Maxwell

FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.247

Report Reference No.....:	**MWR160229105**	
FCC ID.....:	**RQQHLT-E55UTM**	
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Date of issue.....:	March 12, 2016	
Representative Laboratory Name .:	**Maxwell International Co., Ltd.**	
Address .....:	Room 509, Hongfa center building, Baoan District, Shenzhen, Guangdong, China	
Testing Laboratory Name .....:	**Shenzhen CTL Testing Technology Co., Ltd.**	
Address .....:	Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, China 518055	
Applicant's name.....:	**HYUNDAI CORPORATION**	
Address .....:	140-2, Kye-dong, Chongro-ku, Seoul, South Korea	
Test specification .....**:**		
Standard .....:	**FCC Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz**	
TRF Originator.....:	Maxwell International Co., Ltd.	

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Test item description .....:	Mobile Phone
Trade Mark .....:	HYUNDAI
Manufacturer.....:	**Shenzhen Rainbow Time Technology Co.,Ltd**
Model/Type reference.....:	TITAN 5K
Listed Models .....:	/
Modulation Type .....:	DSSS(CCK,DQPSK,DBPSK),OFDM(64QAM,16QAM,QPSK, BPSK)
Operation Frequency.....:	From 2412MHz to 2462MHz
Rating .....:	DC 3.70V
Hardware version .....:	5101DW_WI_V02
Software version .....:	V2.0
Result.....:	**PASS**

T E S T R E P O R T

Test Report No. :	MWR160229105	March 12, 2016 Date of issue

Equipment under Test	:	Mobile Phone
Model /Type	:	TITAN 5K
Listed Models	:	/
Applicant	:	**HYUNDAI CORPORATION**
Address	:	140-2, Kye-dong, Chongro-ku, Seoul, South Korea
Manufacturer	:	**Shenzhen Rainbow Time Technology Co.,Ltd**
Address	:	Room 905, ChangHong Technology Building, Science and Technology Park, Nanshan District, Shenzhen, China

Test Result:	**PASS**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revison History

Revision	Issue Date	Revisions	Revised By
00	2016-03-12	Initial Issue	Dixon Hao

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

ANSI C63.10:2013: American National Standard for Testing Unlicensed Wireless Devices

KDB558074 D01 V03: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

2 SUMMARY

2.1 General Remarks

Date of receipt of test sample	:	Feb.15, 2016
Testing commenced on	:	Feb.16, 2016
Testing concluded on	:	Mach 12, 2016

2.2 Product Description

The **HYUNDAI CORPORATION**'s Model: TITAN 5K or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

Name of EUT	Mobile Phone
Model Number	TITAN 5K
Modilation Type	GMSK for GSM/GPRS, 8-PSK for EDGE,QPSK for UMTS
Antenna Type	Internal
UMTS Operation Frequency Band	Device supported UMTS FDD Band II, FDD Band V
WLAN FCC Operation frequency	IEEE 802.11b:2412-2462MHz IEEE 802.11g:2412-2462MHz IEEE 802.11n HT20:2412-2462MHz IEEE 802.11n HT40:2422-2452MHz
BT FCC Operation frequency	2402MHz-2480MHz
HSDPA Release Version	Release 10
HSUPA Release Version	Release 6
DC-HSUPA Release Version	Not Supported
WCDMA Release Version	R99
WLAN FCC Modulation Type	IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11n HT40: OFDM (64QAM, 16QAM, QPSK,BPSK)
BT Modulation Type	GFSK,8DPSK,π/4DQPSK(BT 3.0+EDR)
Hardware version	5101DW_WI_V02
Software version	V2.0
Android version	Android 5.1
GPS function	Supported
WLAN	Supported 802.11b/802.11g/802.11n
Bluetooth	Supported BT 4.0/BT 3.0+EDR
GSM/EDGE/GPRS	Supported GSM/GPRS/EDGE
GSM/EDGE/GPRS Power Class	GSM850:Power Class 4/ PCS1900:Power Class 1
GSM/EDGE/GPRS Operation Frequency	GSM850 :824.2MHz-848.8MHz/PCS1900:1850.2MHz-1909.8MHz
GSM/EDGE/GPRS Operation Frequency Band	GSM850/PCS1900/GPRS850/GPRS1900/EDGE850/EDGE1900
GSM Release Version	R99
GPRS/EDGE Multislot Class	GPRS/EDGE: Multi-slot Class 12
Extreme temp. Tolerance	-30°C to +50°C
Extreme vol. Limits	3.40VDC to 4.20VDC (nominal: 3.70VDC)
GPRS operation mode	Class B

2.3 Equipment Under Test

Power supply system utilised

Power supply voltage	:	○	120V / 60 Hz	○	115V / 60Hz
		○	12 V DC	○	24 V DC
		●	Other (specified in blank below)		

DC 3.70V

2.4 Description of the test mode

IEEE 802.11b/g/n: The product support Third channels but only use Eleventh channels in USA.

Channel	Frequency(MHz)	Channel	Frequency(MHz)
1	**2412**	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	**11**	**2462**
5	2432		
6	**2437**		
7	2442		

2.5 Short description of the Equipment under Test (EUT)

2.5.1 General Description

TITAN 5K is subscriber equipment in the WCDMA/GSM system. The HSPA/UMTS frequency band is Band I, Band II and Band V; The GSM/GPRS/EDGE frequency band includes GSM850 and GSM900 and DCS1800 and PCS1900, but only Band II, Band V, GSM850 and PCS1900 bands test data included in this report. The Mobile Phone implements such functions as RF signal receiving/transmitting, HSPA/UMTS and GSM/GPRS/EDGE protocol processing, voice, video MMS service, GPS and WIFI etc. Externally it provides micro SD card interface, earphone port (to provide voice service) and SIM card interface. It also provides Bluetooth module to synchronize data between a PC and the phone, or to use the built-in modem of the phone to access the Internet with a PC, or to exchange data with other Bluetooth devices.

NOTE: Unless otherwise noted in the report, the functional boards installed in the units shall be selected from the below list, but not means all the functional boards listed below shall be installed in one unit.

2.5.2 Test Modes

Test Case	Test Conditions	
	Configuration	Description
DTS (6 dB) Bandwidth	Measurement Method	FCC KDB 558074 §8.2 Option 2
	Test Environment	NTNV
	EUT Configuration	11b_L,11b_M,11b_H 11g_L,11g_M,11g_H 11n HT20_L, 11n HT20_M, 11n HT20_H 11n HT40_L, 11n HT40_M, 11n HT40_H
Maximum Peak Conducted Output Power	Measurement Method	FCC KDB 558074§9.1.2
	Test Environment	NTNV
	Test Setup	Test Setup 1
	EUT Configuration	11b_L,11b_M,11b_H 11g_L,11g_M,11g_H 11n HT20_L, 11n HT20_M, 11n HT20_H 11n HT40_L, 11n HT40_M, 11n HT40_H
Maximum Power Spectral Density Level	Measurement Method	FCC KDB 558074 §10.2 (peak PSD).
	Test Environment	NTNV
	EUT Configuration	11b_L,11b_M,11b_H 11g_L,11g_M,11g_H 11n HT20_L, 11n HT20_M, 11n HT20_H 11n HT40_L, 11n HT40_M, 11n HT40_H
Unwanted Emissions into Non-	Measurement Method	FCC KDB 558074§11.0.

Restricted Frequency Bands	Test Environment	NTNV
	Test Setup	Test Setup 1
	EUT Configuration	11b_L,11b_M,11b_H 11g_L,11g_M,11g_H 11n HT20_L, 11n HT20_M, 11n HT20_H 11n HT40_L, 11n HT40_M, 11n HT40_H
Unwanted Emissions into Restricted Frequency Bands (Conducted)	Measurement Method	FCC KDB 558074§12.2, Conducted (antenna-port).
	Test Environment	NTNV
	EUT Configuration	11b_L,11b_M,11b_H 11g_L,11g_M,11g_H 11n HT20_L, 11n HT20_M, 11n HT20_H 11n HT40_L, 11n HT40_M, 11n HT40_H
Unwanted Emissions into Restricted	Measurement Method	FCC KDB 558074§12.1,Radiated(cabinet/case emissions with Impedance matching for antenna-port).
	Test Environment	NTNV
	EUT Configuration	11b_L,11b_M,11b_H 11g_L,11g_M,11g_H 11n HT20_L, 11n HT20_M, 11n HT20_H 11n HT40_L, 11n HT40_M, 11n HT40_H

Test Case	Test Conditions	
	Configuration	Description
AC Power Line Conducted Emissions	Measurement Method	AC mains conducted.
	Test Environment	NTNV
	EUT Configuration	11g_M (Worst Conf.).

Note: 1. For Radiated Emissions, By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that “Z axis” position was the worst, then the final test was executed the worst condition and test data were recorded in this report.

2. Typical working modes for each IEEE 802.11mode are selected to perform tests. The manufacturer provide special test software to control TX duty cycle >98% for TX test; recorded worst case at difference data rate as follows:

Test Mode	Test Modes Description
11b	IEEE 802.11b with data rate of 1 Mbps using SISO mode.
11g	IEEE 802.11g with data rate of 6 Mbps using SISO mode.
11n HT20	IEEE 802.11n with data date of MCS0 and bandwidth of 20MHz using SISO mode.
11n HT40	IEEE 802.11n with data date of MCS7 and bandwidth of 40MHz using SISO mode.

2.6 EUT operation mode

Test Mode	RF Ch.	TX Freq. [MHz]	RX Freq. [MHz]	Ch. BW [MHz]
11b	L	Ch No. 1 / 2412MHz	---	20
	M	Ch No. 6 / 2437 MHz	---	20
	H	Ch No. 11/ 2462MHz	---	20
11g	L	Ch No. 1 / 2412MHz	---	20
	M	Ch No. 6 / 2437 MHz	---	20
	H	Ch No. 11/ 2462MHz	---	20
11n HT20	L	Ch No. 1 / 2412MHz	---	20
	M	Ch No. 6 / 2437 MHz	---	20
	H	Ch No. 11/ 2462MHz	---	20
11n HT40	L	Ch No. 3/ 2422MHz	---	40
	M	Ch No. 6 / 2437 MHz	---	40
	H	Ch No. 9/ 2452 MHz	---	40

2.7 EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

● - supplied by the manufacturer

○ - supplied by the lab

○	Power Cable	Length (m) :	/
		Shield :	/
		Detachable :	/
○	Multimeter	Manufacturer :	/
		Model No. :	/

2.8 Internal Identification of AE used during the test

AE ID*	Description
AE1	Charger

AE1
Model: DC500
INPUT: AC180-240V~ 50/60Hz 0.15A
OUTPUT: DC 5.0V 1000mA

*AE ID: is used to identify the test sample in the lab internally.

2.9 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: RQQHLT-E55UTM** filing to comply with FCC Part 15.247 Rules

2.10 Modifications

No modifications were implemented to meet testing criteria.

2.11 Test Environments

NOTE: The values used in the test report maybe stringent than the declared.

Environment Parameter	Selected Values During Tests		
NTNV	Temperature	Voltage	Relative Humidity
	Ambient	3.70VDC	Ambient

3 TEST ENVIRONMENT

3.1 Address of the test laboratory

Shenzhen CTL Testing Technology Co., Ltd.
Floor 1-A, Baisha Technology Park, No. 3011, Shahexi Road, Nanshan, Shenzhen 518055 China

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4, CISPR 22/EN 55022 and CISPR16-4-1 SVSWR requirements.

3.2 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

IC Registration No.: 9618B

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 9618B on November 13, 2013.

FCC-Registration No.: 970318

Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 970318, December 19, 2013.

