Section A: Basic setting

1. Before tests start

1.1 Stop the "wireless service" and change "IBSS Mode" setting and "IBSS Link indication" setting under Device Manager for REF and DUT.

Step	Station	Instructions

1	DUT and REF	Right-click on "Wireless Network Connect" on Network connect of Control Panel; and then click on "Configuration" in General page.
		Change below default value:
		  a) IBSS Mode ->802.11a/b/g/n Auto
		  b) IBSS Link Indication -> Legacy
		   (you can also issue "wl legacylink 1" instead.)

2	DUT and REF	1) Go to Start> Run and type "regedit" to modify the system registry
		2) Navigate to:
		  "HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters"
		3) Look down the list of Name for "TcpWindowSize"
		  Note: if TcpWindowSize is NOT present it must be added as follows:
		   right-click anywhere in the right-side window and select
		   "new > DWORD Value". Type the name TcpWindowSize and hit Enter.
		4) Update TcpWindowSize as follows:
		  a) Right-click on "TcpWindowSize" and select "Modify"
		  b) Select "Hexadecimal" and type the value "100000"

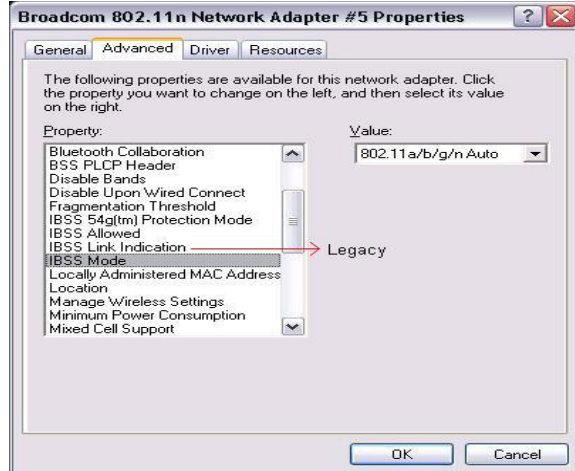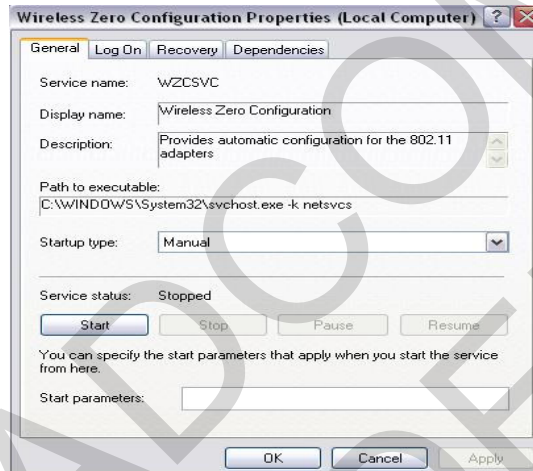Figure 1. Setting for IBSS 54g and IBSS Link Indication   Figure 2. Stop Wireless Zero Configuration Service, see below (or you can issue "net stop wzcsvc" instead).

Step	Station	Command	Parameter	Note
3	DUT (console / telnet)	net	stop wltrysvc	Stop Broadcom Wireless LAN Tray service
4	DUT (console / telnet)	net	stop wzcsvc	Stop Wireless Zero Configuration service
5	REF	net	stop wltrysvc	Stop Broadcom Wireless LAN Tray service
6	REF	net	stop wzcsvc	Stop Wireless Zero Configuration service

1.2 Loading RAMdisk image for mfg test

1.2.1 Check 2 nvram parameters before loading RADdisk image

Step	Station	Command	Parameter	Note
1	DUT (console / telnet)	nvram	get boot_wait	check (1) boot_wait = on
2	DUT (console / telnet)	nvram	get wait_time	check (2) wait_time = 20

1.2.2 RAMdisk test

Step	Station	Command	Parameter	Note
1	DUT (only in console mode)	reboot		Reboot the AP
2	Waiting till "Loading……. " message shows at the console			
3	Dos Box of DUT computer	tftp	-i AP_LAN_IPaddr PUT vmlinuz	PUT vmlinuz to sram of AP while "Loading" message showed at the console
4	DUT (console / telnet)	wl	ver	check the Firmware version

