring its Tx modulation quality.

Results

❖ 2.4GHz:

ANT0 Test Mode	Supply Voltage	Test Channel	TX Output Power (Unit:dBm)		TX Modulation Quality Test (EVM) (Unit:dB)	
			Spec	Test Data	Spec	Test Data
802.11b 1Mbps	3.3V	CH7	14.5~17.5	14.8	-9.11	-13.5
802.11b 11Mbps	3.3V	CH7	14.5~17.5	15.0	-9.11	-12.7
802.11g 6Mbps	3.3V	CH7	14.5~17.5	15.2	-5	-23.1

802.11g 54Mbps	3.3V	CH7	13.5~16.5	14.3	-25	-34.0
802.11n(HT20) MCS0	3.3V	CH7	14.5~17.5	15.4	-5	-20.2
802.11n(HT20) MCS7	3.3V	CH7	12.5~15.5	13.7	-27	-32.8
802.11n(HT40) MCS0	3.3V	CH7	14.5~17.5	16.5	-5	-19.0
802.11n(HT40) MCS7	3.3V	CH7	12.5~15.5	14.5	-27	-33.2

ANT1 Test Mode	Supply Voltage	Test Channel	TX Output Power (Unit:dBm)		TX Modulation Quality Test (EVM) (Unit:dB)	
			Spec	Test Data	Spec	Test Data
802.11b 1Mbps	3.3V	CH7	14.5~17.5	15.6	-9.11	-14.3
802.11b 11Mbps	3.3V	CH7	14.5~17.5	15.8	-9.11	-13.9
802.11g 6Mbps	3.3V	CH7	14.5~17.5	15.9	-5	-22.5
802.11g 54Mbps	3.3V	CH7	13.5~16.5	15.4	-25	-32.8
802.11n(HT20) MCS0	3.3V	CH7	14.5~17.5	16.1	-5	-19.8
802.11n(HT20) MCS7	3.3V	CH7	12.5~15.5	14.3	-27	-33.9
802.11n(HT40) MCS0	3.3V	CH7	14.5~17.5	17.0	-5	-18.7
802.11n(HT40) MCS7	3.3V	CH7	12.5~15.5	14.8	-27	-31.4

❖ 5GHz

ANT0 Test Mode	Supply Voltage	Test Channel	TX Output Power (Unit:dBm)		TX Modulation Quality Test (EVM) (Unit:dB)	
			Spec	Test Data	Spec	Test Data
802.11a 6Mbps	3.3V	CH36	14~17	16.4	-5	-22.3
802.11a 54Mbps	3.3V	CH36	11.5~14.5	14.3	-25	-34.8
802.11n(HT20) MCS0	3.3V	CH36	14~17	16.4	-5	-16.9
802.11n(HT20) MCS7	3.3V	CH36	10.5~13.5	13.2	-27	-34.1
802.11n(HT40) MCS0	3.3V	CH36	14~17	17.0	-5	-16.3
802.11n(HT40) MCS7	3.3V	CH36	10.5~13.5	13.6	-27	-32.4
802.11n(HT80) MCS0	3.3V	CH36	14~17	16.5	-5	-16.1
802.11n(HT80) MCS9	3.3V	CH36	8.5~11.5	11.3	-32	-34.7
802.11a 6Mbps	3.3V	CH100	14~17	15.3	-5	-24.8
802.11a 54Mbps	3.3V	CH100	11.5~14.5	13.3	-25	-38.4
802.11n(HT20) MCS0	3.3V	CH100	14~17	15.5	-5	-20.6
802.11n(HT20) MCS7	3.3V	CH100	10.5~13.5	12.1	-27	-35.9
802.11n(HT40) MCS0	3.3V	CH100	14~17	16.3	-5	-17.7
802.11n(HT40) MCS7	3.3V	CH100	10.5~13.5	12.8	-27	-35.2
802.11n(HT80) MCS0	3.3V	CH100	14~17	16.0	-5	-17.5
802.11n(HT80) MCS9	3.3V	CH100	8.5~11.5	10.4	-32	-35.4