3.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar

3.4 Test Description

Test Item	FCC Part No.	Requirements	Verdict
DTS (6 dB) Bandwidth	15.247(a)(2)	≥ 500 kHz.	PASS
Maximum Peak Conducted Output Power	15.247(b)(3)	For directional gain:< 30dBm – (G[dBi] –6 [dB]),peak; Otherwise :< 30dBm, peak.	PASS
Maximum Power Spectral Density Level	15.247(e)	For directional gain :< 8dBm/3 kHz – (G[dBi] –6[dB]), peak. Otherwise :< 8dBm/3 kHz, peak.	PASS
Band Edges Compliance	15.247(d)	< -20dBr/100 kHz if total peak power ≤power limit.	PASS
Unwanted Emissions into Non-Restricted Frequency Bands	15.247(d)	< -20dBr/100 kHz if total peak power ≤power limit.	PASS
Unwanted Emissions into Restricted Frequency Bands (Conducted)	15.247(d) 15.209	< -20dBr/100 kHz if total peak power ≤power limit.	PASS
Unwanted Emissions into Restricted Frequency Bands (Radiated)	15.247(d) 15.209	FCC Part 15.209 field strength limit;	PASS
AC Power Line Conducted Emissions	15.207	FCC Part 15.207 conducted limit;	PASS

Remark: The measurement uncertainty is not included in the test result.

3.5 Summary of measurement results

Test Specification clause	Test case	Test Mode	Test Channel	Recorded In Report		Pass	Fail	NA	NP	Remark
§15.247(b)(4)	Antenna gain	802.11b	☒ Lowest ☒ Middle ☒ Highest	802.11b	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.247(e)	Power spectral density	802.11b 802.11g 802.11n HT20 802.11n HT40	☒ Lowest ☒ Middle ☒ Highest	802.11b 802.11g 802.11n HT20 802.11n HT40	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.247(a)(1)	Spectrum bandwidth – 6 dB bandwidth	802.11b 802.11g 802.11n HT20 802.11n HT40	☒ Lowest ☒ Middle ☒ Highest	802.11b 802.11g 802.11n HT20 802.11n HT40	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(b)(1)	Maximum output power	802.11b 802.11g 802.11n HT20 802.11n HT40	☒ Lowest ☒ Middle ☒ Highest	802.11b 802.11g 802.11n HT20 802.11n HT40	☒ Lowest ☒ Middle ☒ Highest	☒ ☒ ☒	☐	☐	☐	complies
§15.247(d)	Band edge compliance conducted	802.11b 802.11g 802.11n HT20 802.11n HT40	☒ Lowest ☒ Highest	802.11b 802.11g 802.11n HT20 802.11n HT40	☒ Lowest ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.205	Band edge compliance radiated	802.11b 802.11g 802.11n HT20 802.11n HT40	☒ Lowest ☒ Highest	802.11b 802.11g 802.11n HT20 802.11n HT40	☒ Lowest ☒ Highest	☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions conducted	802.11b 802.11g 802.11n HT20 802.11n HT40	☒ Lowest ☒ Middle ☒ Highest	802.11b 802.11g 802.11n HT20 802.11n HT40	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions radiated	802.11b 802.11g 802.11n HT20 802.11n HT40	☒ Lowest ☒ Middle ☒ Highest	802.11b	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.109	RX spurious emissions radiated	-/-	-/-	-/-	-/-	☒	☐	☐	☐	complies
§15.209(a)	TX spurious Emissions radiated < 30 MHz	802.11b	-/-	802.11b	-/-	☒	☐	☐	☐	complies
§15.107(a) §15.207	Conducted Emissions < 30 MHz	802.11b	-/-	802.11b	-/-	☒	☐	☐	☐	complies

Remark:
1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed

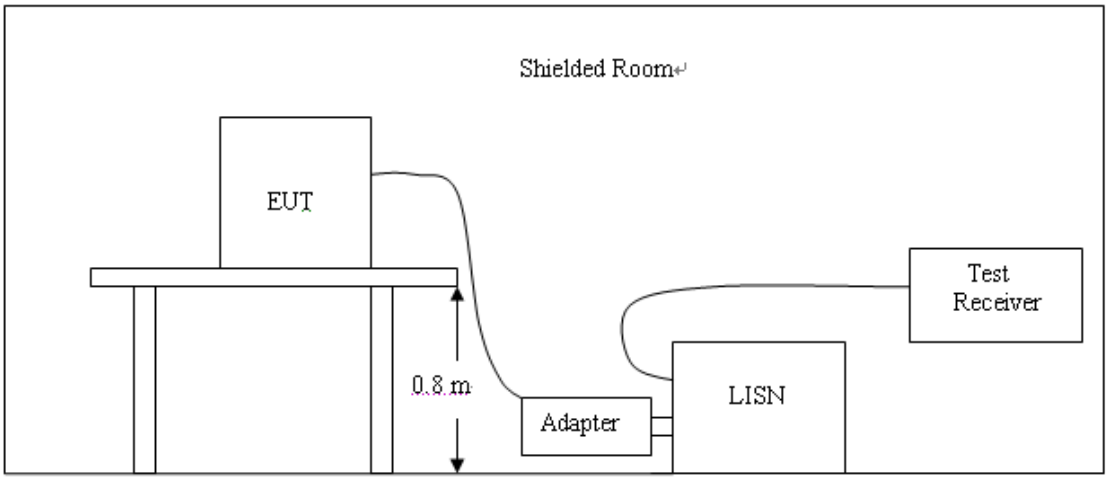
3.6 Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.12	2015/06/02	2016/06/01
LISN	R&S	ESH2-Z5	860014/010	2015/06/02	2016/06/01
Bilog Antenna	Sunol Sciences Corp.	JB1	A061713	2015/06/02	2016/06/01
EMI Test Receiver	R&S	ESCI	103710	2015/06/02	2016/06/01
Spectrum Analyzer	Agilent	N9020A	MY49100067	2015/05/21	2016/05/20
Controller	EM Electronics	Controller EM 1000	N/A	2015/05/21	2016/05/20
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2015/05/19	2016/05/18
Active Loop Antenna	SCHWARZBECK	FMZB1519	1519-037	2015/05/19	2016/05/18
Amplifier	Agilent	8349B	3008A02306	2015/05/19	2016/05/18
Amplifier	Agilent	8447D	2944A10176	2015/05/19	2016/05/18
Temperature/ Humidity Meter	Gangxing	CTH-608	02	2015/05/20	2016/05/19
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	N/A	2015/05/20	2016/05/19
High-Pass Filter	K&L	41H10-1375/U12750-O/O	N/A	2015/05/20	2016/05/19
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-10M	10m	2015/06/02	2016/06/01
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2015/06/02	2016/06/01
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2015/06/02	2016/06/01
RF Cable	Megalon	RF-A303	N/A	2015/06/02	2016/06/01
Power Sensor	R&S	NRP-Z4	823.3618.03	2015/06/02	2016/06/01
Power Meter	R&S	NRVS	1020.1809.02	2015/06/02	2016/06/01

4 TEST CONDITIONS AND RESULTS

4.1 AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
2. Support equipment, if needed, was placed as per ANSI C63.10-2013
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
4. The EUT received DC5V power from the adapter, the adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following:

Frequency (MHz)	Maximum RF Line Voltage (dBμV)			
	CLASS A		CLASS B	
	Q.P.	Ave.	Q.P.	Ave.
0.15 - 0.50	79	66	66-56*	56-46*
0.50 - 5.00	73	60	56	46
5.00 - 30.0	73	60	60	50

* Decreasing linearly with the logarithm of the frequency

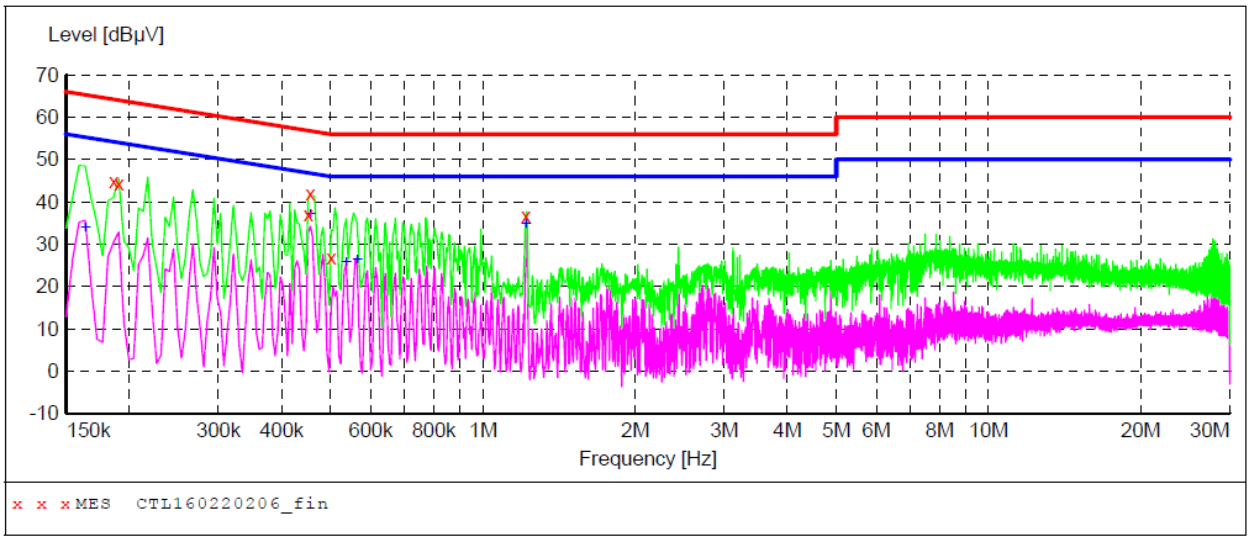
TEST RESULTS

The AC Power Conducted Emission measurement is performed the each test mode (b/g/n) and channel (low/mid/high), the datum recorded below (802.11b mode, the middle channel) is the worst case for all the test modes and channels.

L:

SCAN TABLE: "Voltage (9K-30M)FIN"

Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "CTL160220206_fin"

2/20/2016 10:08AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.186001	44.90	10.2	64	19.3	QP	L1	GND
0.190501	44.40	10.2	64	19.6	QP	L1	GND
0.451501	36.90	10.2	57	19.9	QP	L1	GND
0.456001	41.90	10.2	57	14.9	QP	L1	GND
0.501001	26.80	10.2	56	29.2	QP	L1	GND
1.216501	36.70	10.3	56	19.3	QP	L1	GND

MEASUREMENT RESULT: "CTL160220206_fin2"

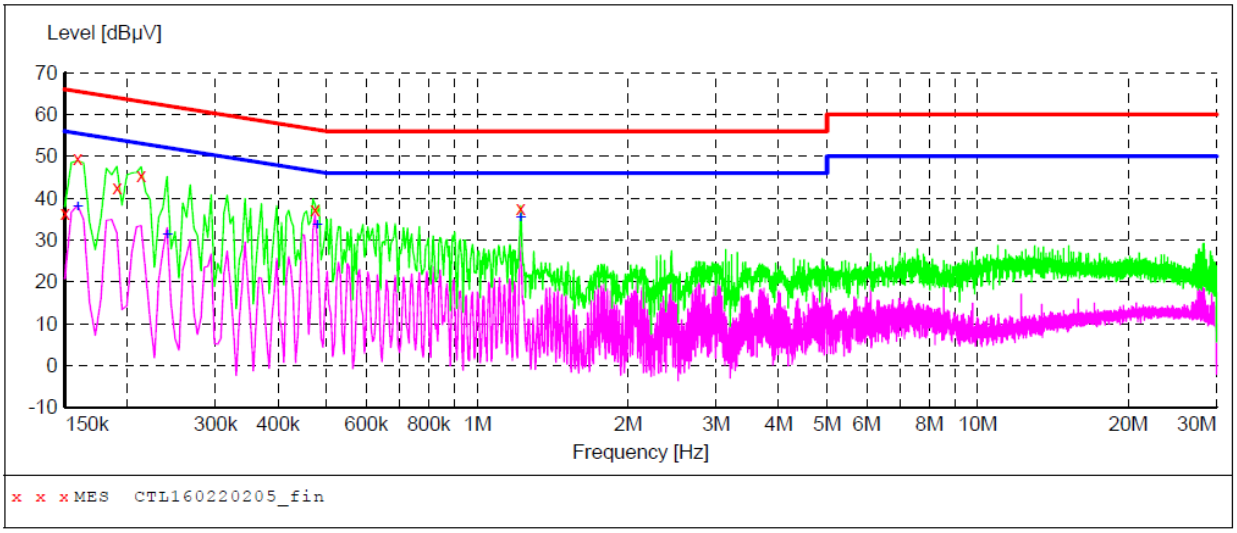
2/20/2016 10:08AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.163501	33.80	10.2	55	21.5	AV	L1	GND
0.456001	37.00	10.2	47	9.8	AV	L1	GND
0.537001	25.60	10.2	46	20.4	AV	L1	GND
0.564001	26.10	10.2	46	19.9	AV	L1	GND
1.216501	34.60	10.3	46	11.4	AV	L1	GND