1.3 Initializing dut unit

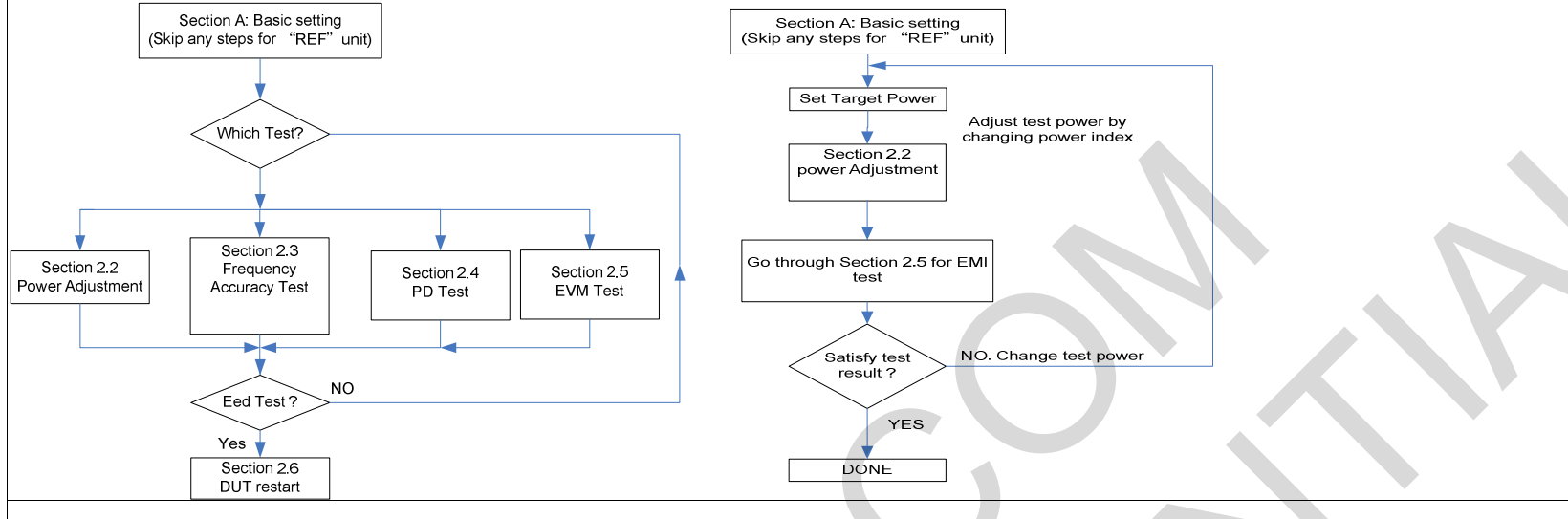| Step	Station	Command	Parameter	Note
1	DUT (console / telnet)	wl	down	Reset and make adapter down (disabled)
2	DUT (console / telnet)	wl	country ALL	Set country code to ALL
3	DUT (console / telnet)	wl	spect 0	Set off for 802.11h spectrum management mode
4	DUT (console / telnet)	wl	ibss_gmode -1	Set the gmode value to -1 and all the gmode settings can be set.
5	DUT (console / telnet)	wl	ampdu 1	Set ampdu to 1. Allowed when driver is down.
6	DUT (console / telnet)	wl	wsec 0	Disable wireless security
7	DUT (console / telnet)	wl	bi 100	set beacon interval to 100ms
8	DUT (console / telnet)	wl	mpc 0	Disable MPC (Minimum Power Consumption in driver)
9	DUT (console / telnet)	wl	up	Reinitialize and make adapter up (operational)
10	DUT (console / telnet)	wl	frameburst 1	Enable frameburst mode
11	DUT (console / telnet)	wl	mimo_bw_cap 1	enable both 20 MHz and 40MHz for 2G band and 5G band
12	DUT (console / telnet)	wl	mimo_ss_stf 0	Set mode to SISO (0: SISO 1: CDD)
13	DUT (console / telnet)	wl	nphy_txpwrctrl 1	Enable close loop power control

1.4 Initializing ref unit

Step	Station	Command	Parameter	Note
1	REF	wl	down	Reset and make adapter down (disabled)
2	REF	wl	country ALL	Set all country code
3	REF	wl	spect 0	Set off for 802.11h spectrum management mode
4	REF	wl	ampdu 1	Set ampdu to 1. Allowed when driver is down.
5	REF	wl	wsec 0	Disable wireless security
6	REF	wl	mpc 0	Disable MPC (Minimum Power Consumption in driver)
7	REF	wl	up	Reinitialize and make adapter up (operational)
8	REF	wl	legacylink 1	Set IBSS link indication to legacy mode
9	REF	wl	frameburst 1	Enable frameburst mode
10	REF	wl	mimo_ss_stf 0	Set mode to SISO (0: SISO 1: CDD)
11	REF	wl	nphy_txpwrctrl 1	Enable close loop power control

Section B: Single Station Test

2. Single Station Test

2.1 Test diagram for section B

Fixed Power Test , Frequency Accuracy Test and 2x3 Antenna Diversity Test

EMI Test

2.2 Power Adjustment

2.2.1 Close Loop Power Adjustment

Step	Station	Command	Parameter	Note
1	DUT (console / telnet)	wl	nphy_txpwrctrl 1	Enable Close Loop Power Control.
2	DUT (console / telnet)	wl	srl 7	Short Retry Limit set to 7
3	DUT (console / telnet)	wl	lrl 4	Long Retry Limit set to 4
4	DUT (console / telnet)	wl	down	Reset and make adapter down (disabled)
If test channel is at 5G then go to 5-a and 6-a, else go to 5-b and 6-b				
5-a	DUT (console / telnet)	wl	band a	Set test band to 5G
6-a	DUT (console / telnet)	wl	chanspec -c cc -b 5 -w BW -s sideband	cc: test channel, set bw to 20MHz for fixed power test. -c : channel number, -b : band (2 for 2.4G band, 5 for 5G band), -w : BW ,bandwidth (20M\40M), -s : sideband, control sideband (0 (none) |1 (upper)	-1 (lower))
			Go to step 7	
5-b	DUT (console / telnet)	wl	band b	Set test band to 2G
6-b	DUT (console / telnet)	wl	chanspec -c cc -b 2 -w BW -s sideband	cc: test channel, set bw to 20MHz for fixed power test. -c : channel number, -b : band (2 for 2.4G band, 5 for 5G band), -w : BW, bandwidth (20M/40M), -s : sideband, control sideband (0 (none) |1 (upper)	-1 (lower))
7	DUT (console / telnet)	wl	up	Reinitialize and make adapter up (operational)
8	go to Section 3.3.1:Change Test Rate for DUT to set test rate			Currently fixed power test only test at mcs 15. So the step 6 is as below: wl nrate -m 15 -s 3
9	DUT (console / telnet)	wl	rateset 54b	Change beacon rate to 54Mb/s for fixed power test
10	DUT (console / telnet)	wl	join test imode infra	Join a BSS network
11	DUT (console / telnet)	wl	txpwr1 -o -q XX	XX is the target power, unit is 0.25dBm
12	Dos Box of DUT computer	epi_ttcp	-tsufm -l 1000 -n 1000 BRODADCASTIP	send out short packets to get stable power.