802.11a 6Mbps	3.3V	CH161	14~17	15.9	-5	-23.9
802.11a 54Mbps	3.3V	CH161	11.5~14.5	13.7	-25	-37.9
802.11n(HT20) MCS0	3.3V	CH161	14~17	16.1	-5	-19.5
802.11n(HT20) MCS7	3.3V	CH161	10.5~13.5	12.5	-27	-36.4
802.11n(HT40) MCS0	3.3V	CH161	14~17	16.1	-5	-18.5
802.11n(HT40) MCS7	3.3V	CH161	10.5~13.5	12.3	-27	-34.5
802.11n(HT80) MCS0	3.3V	CH161	14~17	15.5	-5	-18.3
802.11n(HT80) MCS9	3.3V	CH161	8.5~11.5	9.8	-32	-35.2

ANT1 Test Mode	Supply Voltage	Test Channel	TX Output Power (Unit:dBm)		TX Modulation Quality Test (EVM) (Unit:dB)	
			Spec	Test Data	Spec	Test Data
802.11a 6Mbps	3.3V	CH36	14~17	15.2	-5	-24.4
802.11a 54Mbps	3.3V	CH36	11.5~14.5	13.3	-25	-35.1
802.11n(HT20) MCS0	3.3V	CH36	14~17	15.2	-5	-17.0
802.11n(HT20) MCS7	3.3V	CH36	10.5~13.5	12.1	-27	-35.7
802.11n(HT40) MCS0	3.3V	CH36	14~17	15.9	-5	-16.4
802.11n(HT40) MCS7	3.3V	CH36	10.5~13.5	12.7	-27	-31.9
802.11n(HT80) MCS7	3.3V	CH36	14~17	15.5	-5	-16.7

802.11n(HT80) MCS7	3.3V	CH36	8.5~11.5	10.4	-32	-36.3
802.11a 6Mbps	3.3V	CH100	14~17	14.5	-5	-25.3
802.11a 54Mbps	3.3V	CH100	11.5~14.5	12.4	-25	-39.1
802.11n(HT20) MCS0	3.3V	CH100	14~17	14.7	-5	-18.7
802.11n(HT20) MCS7	3.3V	CH100	10.5~13.5	11.2	-27	-35.0
802.11n(HT40) MCS0	3.3V	CH100	14~17	15.5	-5	-18.1
802.11n(HT40) MCS7	3.3V	CH100	10.5~13.5	12.0	-27	-35.1
802.11n(HT80) MCS0	3.3V	CH100	14~17	15.4	-5	-17.9
802.11n(HT80) MCS9	3.3V	CH100	8.5~11.5	9.8	-32	-34.5
802.11a 6Mbps	3.3V	CH161	14~17	16.2	-5	-24.8
802.11a 54Mbps	3.3V	CH161	11.5~14.5	13.8	-25	-35.9
802.11n(HT20) MCS0	3.3V	CH161	14~17	16.0	-5	-20.0
802.11n(HT20) MCS7	3.3V	CH161	10.5~13.5	12.8	-27	-37.2
802.11n(HT40) MCS0	3.3V	CH161	14~17	16.1	-5	-18.7
802.11n(HT40) MCS7	3.3V	CH161	10.5~13.5	12.6	-27	-35.4
802.11n(HT80) MCS0	3.3V	CH161	14~17	15.3	-5	-18.7
802.11n(HT80) MCS9	3.3V	CH161	8.5~11.5	9.8	-32	-35.7

5 Wi-Fi Rx Sensitivity Test

Requirement

❖ 2.4GHz:

Sensitivity ≦ -86 +/-2 dBm @ 11Mbps of 802.11b, PER ≦ 8%

Sensitivity ≦ -72 +/-2 dBm @ 54Mbps of 802.11g, PER ≦ 10%

Sensitivity ≦ -70 +/-2 dBm @ MCS7, HT20 of 802.11gn, PER ≦ 10%

Sensitivity ≦ -68 +/-2 dBm @ MCS7, HT40 of 802.11gn, PER ≦ 10%

❖ 5GHz:

Sensitivity ≦ -71 +/-2 dBm @ 54Mbps of 802.11a, PER ≦ 10%

Sensitivity ≦ -69 +/-2 dBm @ MCS7,HT20 of 802.11an, PER ≦ 10%

Sensitivity ≦ -67 +/-2 dBm @ MCS7,HT40 of 802.11an, PER ≦ 10%

❖ 5GHz AC:

Sensitivity ≦ -65 +/-2 dBm @ MCS8,HT20 of 802.11ac, PER ≦ 10%

Sensitivity ≦ -62 +/-2 dBm @ MCS8,HT40 of 802.11ac, PER ≦ 10%

Sensitivity ≦ -59 +/-2 dBm @ MCS8,HT80 of 802.11ac, PER ≦ 10%

Method

Let Golden Unit transmit packages. Increase step attenuator, to monitor PER (package error rate), don't let it over spec and calculate its sensitivity.