N:

SCAN TABLE: "Voltage (9K-30M)FIN"

Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "CTL160220205_fin"

2/20/2016 10:04AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.150001	36.40	10.2	66	29.6	QP	N	GND
0.159001	49.50	10.2	66	16.0	QP	N	GND
0.190501	42.40	10.2	64	21.6	QP	N	GND
0.213001	45.30	10.2	63	17.8	QP	N	GND
0.474001	37.20	10.2	56	19.2	QP	N	GND
1.221001	37.70	10.3	56	18.3	QP	N	GND

MEASUREMENT RESULT: "CTL160220205_fin2"

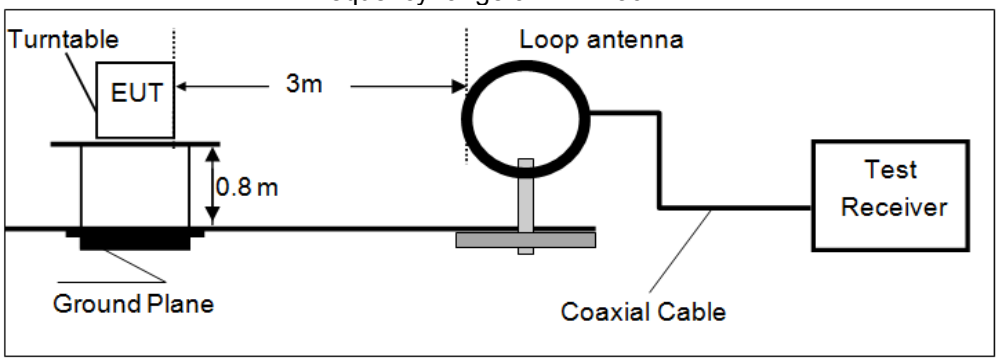
2/20/2016 10:04AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.159001	37.80	10.2	56	17.7	AV	N	GND
0.240001	31.10	10.2	52	21.0	AV	N	GND
0.478501	33.60	10.2	46	12.8	AV	N	GND
1.221001	35.20	10.3	46	10.8	AV	N	GND

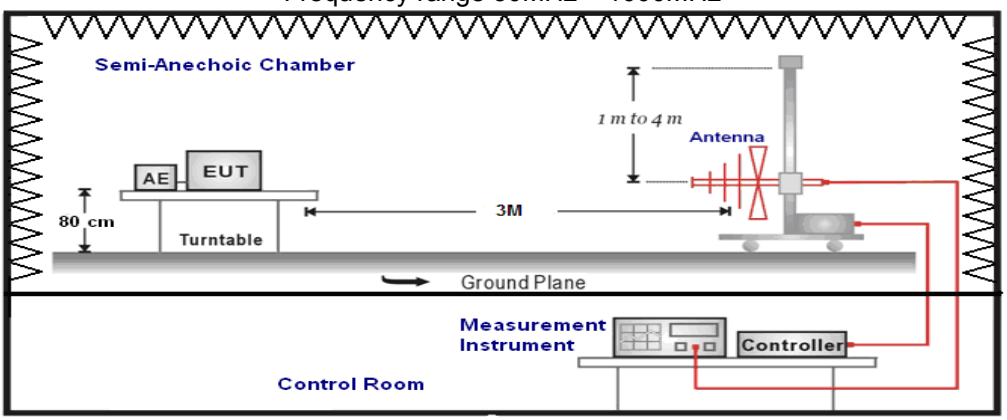
4.2 Radiated Emission

TEST CONFIGURATION

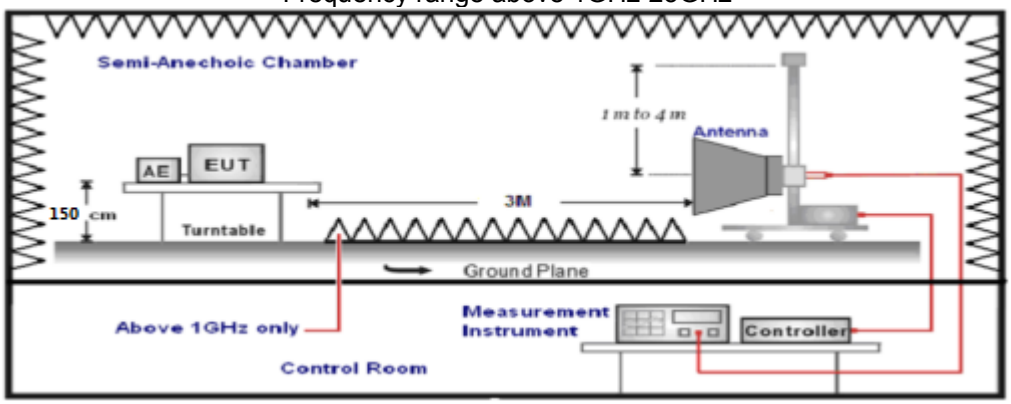
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane for below 1GHz and 1.50m above ground plane for above 1GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. The EUT minimum operation frequency was 32.768 KHz and maximum operation frequency was 2480MHz.so radiated emission test frequency band from 9 KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3

18GHz-25GHz	Horn Anternna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto	Peak
	Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

More procudre as follows;

1) Sequence of testing 9 kHz to 30 MHz

Setup:
--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.
--- If the EUT is a floor standing device, it is placed on the ground.
--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.
--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
--- The measurement distance is 3 meter.
--- The EUT was set into operation.

Premeasurement:
--- The turntable rotates from 0° to 315° using 45° steps.
--- The antenna height is 1.0 meter.
--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:
--- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).
--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QP detector.
--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz

Setup:
--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
--- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
--- Auxiliary equipment and cables were positioned to simulate normal operation conditions
--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
--- The measurement distance is 3 meter.
--- The EUT was set into operation.

Premeasurement:
--- The turntable rotates from 0° to 315° using 45° steps.
--- The antenna is polarized vertical and horizontal.
--- The antenna height changes from 1 to 4 meter.
--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:
--- The final measurement will be performed with minimum the six highest peaks.
--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.
--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 18 GHz

Setup:
--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
--- Auxiliary equipment and cables were positioned to simulate normal operation conditions
--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
--- The measurement distance is 3 meter.
--- The EUT was set into operation.

Premeasurement:
--- The turntable rotates from 0° to 315° using 45° steps.
--- The antenna is polarized vertical and horizontal.
--- The antenna height scan range is 1 meter to 2.5 meter.
--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:
--- The final measurement will be performed with minimum the six highest peaks.
--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.
--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz

Setup:
--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
--- Auxiliary equipment and cables were positioned to simulate normal operation conditions
--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
--- The measurement distance is 1 meter.
--- The EUT was set into operation.

Premeasurement:
--- The antenna is moved spherical over the EUT in different polarizations of the antenna.
Final measurement:
--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.
--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

<u>Field Strength Calculation</u>

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

For example

Frequency (MHz)	FS (dBμV/m)	RA (dBμV/m)	AF (dB)	CL (dB)	AG (dB)	Transd (dB)
300.00	40	58.1	12.2	1.6	31.90	-18.1

Transd=AF +CL-AG

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.
In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	300	20log(2400/F(KHz))+80	2400/F(KHz)
0.49-1.705	30	20log(24000/F(KHz))+40	24000/F(KHz)
1.705-30	30	20log(30)+40	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

TEST RESULTS

Remark:
1. The radiated measurement are performed the each test mode (b/g/n) and channel (low/mid/high), the datum recorded below (802.11b mode, the middle channel) is the worst case for all the test mode and channel.
2. ULTRA-BROADBAND ANTENNA for the radiation emission test below 1G.
3. HORN ANTENNA for the radiation emission test above 1G.
4. We tested both battery powered and powered by adapter charging mode at three orientate ons, recorded worst case at powered by adapter charging mode.
5. “---” means not recorded as emission levels lower than limit.
6. Margin= Limit - Level

For 9KHz to 30MHz

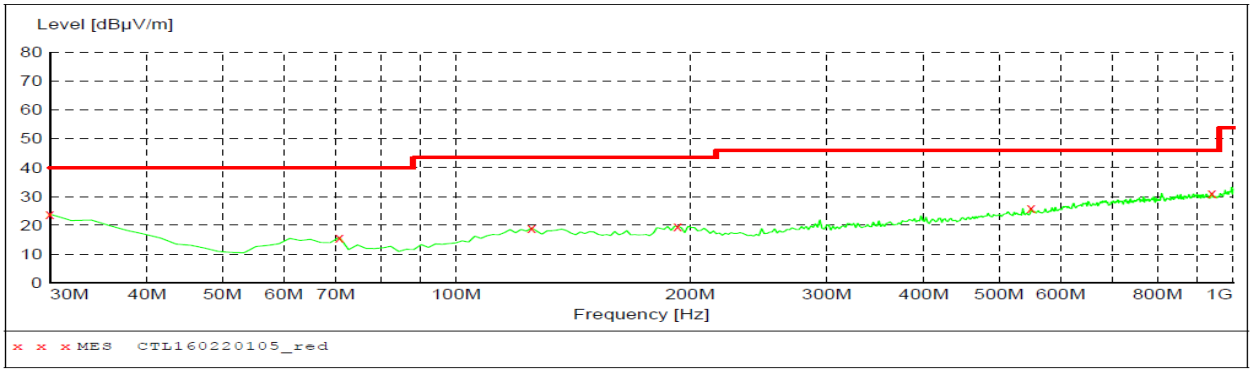
Frequency (MHz)	Corrected Reading (dBμV/m)@3m	FCC Limit (dBμV/m) @3m	Margin (dB)	Detector	Result
15.85	48.95	69.54	20.59	QP	PASS
25.79	46.44	69.54	23.10	QP	PASS

For 30MHz to 1000MHz

Polarization	Horizontal

SWEEP TABLE: "test (30M-1G)"

Short Description:			Field Strength		
Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	300.0 ms	120 kHz	JB1



MEASUREMENT RESULT: "CTL160220105_red"

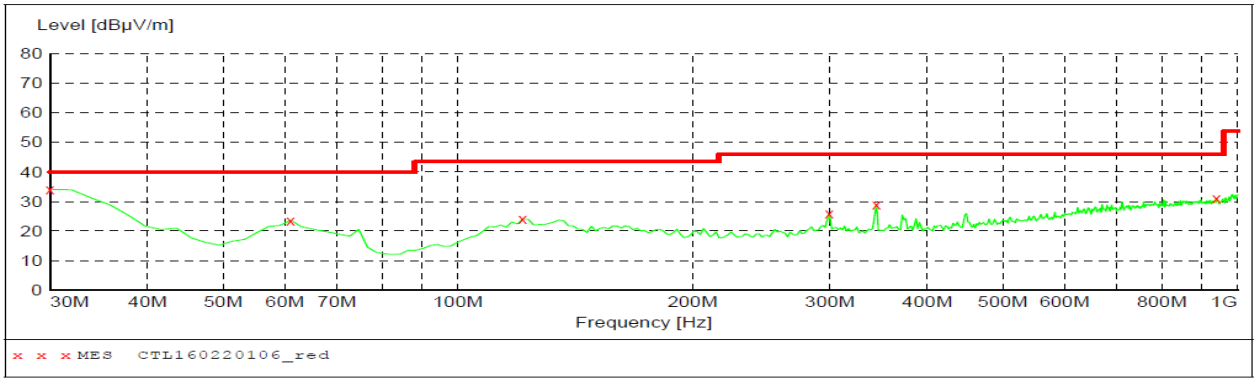
2/20/2016 9:35AM

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
30.000000	23.80	20.8	40.0	16.2	---	0.0	0.00	HORIZONTAL
70.740000	15.80	8.2	40.0	24.2	---	0.0	0.00	HORIZONTAL
125.060000	19.10	14.6	43.5	24.4	---	0.0	0.00	HORIZONTAL
192.960000	19.70	13.2	43.5	23.8	---	0.0	0.00	HORIZONTAL
549.920000	25.90	21.0	46.0	20.1	---	0.0	0.00	HORIZONTAL
939.860000	31.10	26.4	46.0	14.9	---	0.0	0.00	HORIZONTAL

Polarization	Vertical

SWEEP TABLE: "test (30M-1G)"

Short Description:			Field Strength		
Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	300.0 ms	120 kHz	JB1



MEASUREMENT RESULT: "CTL160220106_red"

2/20/2016 9:36AM

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
30.000000	34.10	20.8	40.0	5.9	---	0.0	0.00	VERTICAL
61.040000	23.60	8.1	40.0	16.4	---	0.0	0.00	VERTICAL
121.180000	24.10	14.7	43.5	19.4	---	0.0	0.00	VERTICAL
299.660000	25.80	15.2	46.0	20.2	---	0.0	0.00	VERTICAL
344.280000	28.90	16.6	46.0	17.1	---	0.0	0.00	VERTICAL
939.860000	31.20	26.4	46.0	14.8	---	0.0	0.00	VERTICAL

For 1GHz to 25GHz

Note:We tested 11b,11g,11n HT20,11n HT40 and rcorded the worst case at the 11b Mode.