2.2.2 Open Loop Power Adjustment

Step	Station	Command	Parameter	Note
1	DUT (console / telnet)	wl	nphy_txpwrctrl 0	Disable Close Loop Power Control.
2	DUT (console / telnet)	wl	srl 7	Short Retry Limit set to 7
3	DUT (console / telnet)	wl	lrl 4	Long Retry Limit set to 4
4	DUT (console / telnet)	wl	down	Reset and make adapter down (disabled)
If test channel is at 5G then go to 5-a and 6-a, else go to 5-b and 6-b				
5-a	DUT (console / telnet)	wl	band a	Set test band to 5G
6-a	DUT (console / telnet)	wl	chanspec -c cc -b 5 -w 20 -s 0	cc: test channel, set bw to 20MHz for fixed power test. -c : channel number, -b : band (2 for 2.4G band, 5 for 5G band), -w : bandwidth (20M/40M), -s : control sideband (0 (none) |1 (upper)	-1 (lower))
			Go to step 7	
5-b	DUT (console / telnet)	wl	band b	Set test band to 2G
6-b	DUT (console / telnet)	wl	chanspec -c cc -b 2 -w 20 -s 0	cc: test channel, set bw to 20MHz for fixed power test. -c : channel number, -b : band (2 for 2.4G band, 5 for 5G band), -w : bandwidth (20M/40M), -s : control sideband (0 (none) |1 (upper)	-1 (lower))
7	DUT (console / telnet)	wl	up	Reinitialize and make adapter up (operational)
8	go to Section 3.3.1:Change Test Rate for DUT to set test rate			Currently fixed power test only test at mcs 15. So the step 6 is as below: wl nrate -m 15 -s 3
9	DUT (console / telnet)	wl	rateset 54b	Change beacon rate to 54Mb/s for fixed power test
10	DUT (console / telnet)	wl	join test imode infra	Join a BSS network

	find power index for Antenna 0			
11	DUT (console / telnet)	wl	txant 0	force use of antenna 0
12	DUT (console / telnet)	wl	nphy_txrx_chain 0	force the chain to stream 0
13	DUT (console / telnet)	wl	nphy_txpwrindex 0x287F	set powerindex to 40 at antenna 0 for both 2G and 5G
14	Read measured power back from power meter			
15	deltaindex = get integer of ((measured power-target power)* 2.5)			
16	CurPowerIndex=40+deltaindex , MaxPowerIndex=CurPowerIndex+16, MinPowerIndex=CurPowerIndex-16			

```
                    127, attenuation is maximal,
_____            the output power is minimal.
-------------------------- MaxPowerIndex
     ↕16
           _____ CurPowerIndex
      ↕16
-------------------------- MinPowerIndex

_____             0, attenuation is minimal, the
                     output power is maximal.
```

17	Adjust power index , high byte of nphy_txpwrindex, from MaxPowerIndex to MinPowerIndex and find power index for the closest and less than target power. Set found power index to XX.			
	find power index for Antenna 1			
18	DUT (console / telnet)	wl	txant 1	force use of antenna 1
19	DUT (console / telnet)	wl	nphy_txrx_chain 1	force the chain to stream 1
20	DUT (console / telnet)	wl	nphy_txpwrindex 0x7F28	set powerindex to 40 at antenna 1 for both 2G and 5G
21	Read back output power from power meter			
22	deltaindex= get integer of ((measured power-target power)* 2.5)			Each step is 0.25dB in nphy_txpwrindex
23	CurPowerIndex=40+deltaindex , MaxPowerIndex=CurPowerIndex+16, MinPowerIndex=CurPowerIndex-16			

```
                    127, attenuation is maximal,
_____            the output power is minimal.
-------------------------- MaxPowerIndex
     ↕16
           _____ CurPowerIndex
      ↕16
-------------------------- MinPowerIndex

_____             0, attenuation is minimal, the
                     output power is maximal.
```

24	Adjust power index, low byte of nphy_txpwrindex, from MaxPowerIndex to MinPowerIndex and find power index for the closest and less than target power. Set found power index to YY.			
25	DUT (console / telnet)	wl	nphy_txrx_chain -1	Set the chain to default
26	DUT (console / telnet)	wl	txant -1	Set back to driver antenna default
27	DUT (console / telnet)	wl	nphy_txpwrctrl 1	Enable Close Loop Power Control.

2.3 Frequency Accuracy Test

		Test spect. in 4322 Frequency Tolerance Test at room temperature		
	band	Limit	Value	
	2G	High limit	<=10 ppm	
		Low limit	>=-10 ppm	
	5G	High limit	<=10 ppm	
		Low limit	>=-10 ppm	