Results

❖ 2.4GHz

ANT0 Test Mode	Supply Voltage	Test Channel	Spec	Test Data
802.11b 11Mbps	Vbat : 3.3V	CH7	PER ≦ 8%	**-87**
802.11g 54Mbps	Vbat : 3.3V	CH7	PER ≦ 10%	**-73**
802.11n(HT20) MCS7	Vbat : 3.3V	CH7	PER ≦ 10%	**-70**
802.11n(HT40) MCS7	Vbat : 3.3V	CH7	PER ≦ 10%	**-67**

(Unit: dBm)

ANT1 Test Mode	Supply Voltage	Test Channel	Spec	Test Data
802.11b 11Mbps	Vbat : 3.3V	CH7	PER≦ 8%	-87
802.11g 54Mbps	Vbat : 3.3V	CH7	PER≦ 10%	-74
802.11gn(HT20) MCS7	Vbat : 3.3V	CH7	PER≦ 10%	-71
802.11gn(HT40) MCS7	Vbat : 3.3V	CH7	PER≦ 10%	-67

❖ 5GHz

ANT0 Test Mode	Supply Voltage	Test Channel	Spec	Test Data
802.11a 54Mbps	Vbat : 3.3V	CH36	PER≦ 10%	-73
		CH100	PER≦ 10%	-72
		CH161	PER≦ 10%	-73
802.11an(HT20) MCS7	Vbat : 3.3V	CH36	PER≦ 10%	-70
		CH161	PER≦ 10%	-70
802.11an(HT40) MCS7	Vbat : 3.3V	CH36	PER≦ 10%	-67
		CH157	PER≦ 10%	-67

ANT1 Test Mode	Supply Voltage	Test Channel	Spec	Test Data
802.11a 54Mbps	Vbat : 3.3V	CH36	PER≦ 10%	-72
		CH100	PER≦ 10%	-70
		CH161	PER≦ 10%	-73
802.11an(HT20) MCS7	Vbat : 3.3V	CH36	PER≦ 10%	-69
		CH161	PER≦ 10%	-70
802.11an(HT40) MCS7	Vbat : 3.3V	CH36	PER≦ 10%	-64
		CH157	PER≦ 10%	-67

❖ 5GHz AC:

ANT0 Test Mode	Supply Voltage	Test Channel	Spec	Test Data
802.11ac(HT20) MCS8	Vbat : 3.3V	CH36	PER≦ 10%	**-66**
		CH161	PER≦ 10%	**--66**
802.11ac(HT40) MCS8	Vbat : 3.3V	CH36	PER≦ 10%	**-64**
		CH161	PER≦ 10%	**--63**
802.11an(HT80) MCS8	Vbat : 3.3V	CH36	PER≦ 10%	**-60**
		CH161	PER≦ 10%	**-60**

ANT1 Test Mode	Supply Voltage	Test Channel	Spec	Test Data
802.11ac(HT20) MCS8	Vbat : 3.3V	CH36	PER≦ 10%	**-66**
		CH161	PER≦ 10%	**--66**
802.11ac(HT40) MCS8	Vbat : 3.3V	CH36	PER≦ 10%	**-63**
		CH161	PER≦ 10%	**--64**
802.11an(HT80) MCS8	Vbat : 3.3V	CH36	PER≦ 10%	**-60**
		CH161	PER≦ 10%	**-60**