802.11b Mode (above 1GHz)

Frequency(MHz):				2412		Polarity:			HORIZONTAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	4824.00	58.61	PK	74	15.39	54.06	33.52	6.92	35.89	4.55
1	4824.00	51.25	AV	54	2.75	46.70	33.52	6.92	35.89	4.55
2	5215.50	50.42	PK	74	23.58	43.02	34.56	7.15	34.31	7.40
2	5215.50	--	AV	54	--	--	--	--	--	--
3	7236.00	49.32	PK	74	24.68	38.05	37.10	9.19	35.02	11.27
3	7236.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):				2412		Polarity:			VERTICAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	4824.00	58.65	PK	74	15.35	54.10	33.52	6.92	35.89	4.55
1	4824.00	49.52	AV	54	4.48	44.97	33.52	6.92	35.89	4.55
2	5365.75	50.31	PK	74	23.69	42.73	34.71	7.24	34.36	7.58
2	5365.75	--	AV	54	--	--	--	--	--	--
3	7236.00	48.42	PK	74	25.58	37.15	37.10	9.19	35.02	11.27
3	7236.00	--	AV	54	--	--	--	--	--	--

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.
6. RBW=1MHz VBW=3MHz Peak detector is for PK value; RBW =1MHz VBW=10Hz Peak detector is for AV value.

Frequency(MHz):				2437		Polarity:			HORIZONTAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	4015.50	46.32	PK	74	27.68	41.64	33.07	6.40	34.79	4.68
1	4015.50	--	AV	54	--	--	--	--	--	--
2	4874.00	56.39	PK	74	17.61	50.15	33.59	6.95	34.30	6.24
2	4874.00	48.25	AV	54	5.75	42.01	33.59	6.95	34.30	6.24
3	5375.75	43.21	PK	74	30.79	35.26	34.72	7.25	34.02	7.95
3	5375.75	--	AV	54	--	--	--	--	--	--
4	7311.00	52.41	PK	74	21.59	40.75	37.44	9.22	35.00	11.66
4	7311.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):				2437		Polarity:			VERTICAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	4075.75	46.58	PK	74	27.42	42.01	32.89	6.44	34.76	4.57
1	4075.75	--	AV	54	--	--	--	--	--	--
2	4874.00	59.33	PK	74	14.67	53.09	33.59	6.95	34.30	6.24
2	4874.00	49.54	AV	54	4.46	43.30	33.59	6.95	34.30	6.24
3	5215.75	43.32	PK	74	30.68	35.72	34.56	7.15	34.11	7.60
3	5215.75	--	AV	54	--	--	--	--	--	--
4	7311.00	53.39	PK	74	20.61	41.73	37.44	9.22	35.00	11.66
4	7311.00	--	AV	54	--	--	--	--	--	--

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.
6. RBW=1MHz VBW=3MHz Peak detector is for PK value; RBW =1MHz VBW=10Hz Peak detector is for AV value.

Frequency(MHz):				2462		Polarity:			HORIZONTAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	4924.00	58.78	PK	74	15.22	54.00	33.71	6.98	35.91	4.78
1	4924.00	51.24	AV	54	2.76	46.46	33.71	6.98	35.91	4.78
2	5175.75	48.51	PK	74	25.49	41.19	34.49	7.13	34.29	7.32
2	5175.75	--	AV	54	--	--	--	--	--	--
3	7386.00	50.69	PK	74	23.31	38.81	37.61	9.25	34.98	11.88
3	7386.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):				2462		Polarity:			VERTICAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	4924.00	58.63	PK	74	15.37	53.85	33.71	6.98	35.91	4.78
1	4924.00	50.39	AV	54	3.61	45.61	33.71	6.98	35.91	4.78
2	5211.50	48.54	PK	74	25.46	41.15	34.55	7.15	34.31	7.39
2	5211.50	--	AV	54	--	--	--	--	--	--
3	7386.00	50.21	PK	74	23.79	38.33	37.61	9.25	34.98	11.88
3	7386.00	--	AV	54	--	--	--	--	--	--

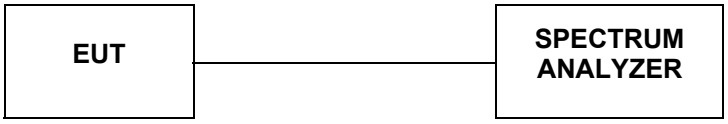
REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

6. RBW=1MHz VBW=3MHz Peak detector is for PK value; RBW=1MHz VBW=10Hz Peak detector is for AV value.

4.3 Duty Cycle

TEST CONFIGURATION



LIMIT

The Maximum Peak Output Power Measurement is 30dBm.
Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%).

TEST PROCEDURE

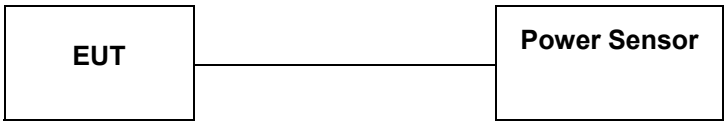
a. A diode detector and an oscilloscope that together have sufficiently short response time to permit accurate measurements of the on and off times of the transmitted signal.
b. The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

TEST RESULTS

The Manufacturer provide engineer mode *#3646633#* to setup 100% continuous transmit for WLAN;

4.4 Maximum Output Power

TEST CONFIGURATION



TEST PROCEDURE

According to KDB558074 D01 DTS Meas Guidance v03:
PKPM1 Peak power meter method: The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.
Maximum conducted (average) output power: As an alternative to spectrum analyzer or EMI receiver measurements, measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied.
1. The EUT is configured to transmit continuously, or to transmit with a constant duty factor.
2. At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
3. The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
If the transmitter does not transmit continuously, measure the duty cycle (x) of the transmitter output signal as described in Section 6.0.
Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
Adjust the measurement in dBm by adding 10log (1/x), where x is the duty cycle to the measurement result.

LIMIT

The Maximum Peak Output Power Measurement is 30dBm.

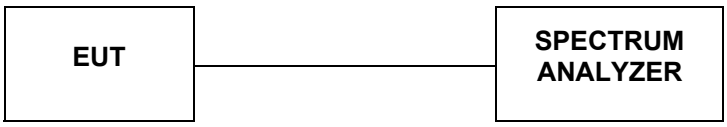
TEST RESULTS

Test Mode	Channel	Frequency (MHz)	Measured Output Peak Power (dBm)	Limits (dBm)	Verdict
IEEE 802.11 b	1	2412	17.57	30	PASS
	6	2437	18.17		
	11	2462	18.19		
IEEE 802.11 g	1	2412	19.30	30	PASS
	6	2437	18.98		
	11	2462	18.69		
IEEE 802.11 n HT20	1	2412	20.30	30	PASS
	6	2437	19.83		
	11	2462	19.72		
IEEE 802.11 n HT40	3	2422	19.74	30	PASS
	6	2437	19.95		
	9	2452	19.86		

Remark:
1. *Measured output power at difference data rate for each mode and recorded woest case for each mode.*
2. *Test results including cable loss;*
3. *Worst case data at 1Mbps at IEEE 802.11 b; 6Mbps at IEEE 802.11 g; 6.5Mbps at IEEE 802.11 n HT20; 13.5Mbps at IEEE 802.11 n HT40;*

4.5 Power Spectral Density

TEST CONFIGURATION



TEST PROCEDURE

According to KDB 558074 D01 V03 Method PKPSD (peak PSD) this procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.
1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

LIMIT

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

TEST RESULTS

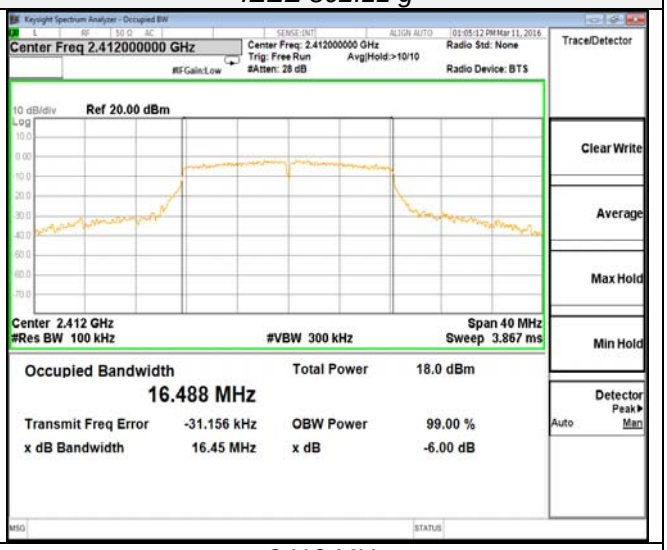
Test Mode	Channel	Frequency (MHz)	Measured Peak Power Spectral Density (dBm/100KHz)	Limits (dBm/3KHz)	Verdict
IEEE 802.11 b	1	2412	3.982	8	PASS
	6	2437	3.431		
	11	2462	3.351		
IEEE 802.11 g	1	2412	-1.922	8	PASS
	6	2437	-2.243		
	11	2462	-2.516		
IEEE 802.11 n HT20	1	2412	-0.854	8	PASS
	6	2437	-1.206		
	11	2462	-1.276		
IEEE 802.11 n HT40	3	2422	-3.435	8	PASS
	6	2437	-3.568		
	9	2452	-3.374		

Remark:
1. *Measured output power at difference data rate for each mode and recorded woest case for each mode.*
2. *Test results including cable loss;*
3. *Worst case data at 1Mbps at IEEE 802.11 b; 6Mbps at IEEE 802.11 g; 6.5Mbps at IEEE 802.11 n HT20; 13.5Mbps at IEEE 802.11 n HT40;*
4. *please refer to following plots;*