Step	**Station**	**Command**	**Parameter**	**Note**
If test channel is at 5G then go to 5-a and 6-a, else go to 5-b and 6-b				
1-a	DUT (console / telnet)	wl	band a	Change test band to 5G band
		Go to step 2		
1-b	DUT (console / telnet)	wl	band b	Change test band to 2G band
2	DUT (console / telnet)	wl	disassoc	Disassociate from the current settings
3	DUT (console / telnet)	wl	join fqactest imode infra	Join a BSS network
4	DUT (console / telnet)	wl	out	Make adaptor down but do not reset hardware (disabled)
5	DUT (console / telnet)	wl	fqacurcy XX	MFG test, set frequency accuracy mode. XX is the test channel
6	SA		1) Change center frequency of SA to test channel. Set SPAN to 500KHz, resolution bandwidth to 10KHz and video bandwidth to 10KHz 2) Enable marker frequency counter in SA 3) Set resolution for marker frequency counter to 100 4) Peak search 5) Read back measured power and frequency from SA 6) deltafreq = measured frequency - frequency of test channel	
7	DUT (console / telnet)	wl	fqacurcy 0	stop testing.
8	DUT (console / telnet)	wl	up	Reinitialize and make adapter up (operational)

2.4 PD test

	Test spect.		Note	
	Test Limit for 2G band	+- 1.5dB		
	Test Limit for 5G band	+- 1.5dB		
Step	**Station**	**Command**	**Parameter**	**Note**
1	DUT (console / telnet)	wl	nphy_txpwrctrl 1	Enable Close Loop Power Control.
2	DUT (console / telnet)	wl	txpwr1 -o -q XX	XX is the target power, unit is 0.25dBm
3	DOS Box of DUT computer	epi_ttcp	-tsufm -l 1000 -n 1000 BRODADCASTIP	send out short packets to get stable power.
find power delta for Antenna 0				
4	DUT (console / telnet)	wl	txant 0	
5	DUT (console / telnet)	wl	nphy_txrx_chain 0	
6	Power Meter	Reading back actual power from power meter.		
7	DUT (console / telnet)	wl	nphy_est_power	reports estimated power in quarter dBms. 16-bit output consists of estimated power of cores 0 and 1 in MSbyte and LSbyte, respectively when estimated power is not valid, 0x80 is returned for that core
8	power delta=Actual power - est_power			
find power delta for Antenna 1				
8	DUT (console / telnet)	wl	txant 1	
9	DUT (console / telnet)	wl	nphy_txrx_chain 1	
10	Power Meter	Reading back actual power from power meter.		
11	DUT (console / telnet)	wl	nphy_est_power	reports estimated power in quarter dBms. 16-bit output consists of estimated power of cores 0 and 1 in MSbyte and LSbyte, respectively when estimated power is not valid, 0x80 is returned for that core
12	Power Meter	power delta=Actual power - est_power		
13	DUT (console / telnet)	wl	txant -1	
14	DUT (console / telnet)	wl	nphy_txrx_chain 0xffff	

2.5 EMI Test

Regulatory Requirements

Regulatory	Frequency (MHz)	Requirements
FCC 15.247(b)	2400 - 2483.5	30 dBm conducted power +6dBi antenna
FCC 15.407 (a), (1), (2), (3)	5150 - 5250	17 dBm conducted + 6 dBi antenna
	5250 - 5350	24 dBm conducted + 6 dBi antenna
	5725 - 5825	30 dBm conducted + 6 dBi antenna
EN 300 328 4.3.1	2400 - 2483	Power limited to 20 dBm EIRP
EN 301 893 4.3.2	5150 - 5350	Power limited to 23 dBm EIRP
	5470 - 5725	Power limited to 30 dBm EIRP

Regulatory Power limiting factor

Regulatory	limiting factor	Note
FCC	Band Edge	1) FCC Emissions mask based upon measurement @ 3m. 2) Average Measurements performed in 1MHz RBW, 10Hz VBW, Limit = 54dBuV/m as per 15.209(a) 3) Peak Measurements performed in 1MHz RBW/VBW, Limit = 74dBuV/m as per 15.35(b) 4) Peak and average measurements ONLY apply for emissions in the restricted bands defined under 15.205(a). Band Edge requirements therefore do not apply to all 5GHz bands.
FCC	Spurious Emissions.	Peak and average limits as per Band Edge requirements.
EU	Power Spectral Density (2.4GHz and 5GHz low band)	EN 300 328 1) 10 dBm per MHZ EIRP
EU	Spurious Emissions.	Ref EN 300 328

2.5.1 802.11n 2.4GHz with 20MHz

Step	Station	Command	Parameter	Note
1	DUT (console / telnet)	wl	chanspec -c xx -b 2 -w 20 -s 0	Set channel xx to 11 for FCC band edge test. -c : channel number, -b : band (2 for 2.4G band, 5 for 5G band), -w : bandwidth (20M\40M), -s : control sideband (0 (none) |1 (upper) | -1 (lower))
2	DUT (console / telnet)	wl	wl join test_20MHz_2GHz imode infra	Join a BSS network
3	DUT (console / telnet)	wl	nrate -m 0 -s 1	Go to Section 3.2 to change test rate
4	DUT (console / telnet)	wl	mimo_txbw 2	Set mimo txbw to 20MHz (lower)
5	DUT (console / telnet)	wl	nphy_txpwrindex 0xXXYY	Set power index to XXYY. The power index is found during fixed power test
6	Dos Box of DUT computer	epi_ttcp	-tsufm -n 10000000 BRODADCASTIP	Send out long packets

2.5.2 802.11n 2.4GHz with 40MHz

Step	Station	Command	Parameter	Note
1	DUT (console / telnet)	wl	chanspec -c xx -b 2 -w 40 -s 1	Set channel xx to 11 for FCC band edge test. -c : channel number, -b : band (2 for 2.4G band, 5 for 5G band), -w : bandwidth (20M\40M), -s : control sideband (0 (none) |1 (upper) | -1 (lower))
2	DUT (console / telnet)	wl	wl join test_40MHz_2GHz imode infra	Join a BSS network
3	DUT (console / telnet)	wl	nrate -m 0 -s 1	Go to Section 3.2 to change test rate
4	DUT (console / telnet)	wl	mimo_txbw 4	Set mimo txbw to 40MHz
5	DUT (console / telnet)	wl	nphy_txpwrindex 0xXXYY	Set power index to XXYY. The power index is found during fixed power test
6	Dos Box of DUT computer	epi_ttcp	-tsufm -n 10000000 BRODADCASTIP	Send out long packets