6. BT RF performance test for Bluetooth

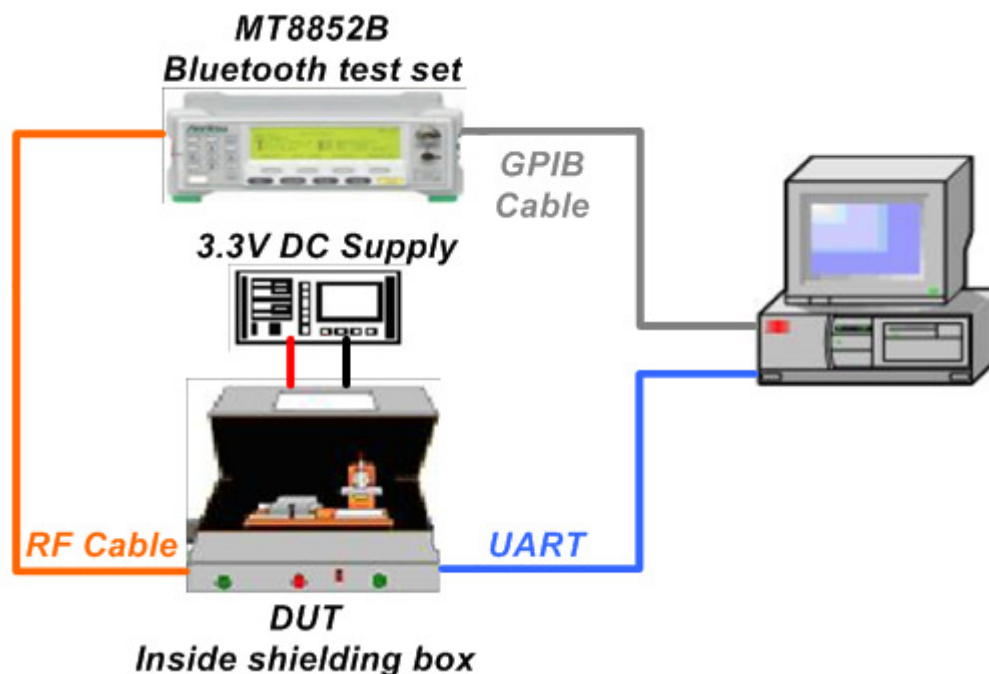**Bluetooth RF Transceiver Characteristics**

Figure 8.1   Test configuration for RF transceiver characteristics measurement

Figure 8.1 shows the test configuration for RF transceiver characteristics measurement for AP6335

Bluetooth. The system consists of one PC, Anritsu 8852B and some instrument equipment. High

isolation RF shielding box is necessary for DUT. The test results are shown in table 8.1.

Table 8.1 Bluetooth RF transceiver characteristics test results

VBAT@3.3V,25℃ at normal condition			
Items	**Limitation**	**Values**	**Unit**
BDR Test Item			
TRM/CA/01/C (Output Power)	4dBm < Power < 20dBm	**8.5**	dBm
TRM/CA/03/C (Power Control)	2dB < Min. Step < 8dB	**3.6**	dB
	2dB < Max. Step < 8dB	**4.6**	

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TRM/CA/08/C (Initial Carrier)	Offset <= +/- 75KHz	**-8.8**	KHz
TRM/CA/09/C (Carrier Drift)	DH1: +/- 25KHz	**5.7**	KHz
	DH3: +/- 40 KHz	**-9.2**	
	DH5: +/- 40 KHz	**2.5**	
TRM/CA/07/C (Modulation Characteristic)	140kHz < F1 < 175kHz	**156.9**	KHz
	F2 Max >= 115 kHz	**133.7**	
	F1/F2 Ratio >= 0.8	**0.89**	
RCV/CA/01/C (Single Sensitivity)	Limit :-70 dBm Dirty ON, BER <= 0.1%	**-90**	dBm
RCV/CA/06/C (Max Input Level)	Limit :-20 dBm Dirty ON, BER <= 0.1%	**-20**	dBm
EDR Test Item			
TRM/CA/11/C (EDR Carrier Frequency Stability and Modulation Accuracy)	2Mbps RMS DEVM <= 0.2	**0.05**	-
	2Mbps Peak DEVM <= 0.35	**0.177**	
RCV/CA/07/C (EDR Sensitivity 2 Mbps)	Limit :-70 dBm Dirty ON, Overall BER<= 7.0E-005	**-89**	dBm
RCV/CA/07/C (EDR Sensitivity 3 Mbps)	Limit :-70 dBm Dirty ON, Overall BER<= 7.0E-005	**-86**	dBm