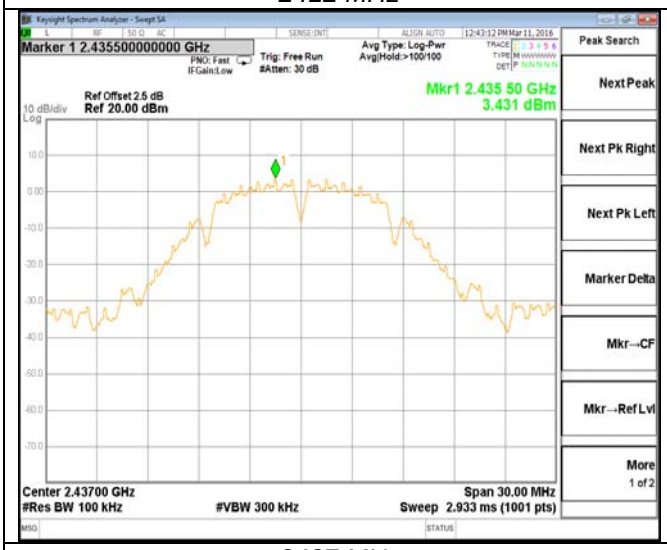
Peak Power Spectral Density

IEEE 802.11 b

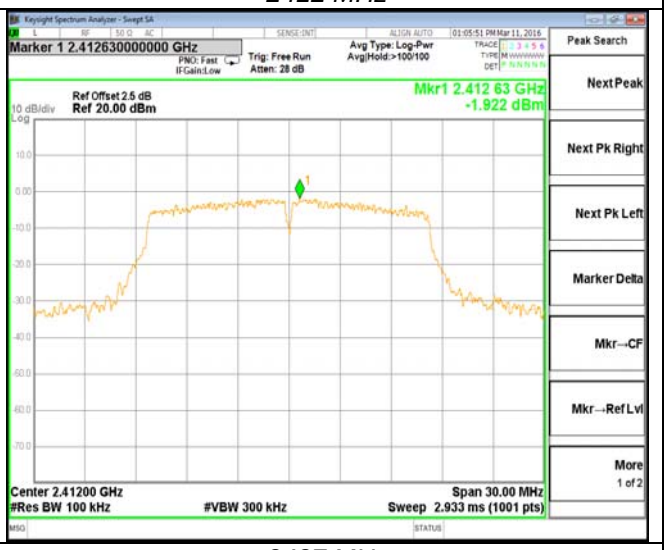
IEEE 802.11 g



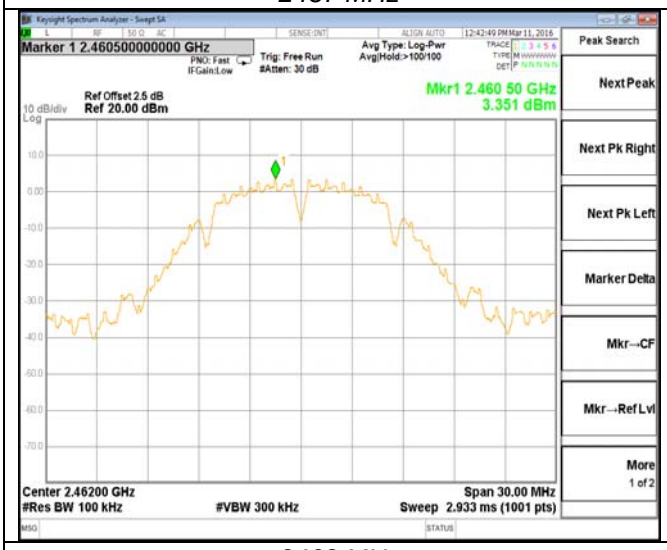
2412 MHz



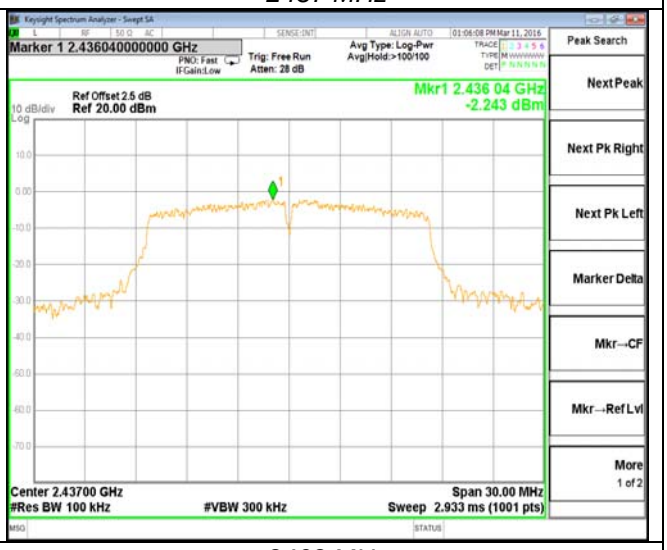
2412 MHz



2437 MHz

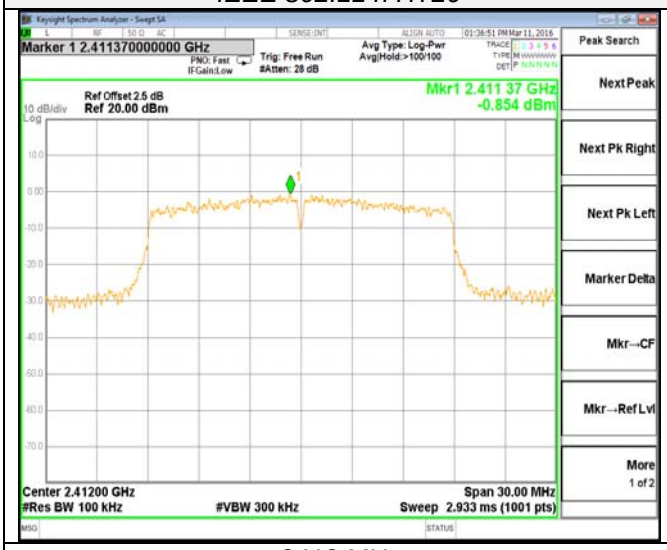
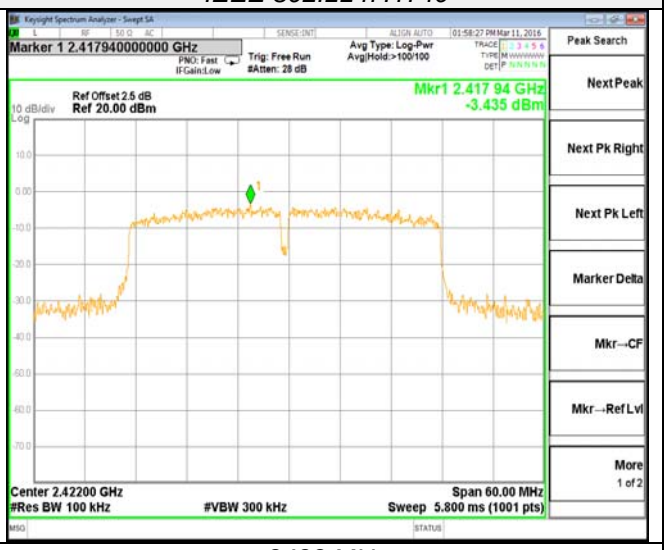
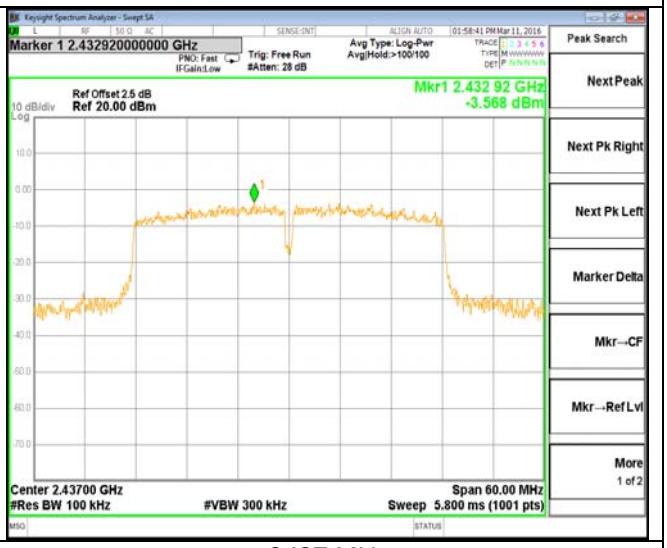
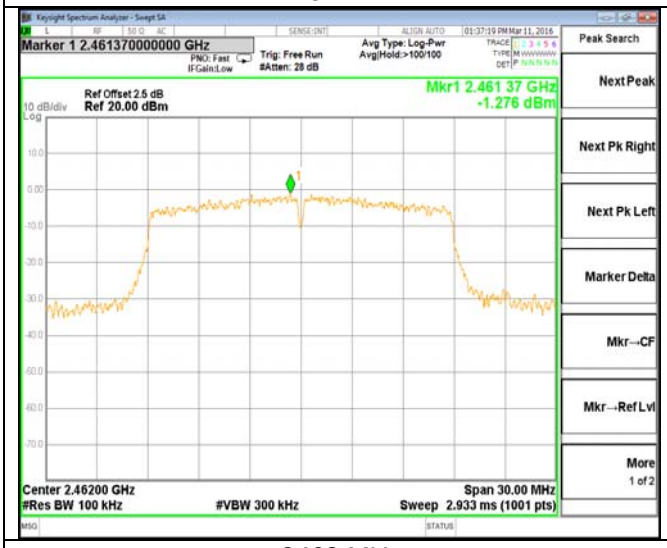
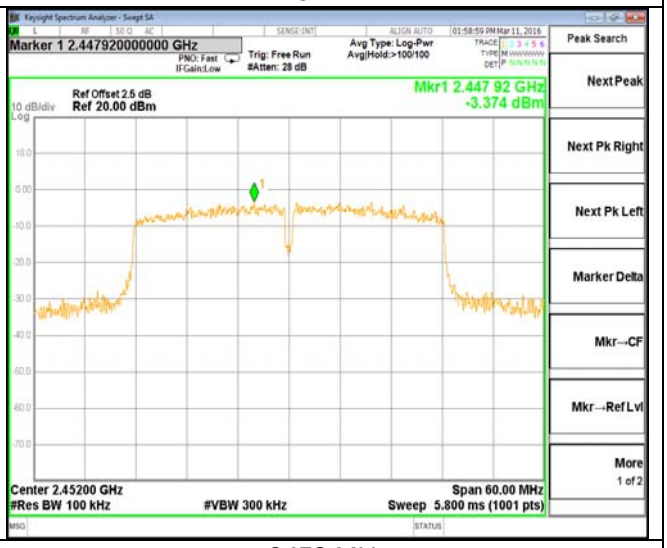


2437 MHz



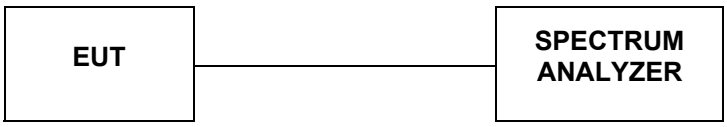
2462 MHz

2462 MHz

Peak Power Spectral Density	
IEEE 802.11 n HT20	IEEE 802.11 n HT40
	
2412 MHz	2422 MHz
	
2437 MHz	2437 MHz
	
2462 MHz	2452 MHz

4.6 Spurious RF Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=100 kHz and VBW= 300 KHz to measure the peak field strength, and measure frequency range from 9 KHz to 26.5GHz.

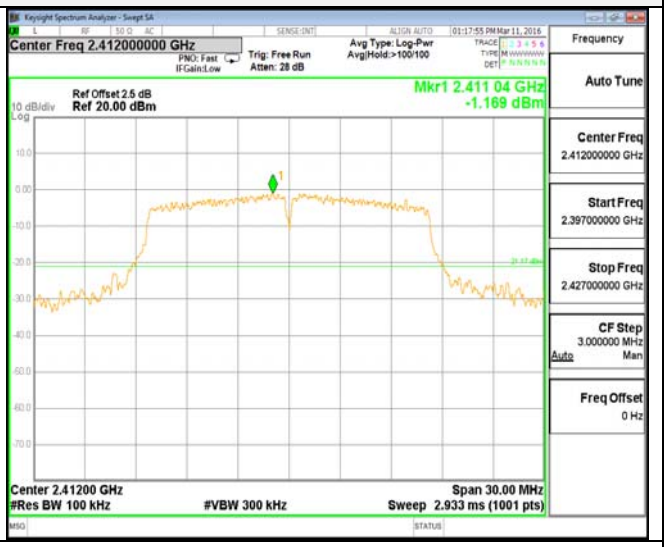
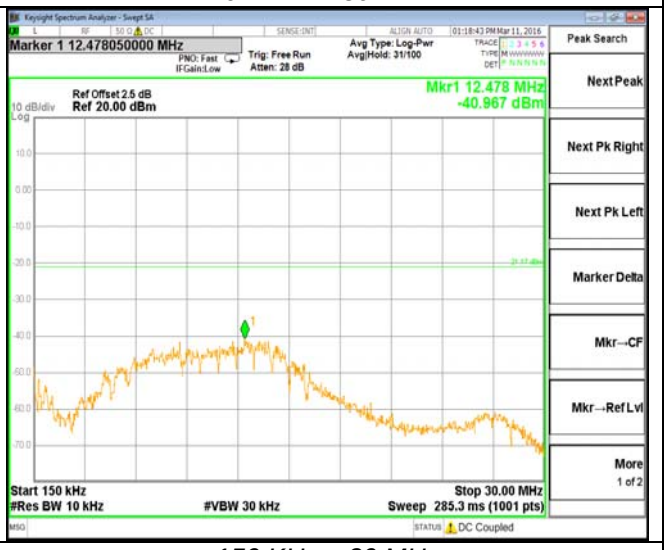
LIMIT