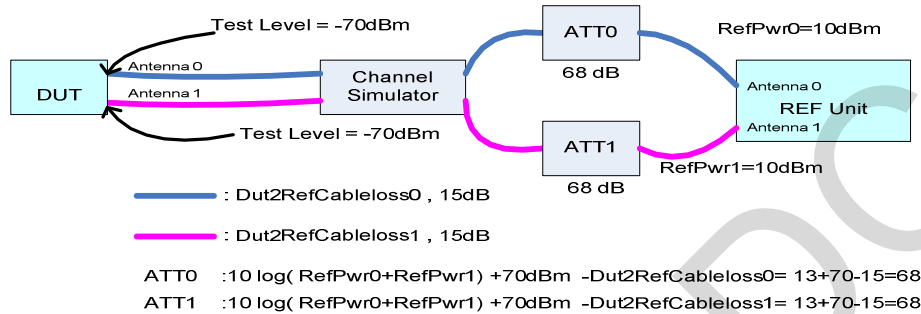| 2.5.3 Legacy b , 1Mbps 2.4GHz with 20MHz			
Step	**Station**	**Command**	**Parameter**	**Note**
1	DUT (console / telnet)	wl	chanspec -c xx -b 2 -w 20 -s 0	Set channel xx to 1 or 11 for FCC band edge test. -c : channel number, -b : band (2 for 2.4G band, 5 for 5G band), -w : bandwidth (20M\40M), -s : control sideband (0 (none) |1 (upper) | -1 (lower))
2	DUT (console / telnet)	wl	wl join EMITest1 imode infra	Join a BSS network
3	DUT (console / telnet)	wl	nrate -r 1	Set to legacy mode 1 M rate
4	DUT (console / telnet)	wl	mimo_txbw -1	Set mimo txbw to default
5	DUT (console / telnet)	wl	cck_txbw 2	set/get the cck frame tx bandwidth: 2=20Mhz lower, 3=20Mhz upper
6	DUT (console / telnet)	wl	nphy_txpwrindex 0xXXYY	Set power index to XXYY. The power index is found during fixed power test
7	Dos Box of DUT computer	epi_ttcp	-tsufm -n 10000000 BRODADCASTIP	Send out long packets
2.5.4 Legacy g , 6 Mbps 2.4GHz with 20MHz			
Step	**Station**	**Command**	**Parameter**	**Note**
1	DUT (console / telnet)	wl	chanspec -c xx -b 2 -w 20 -s 0	Set channel xx to 1 or 11 for FCC band edge test. -c : channel number, -b : band (2 for 2.4G band, 5 for 5G band), -w : bandwidth (20M\40M), -s : control sideband (0 (none) |1 (upper) | -1 (lower))
2	DUT (console / telnet)	wl	wl join EMITest6 imode infra	Join a BSS network
3	DUT (console / telnet)	wl	nrate -r 6	Set to legacy mode 6 M rate
4	DUT (console / telnet)	wl	mimo_txbw 2	Set mimo txbw to 20MHz(lower)
5	DUT (console / telnet)	wl	nphy_txpwrindex 0xXXYY	Set power index to XXYY. The power index is found during fixed power test
6	Dos Box of DUT computer	epi_ttcp	-tsufm -n 10000000 BRODADCASTIP	Send out long packets

Section C: Change Test Channel & Rate

3. Switch attenuator and set Test Channel & Test Rate

3.1 Set switch attenuator to correct test level

3.1.1 Channel simulator is used in test system.

Step	Name	Value	Note
1	Number of Antenna	N	94321cb2 is 2
2	Tx power @ antenna 0 for REF (dBm)	RefPwr0	default value is 10 dBm
3	Tx power @ antenna 1 for REF (dBm)	RefPwr1	default value is 10 dBm
4	The cable loss of DUT to REF at antenna 0 at test channel	DUT2REFCableloss0	
5	The cable loss of DUT to REF at antenna 1 at test channel	DUT2REFCableloss1	
6	PER or Throughput test level (dBm), A	A	A=-50dBm for RX PER test and A=-35dBm for throughput test
7	PER or Throughput test level (mW), B	$B = 10^{\frac{A}{10}}$	dBm=10 log (x/1mW) , the unit for x is mW
8	The test level per antenna (mW) , C	C=B/N	
9	The test level per antenna (dBm) ,S	S=10 log (C/1mW)	S=A- 10*log (N) dBm
10	value of attenuator 0 (antenna 0) , Att0	Att0= RefPwr0-Dut2RefCableloss0-S	
11	value of attenuator 1 (antenna 1), Att1	Att1= RefPwr1-Dut2RefCableloss1-S	

Illustration is the setting of switch attenuators for n rate

Test Level = -70dBm
Antenna 0
DUT
Antenna 1
Channel Simulator
ATT0
68 dB
RefPwr0=10dBm
Antenna 0
REF Unit
Antenna 1
Test Level = -70dBm
ATT1
68 dB
RefPwr1=10dBm

— : Dut2RefCableloss0 , 15dB
— : Dut2RefCableloss1 , 15dB

ATT0 :10 log(RefPwr0+RefPwr1) +70dBm -Dut2RefCableloss0= 13+70-15=68
ATT1 :10 log(RefPwr0+RefPwr1) +70dBm -Dut2RefCableloss1= 13+70-15=68