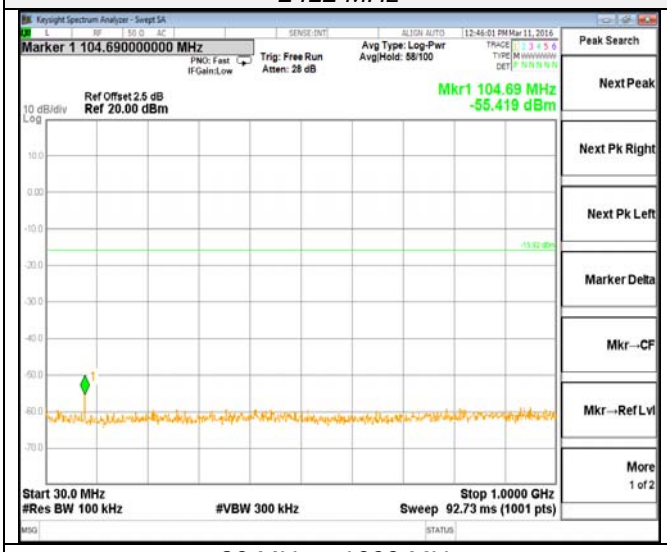
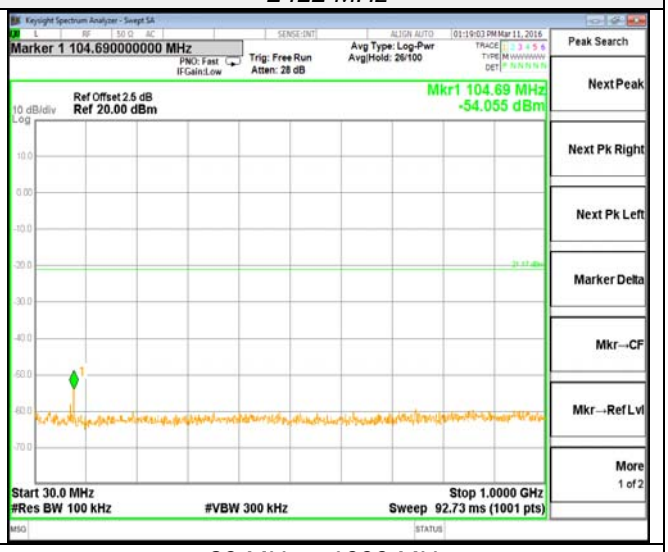
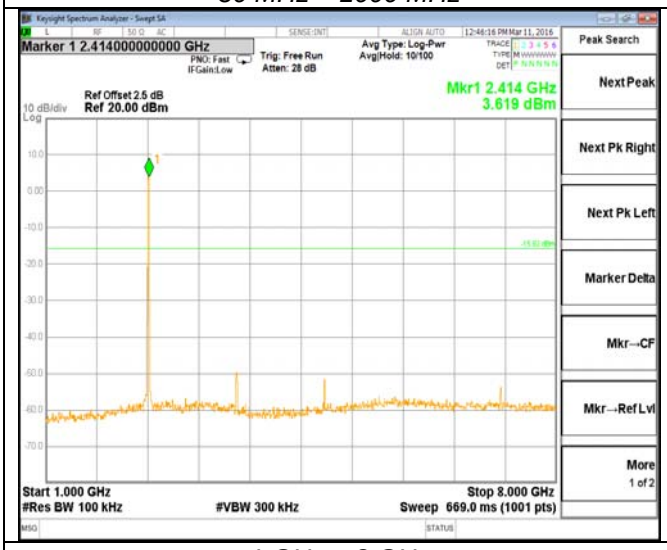
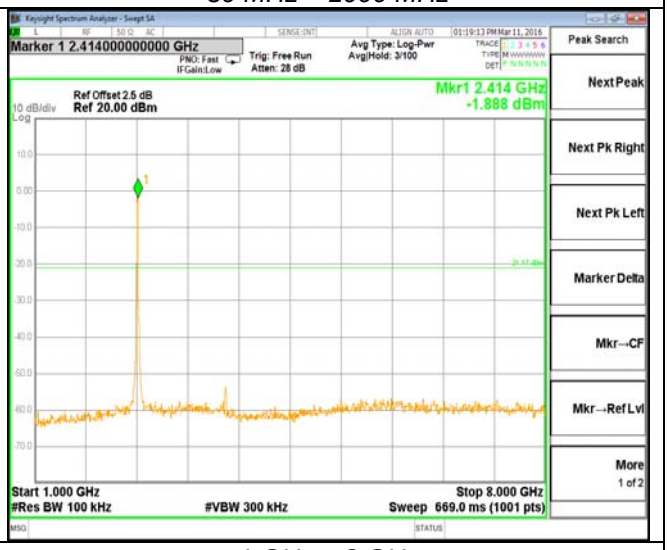
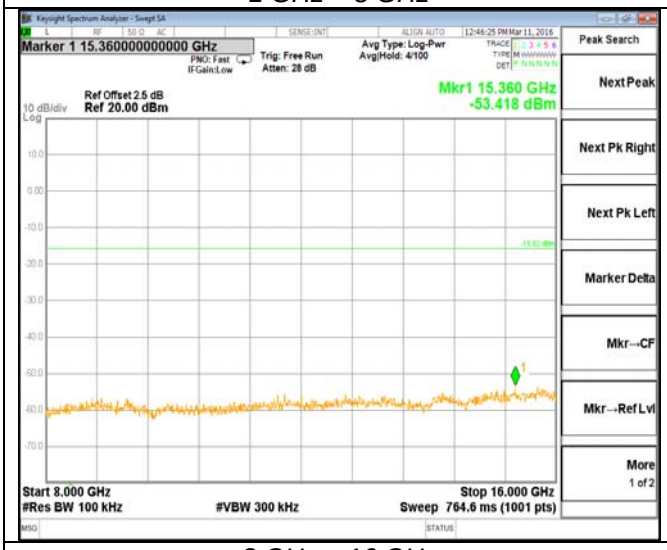
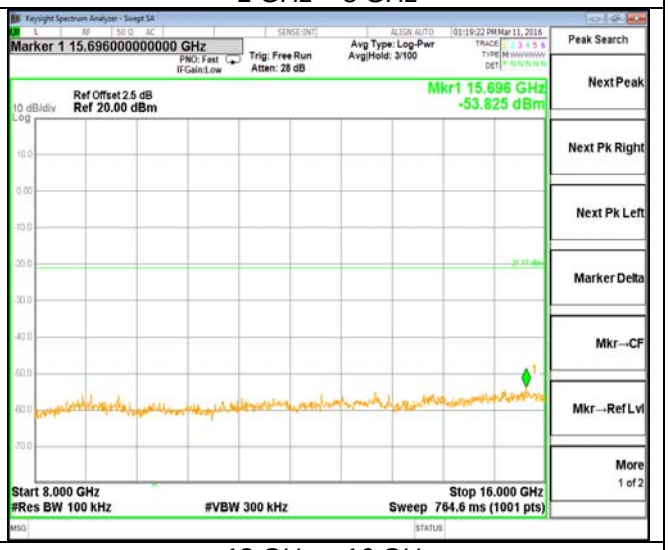
1. Below -20dB of the highest emission level in operating band.
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.

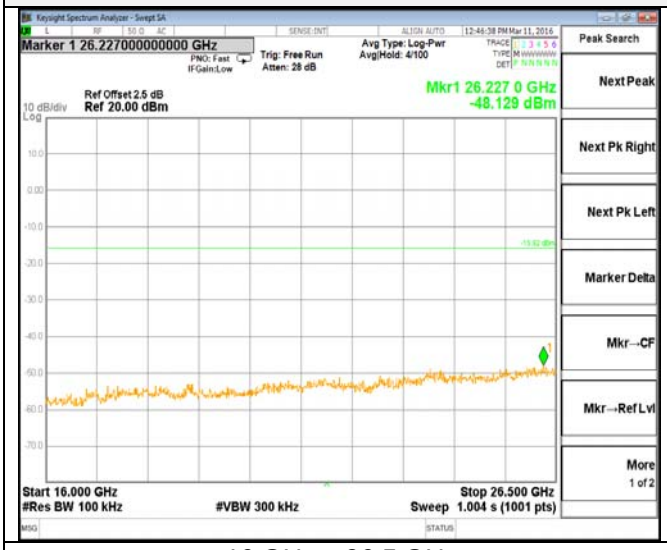
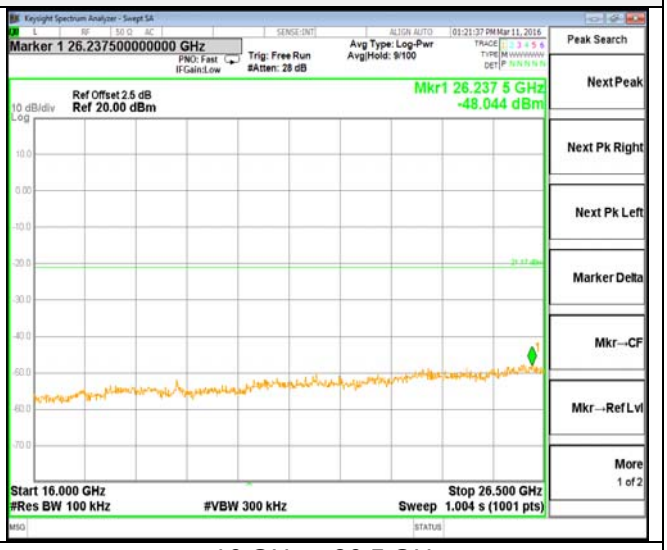
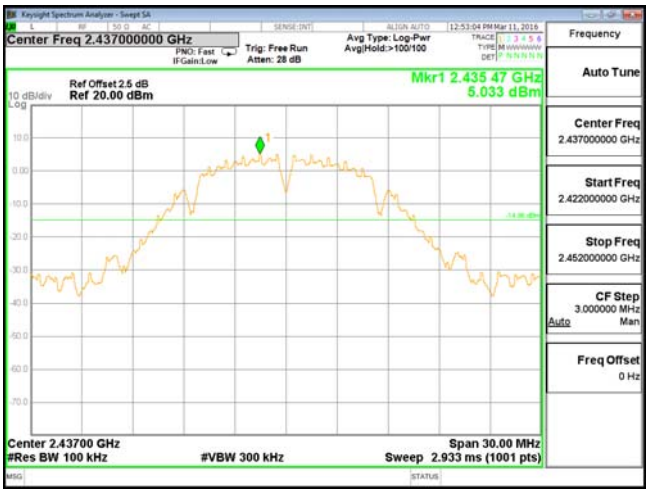
TEST RESULTS