3.1.2 No channel simulator is used in test system.

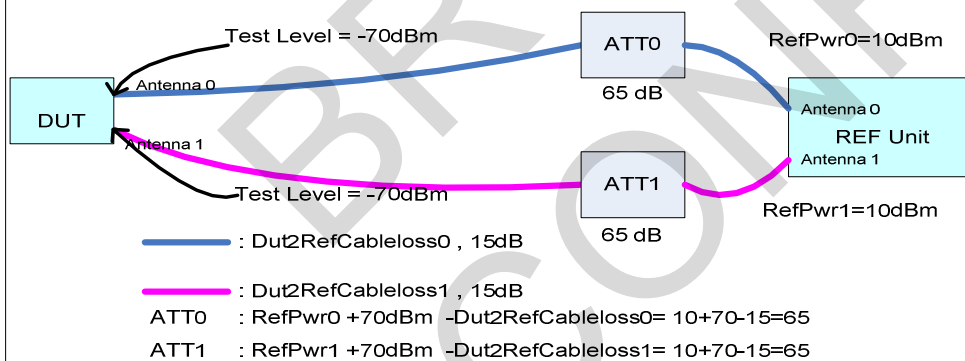| Step	Name	Value	Note
1	Tx power @ antenna 0 for REF (dBm)	RefPwr0	default value is 10 dBm
2	Tx power @ antenna 1 for REF (dBm)	RefPwr1	default value is 10 dBm
3	The cable loss of DUT to REF at antenna 0 at test channel	DUT2REFCableloss0	
4	The cable loss of DUT to REF at antenna 1 at test channel	DUT2REFCableloss1	
5	PER or Throughput test level (dBm), A	A	A=-50dBm for RX PER test and A=-35dBm for throughput test
6	value of attenuator 0 (antenna 0) , Att0	Att0= RefPwr0-Dut2RefCableloss0-A	
7	value of attenuator 1 (antenna 1) , Att1	Att1= RefPwr1-Dut2RefCableloss1-A	

Illustration is switch attenuator settings for n mode

Test Level = -70dBm
Antenna 0
DUT
Antenna 1
ATT0
65 dB
RefPwr0=10dBm
Antenna 0
REF Unit
Antenna 1
Test Level = -70dBm
ATT1
65 dB
RefPwr1=10dBm

— : Dut2RefCableloss0 , 15dB
— : Dut2RefCableloss1 , 15dB

ATT0 : RefPwr0 +70dBm -Dut2RefCableloss0= 10+70-15=65
ATT1 : RefPwr1 +70dBm -Dut2RefCableloss1= 10+70-15=65

3.2 Initializing channel setting / Change test channel

Step	Station	Command	Parameter	Note
If test channel is at 5G then go to step 1-a , else go to step 1-b				
1-a	DUT (console / telnet)	wl	band a	set test band to 5G
			go to step 2	
1-b	DUT (console / telnet)	wl	band b	Set test band to 2G
2	DUT (console / telnet)	wl	up	Reinitialize and make adapter up (operational)
3	DUT (console / telnet)	wl	frameburst 1	Enable frameburst mode
4	DUT (console / telnet)	wl	mimo_txbw -1	Set mimo txbw to default
5	Switch all attenuators to proper value before join wireless networking, say 30 dB			
6	DUT (console / telnet)	wl	down	set test band to 5G
If test channel is at 5G then go to step 7-a , else go to step 7-b				
7-a	DUT (console / telnet)	wl	chanspec -c cc -b 5 -w bb -s ss	-c : channel number, -b : band (2 for 2.4G band, 5 for 5G band), -w : bandwidth (20M\40M), -s : control sideband (0 (none) |1 (upper) | -1 (lower))
			go to step 10	
7-b	DUT (console / telnet)	wl	chanspec -c cc -b 2 -w bb -s ss	-c : channel number, -b : band (2 for 2.4G band, 5 for 5G band), -w : bandwidth (20M\40M), -s : control sideband (0 (none) |1 (upper) | -1 (lower))
8	DUT (console / telnet)	wl	up	Reinitialize and make adapter up (operational)
9	DUT (console / telnet)	wl	rate -1	Set DUT rate to auto
If test channel is at 5G then go to step 10-a , else go to step 10-b				
10-a	REF	wl	band a	set test band to 5G
			go to step 13	
10-b	REF	wl	band b	Set test band to 2G
11	DUT (console / telnet)	wl	join ibssxxx imode infra	Wireless networking name:ibssxxx
12	REF	wl	up	Reinitialize and make adapter up (operational)
13	REF	wl	rate -1	Set DUT rate to auto
14	REF	wl	join ibssxxx imode infra	Join a BSS network
15	Dos Box of DUT computer	ping	REFIP	ping IP address of REF unit to check a wireless link.
16	REF	wl	scansuppress 1	Disable scansuppress to get stable result

3.3 Change Test Rate

3.3.1 Change Test Rate for DUT

3.3.1.1   Test rate is n rate

Step	Station	Command	Parameter	Note
If test rate < 8 then go to step 1-a , else go to step 1-b				
1-a	DUT (console / telnet)	wl	nrate -m TestRate -s 1	for rate mcs 0-7 , enable CDD mode for rates m 0-7
		END		
1-b	DUT (console / telnet)	wl	nrate -m TestRate -s 3	for rate mcs >=8, enable SDM mode for rate m 8 - m15

3.3.1.2   Test rate is legacy rate

Step	Station	Command	Parameter	Note
1	DUT (console / telnet)	wl	nrate -r TestRate	

3.3.2 Change Test Rate for REF

3.3.2.1   Test rate is n rate

Step	Station	Command	Parameter	Note
If test rate < 8 then go to step 1-a , else go to step 1-b				
1-a	REF	wl	nrate -m TestRate -s 1	for rate mcs 0-7 , enable CDD mode for rates m 0-7
		END		
1-b	REF	wl	nrate -m TestRate -s 3	for rate mcs >=8, enable SDM mode for rate m 8-m15

3.3.2.2   Test rate is legacy rate

Step	Station	Command	Parameter	Note
1	REF	wl	nrate -r TestRate	

4.PER and Throughput Test

4.1 Test Flow Control for Section D

Test flowchart for PER and throughput test
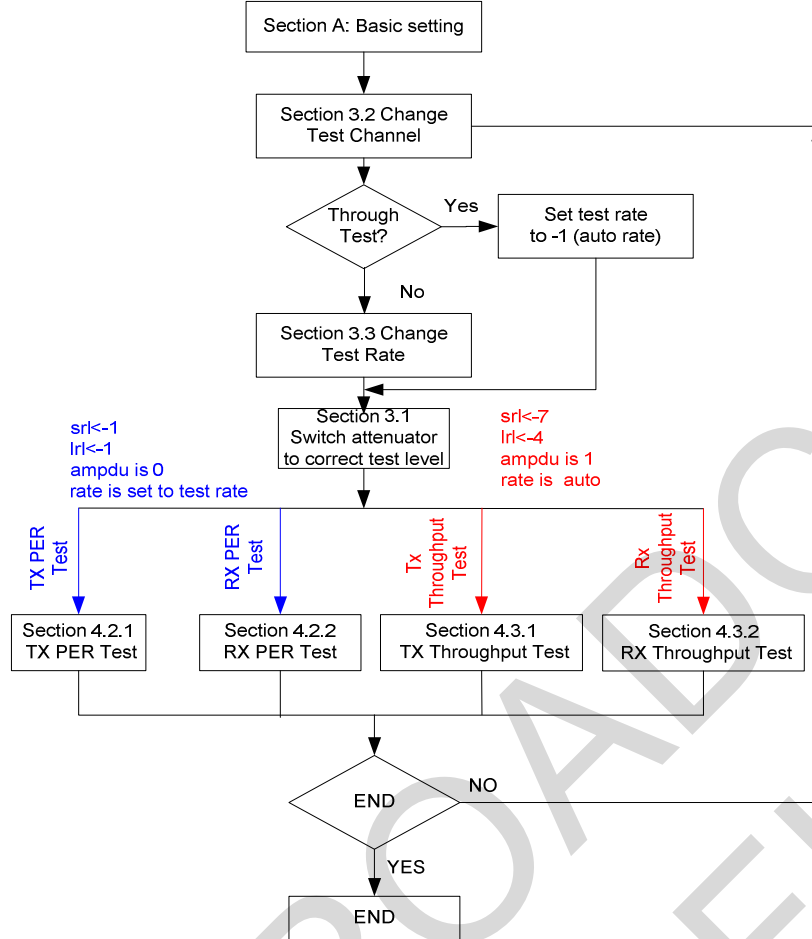
4.2 PER Test

4.2.1 TX PER Test

Test spect. in 4322 TX PER Test		
Test Level	Test Limit	
-40dBm	<= 4%	

Step	Station	Command	Parameter	Note
1	DUT (console / telnet)	wl	down	Reset and make adapter down (disabled)
2	DUT (console / telnet)	wl	ampdu 0	turn off ampdu. Allowed when driver is down.
3	DUT (console / telnet)	wl	up	Reinitialize and make adapter up (operational)
4	REF	wl	down	Reset and make adapter down (disabled)
5	REF	wl	ampdu 0	turn off ampdu. Allowed when driver is down.
6	REF	wl	up	Reinitialize and make adapter up (operational)
7		go to Section 3.2 Change Test Channel		Change test change
8		go to Section 3.3 Change Test Rate		Change test rate
9	DUT (console / telnet)	wl	srl 1	Short Retry Limit set to 1
10	DUT (console / telnet)	wl	lrl 1	Long Retry Limit set to 1
11	REF	wl	srl 1	Short Retry Limit set to 1
12	REF	wl	lrl 1	Long Retry Limit set to 1
13	REF	epi_ttcp	-rsufm -p 5010	Receiver must be ready first (using UDP protocol)
If test in MIMO rate go to step 14-a and test in legacy rate go to step 14-b				
14-a	Dos Box of DUT computer	epi_ttcp	-tsufm -l 1000 -p 5010 -p 5010 -n 1000 REF_IP	Send 1000 UDP packets to REF unit (need to add -S 5 to delay the speed from NIC to router) MIMO
			go to step 15	
14-b	Dos Box of DUT computer	epi_ttcp	-tsufm -l 1000 -p 5010 -p 5010 -n 1000 REF_IP	Send 1000 UDP packets to REF unit (need to add -S 10 to delay the speed from NIC to router) Legacy
15	REF	wl	srl 7	Restore srl to default value
16	REF	wl	lrl 4	Restore lrl to default value
17	DUT (console / telnet)	wl	srl 7	Restore srl to default value
18	DUT (console / telnet)	wl	lrl 4	Restore lrl to default value

4.2.2 RX PER Test

Test spect. in 4322 RX PER Test			
band	rate	Test Level	Test Limit
2G	mcs 15, BW 40	-62	<=10 %
2G	mcs 15, BW 20	-64	<=10 %
5G	mcs 15, BW 40	-60	<=10 %
5G	mcs 15, BW 20	-62	<=10 %