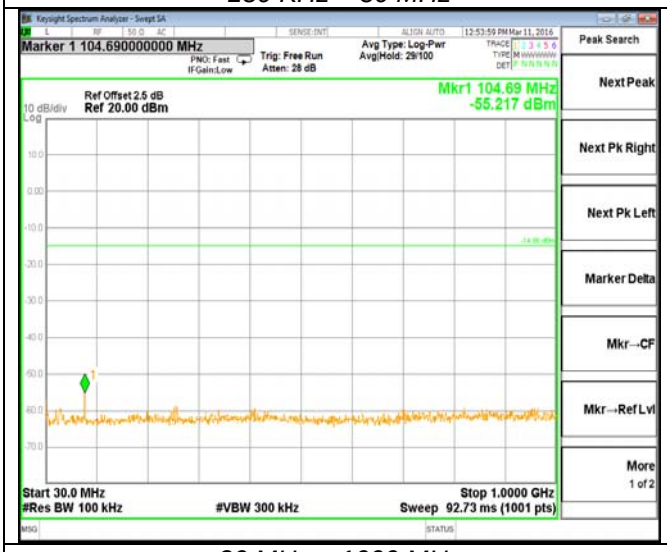
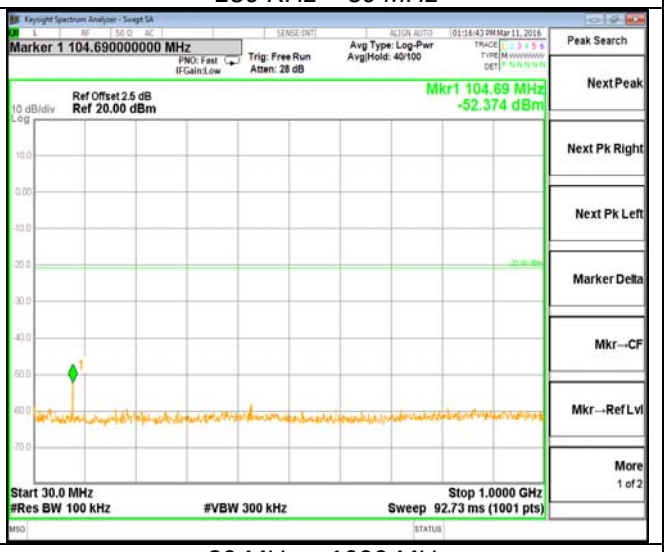
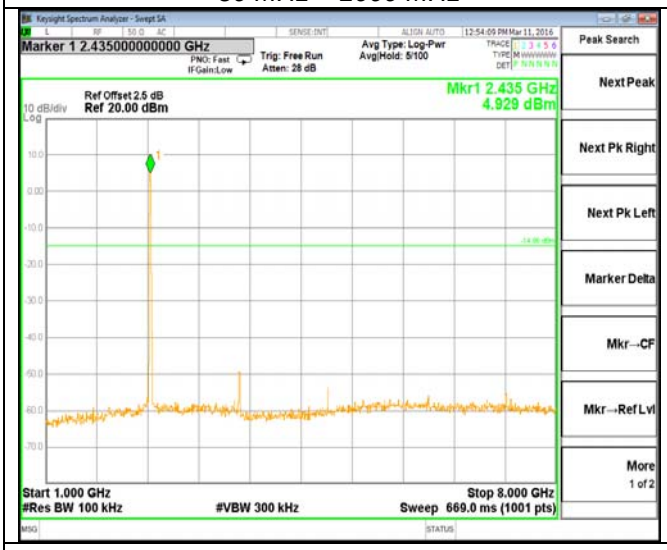
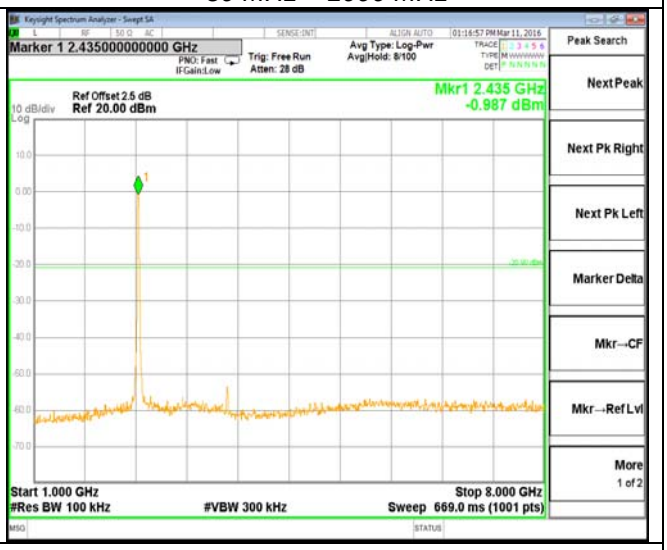
Test Mode	Channel	Frequency (MHz)	Spurious RF Conducted Emission (dBc)	Limits (dBc)	Verdict
IEEE 802.11 b	1	2412	<-20dBc	-20	PASS
	6	2437	<-20dBc	-20	
	11	2462	<-20dBc	-20	
IEEE 802.11 g	1	2412	<-20dBc	-20	PASS
	6	2437	<-20dBc	-20	
	11	2462	<-20dBc	-20	
IEEE 802.11 n HT20	1	2412	<-20dBc	-20	PASS
	6	2437	<-20dBc	-20	
	11	2462	<-20dBc	-20	
IEEE 802.11 n HT40	3	2422	<-20dBc	-20	PASS
	6	2437	<-20dBc	-20	
	9	2452	<-20dBc	-20	

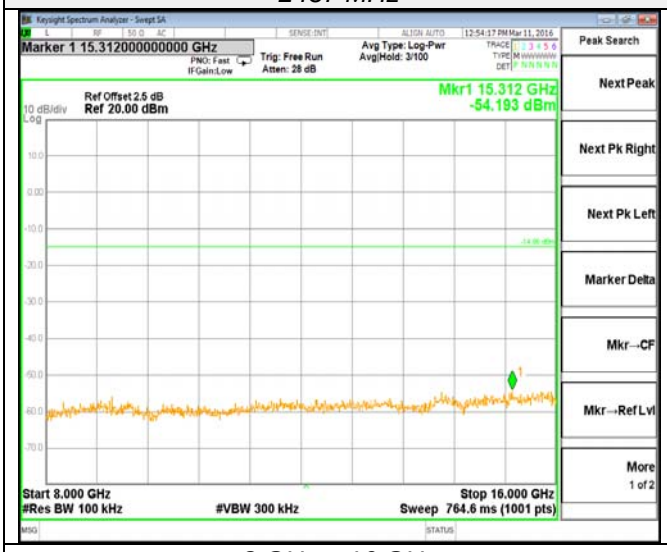
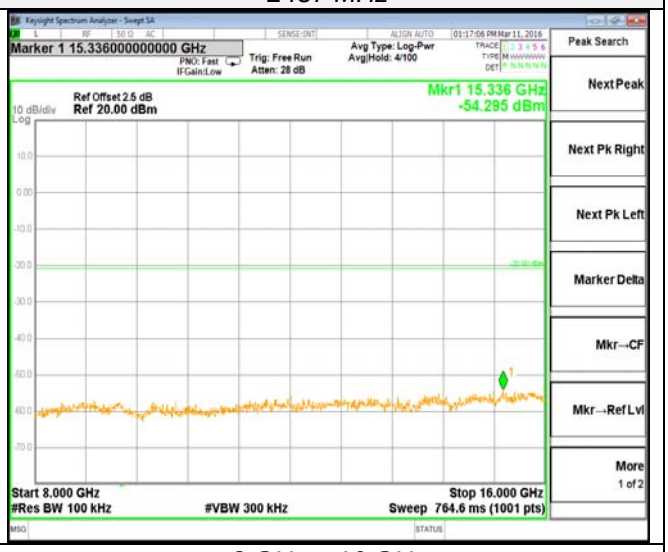
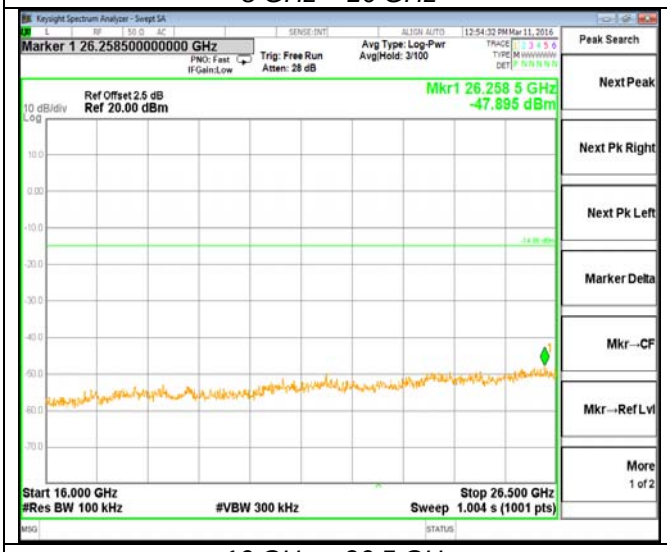
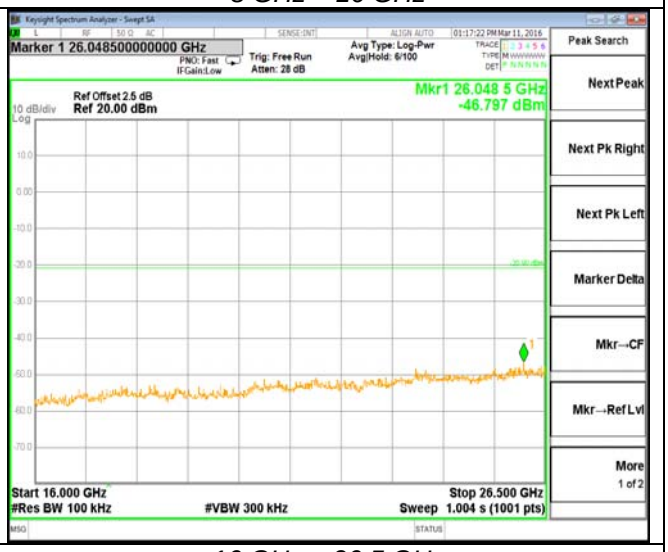
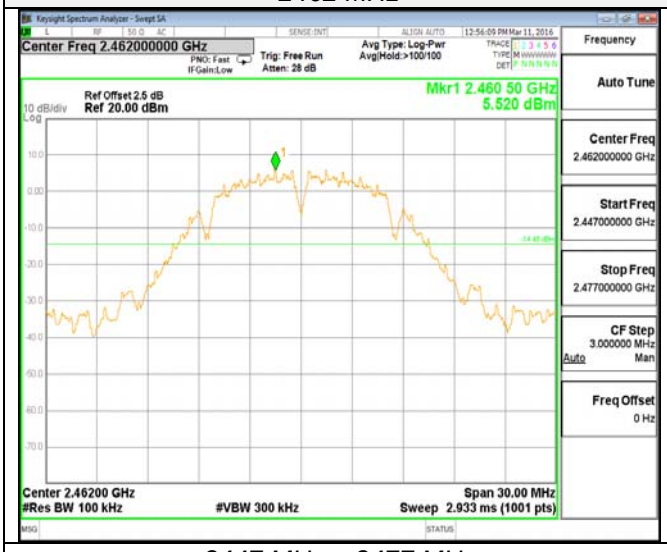
Remark:
1. *Measured output power at difference data rate for each mode and recorded woest case for each mode.*
2. *Test results including cable loss;*
3. *Worst case data at 1Mbps at IEEE 802.11 b; 6Mbps at IEEE 802.11 g; 6.5Mbps at IEEE 802.11 n HT20; 13.5Mbps at IEEE 802.11 n HT40;*
4. *"---" means that the fundamental frequency not for 15.209 limits requirement.*
5. *please refer to following plots;*