Step	Station	Command	Parameter	Note
1	DUT (console / telnet)	wl	down	Reset and make adapter down (disabled)
2	DUT (console / telnet)	wl	ampdu 0	turn off ampdu. Allowed when driver is down.
3	DUT (console / telnet)	wl	up	Reinitialize and make adapter up (operational)
4	REF	wl	down	Reset and make adapter down (disabled)
5	REF	wl	ampdu 0	turn off ampdu. Allowed when driver is down.
6	REF	wl	up	Reinitialize and make adapter up (operational)
7		go to Section 3.2 Change Test Channel		Change test change
8		go to Section 3.3 Change Test Rate		Change test rate
9	DUT (console / telnet)	wl	srl 1	Short Retry Limit set to 1
10	DUT (console / telnet)	wl	lrl 1	Long Retry Limit set to 1
11	REF	wl	srl 1	Short Retry Limit set to 1
12	REF	wl	lrl 1	Long Retry Limit set to 1
13	Dos Box of DUT computer	epi_ttcp	-rsufm -p 5030	Receiver must be ready first (using UDP protocol)
14	REF	epi_ttcp	-tsufm -l 1000 -p 5030 -n 1000 DUT_IP	Send 1000 UDP packets to DUT unit
15	REF	wl	srl 7	Restore srl to default value
16	REF	wl	lrl 4	Restore lrl to default value
17	DUT (console / telnet)	wl	srl 7	Restore srl to default value
18	DUT (console / telnet)	wl	lrl 4	Restore lrl to default value

4.3 Throughput Test

	Test spect. in 802.11n TX Throughput Test limitation with different RAM type		
Type of RAM	DDR 32	DDR 16	SDR 16
Throughput of percentage	100%	90%	80%

4.3.1 TX Throughput Test

	Test spect. in 802.11n TX Throughput Test limitation			
Board type	Test Level (dBm)	Bandwidth (MHz)	Test Limitation (Mbps)	RAM type and Ethernet Type
4705	-40	40	120	DDR32/16 SDR32/16 with Gigaphy
4705	-40	20	70	DDR32/16 SDR32/16 with Gigaphy
4704	-40	40	75	DDR32/16 SDR32/16 with 10/100 phy
4704	-40	20	70	DDR32/16 SDR32/16 with 10/100 phy

Step	Station	Command	Parameter	Note
1	DUT (console / telnet)	wl	down	Reset and make adapter down (disabled)
2	DUT (console / telnet)	wl	ampdu 1	turn on ampdu. Allowed when driver is down.
3	DUT (console / telnet)	wl	up	Reinitialize and make adapter up (operational)
4	REF	wl	down	Reset and make adapter down (disabled)
5	REF	wl	ampdu 1	turn on ampdu. Allowed when driver is down.
6	REF	wl	up	Reinitialize and make adapter up (operational)
7		go to Section 3.2 Change Test Channel		Change test change
8	DUT (console / telnet)	wl	rate -1	set rate to auto rate
9	REF	wl	rate -1	set rate to auto rate
10	DUT (console / telnet)	wl	srl 7	Short Retry Limit set to 7
11	DUT (console / telnet)	wl	lrl 4	Long Retry Limit set to 4
12	REF	wl	srl 7	Short Retry Limit set to 7
13	REF	wl	lrl 4	Long Retry Limit set to 4
14	REF	epi_ttcp	-rsfm -p 5050	Receiver must be ready first (using TCP/IP protocol)
15	Dos Box of DUT computer	epi_ttcp	-tsfm -p 5050 -b 262114 -n 2000 REF_IP	The buffer sizes are critical to get high throughput result.

4.3.2 RX Throughput Test

	Test spect. in 802.11n RX Throughput Test limitation			
Board type	Test Level (dBm)	Bandwidth (MHz)	Test Limitation (Mbps)	RAM type and Ethernet Type
4705	-40	40	150	DDR 32 with Gigaphy
4705	-40	20	80	DDR32/16 SDR32/16 with Gigaphy
4704	-40	40	75	DDR32/16 SDR32/16 with 10/100 phy
4704	-40	20	70	DDR32/16 SDR32/16 with 10/100 phy

Step	Station	Command	Parameter	Note
1	DUT (console / telnet)	wl	down	Reset and make adapter down (disabled)
2	DUT (console / telnet)	wl	ampdu 1	turn on ampdu. Allowed when driver is down.
3	DUT (console / telnet)	wl	up	Reinitialize and make adapter up (operational)
4	REF	wl	down	Reset and make adapter down (disabled)
5	REF	wl	ampdu 1	turn on ampdu. Allowed when driver is down.
6	REF	wl	up	Reinitialize and make adapter up (operational)
7		go to Section 3.2 Change Test Channel		Change test change
8	DUT (console / telnet)	wl	rate -1	set rate to auto rate
9	REF	wl	rate -1	set rate to auto rate
10	REF	wl	srl 7	Short Retry Limit set to 7
11	REF	wl	lrl 4	Long Retry Limit set to 4
12	DUT (console / telnet)	wl	srl 7	Short Retry Limit set to 7
13	DUT (console / telnet)	wl	lrl 4	Long Retry Limit set to 4
14	Dos Box of DUT computer	epi_ttcp	-rsfm -p 5070	Receiver must be ready first (using TCP/IP protocol)
15	REF	epi_ttcp	-tsfm -p 5070 -b 262114 -n 2000 DUT_IP	The buffer sizes are critical to get high throughput result.