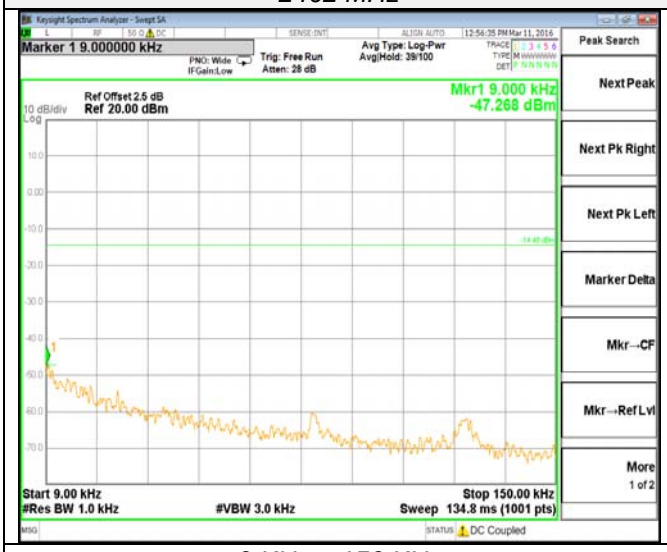
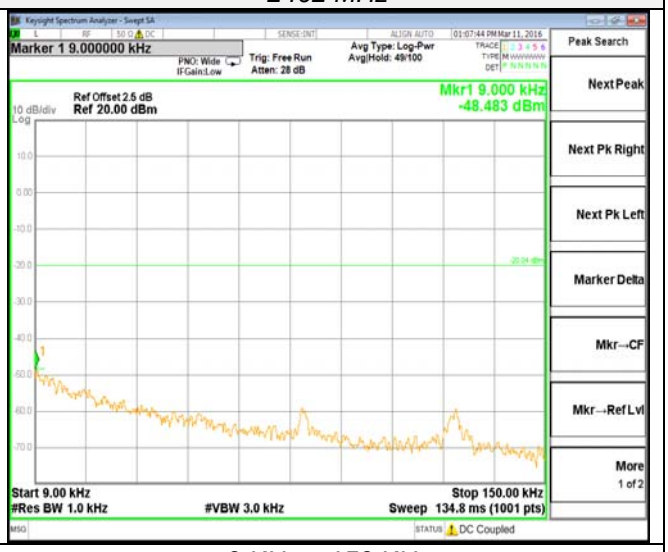
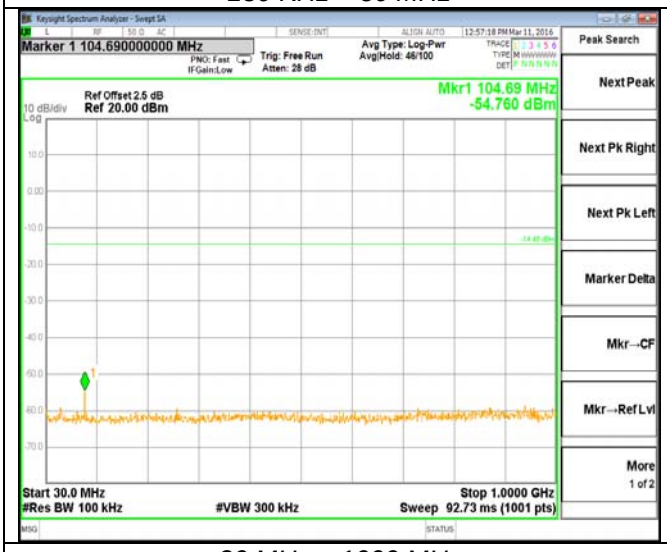
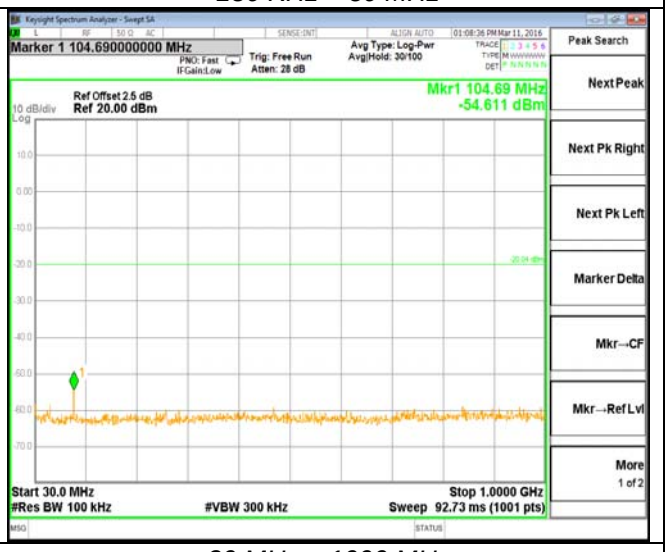
Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 b	*IEEE 802.11 g*
2412 MHz	*2412 MHz*
	
2397 MHz – 2427 MHz	*2397 MHz – 2427 MHz*
9 KHz – 150 KHz	*9 KHz – 150 KHz*
	
150 KHz – 30 MHz	*150 KHz – 30 MHz*

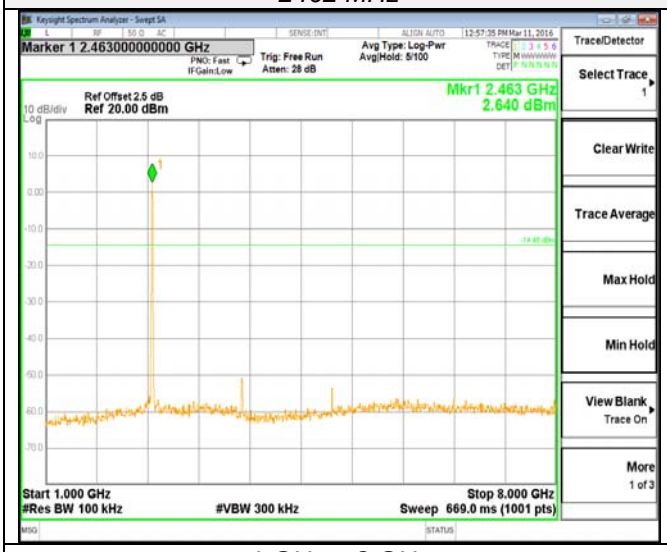
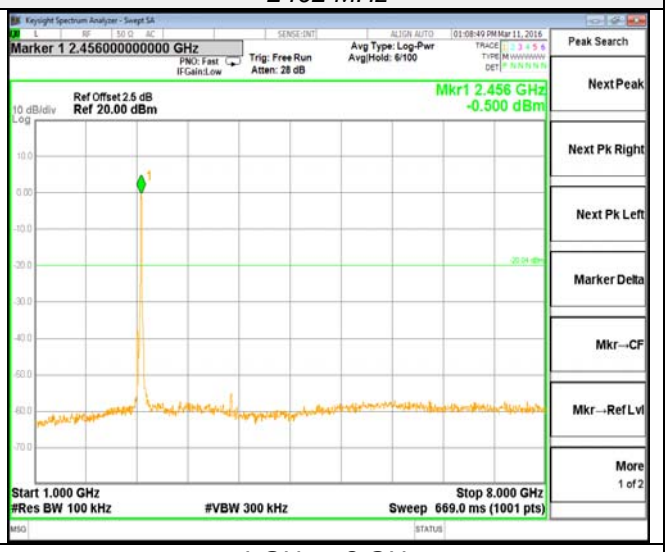
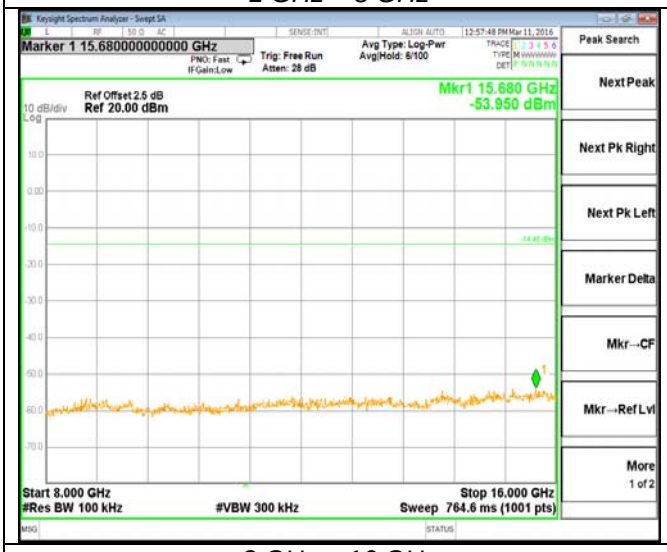
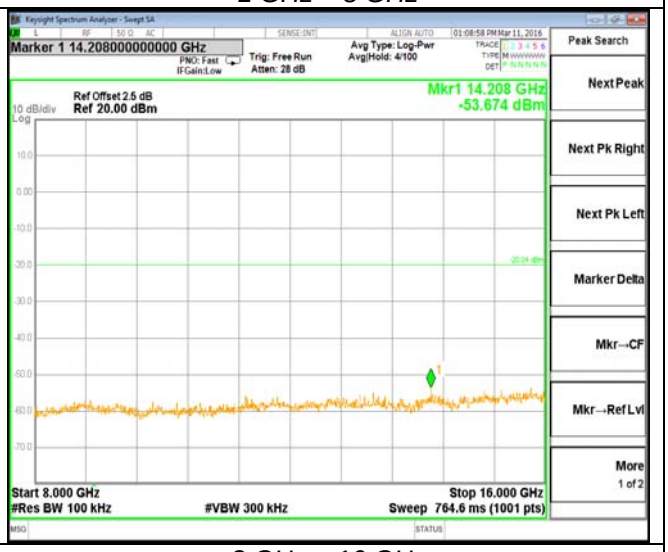
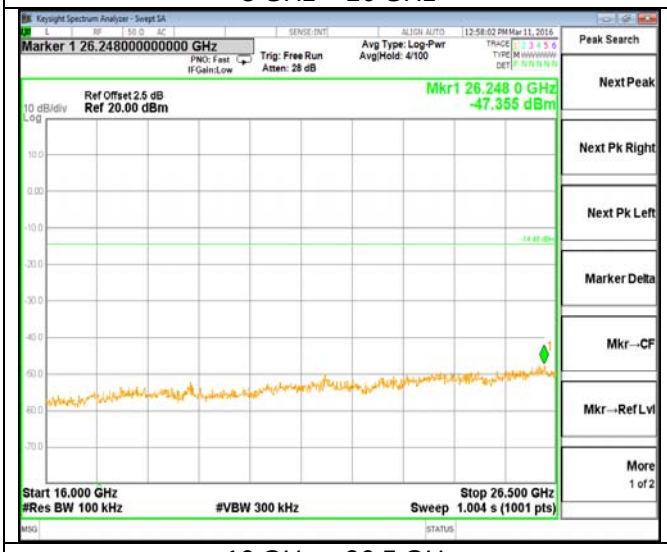
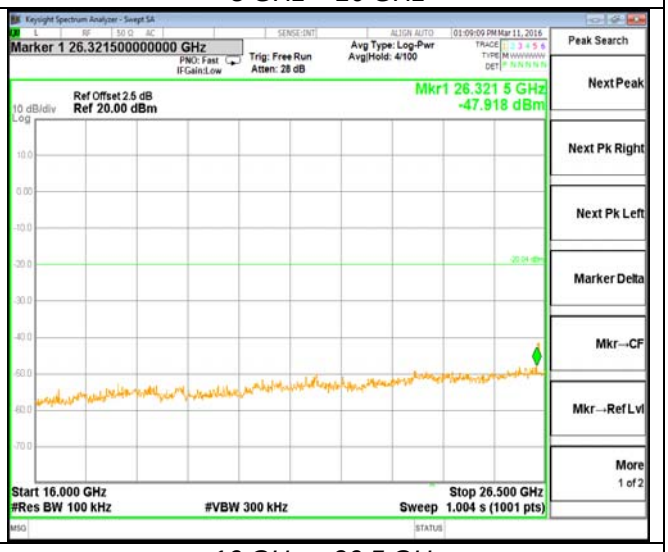
Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 b	*IEEE 802.11 g*
2412 MHz	*2412 MHz*
	
30 MHz – 1000 MHz	*30 MHz – 1000 MHz*
	
1 GHz – 8 GHz	*1 GHz – 8 GHz*
	
8 GHz – 16 GHz	*18 GHz – 16 GHz*

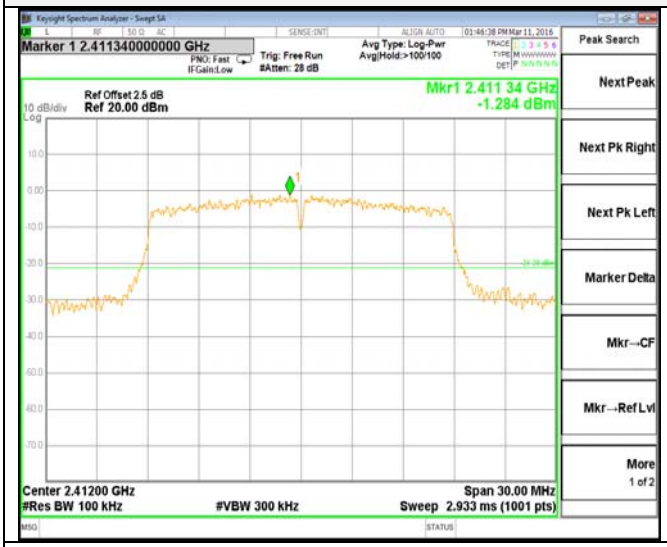
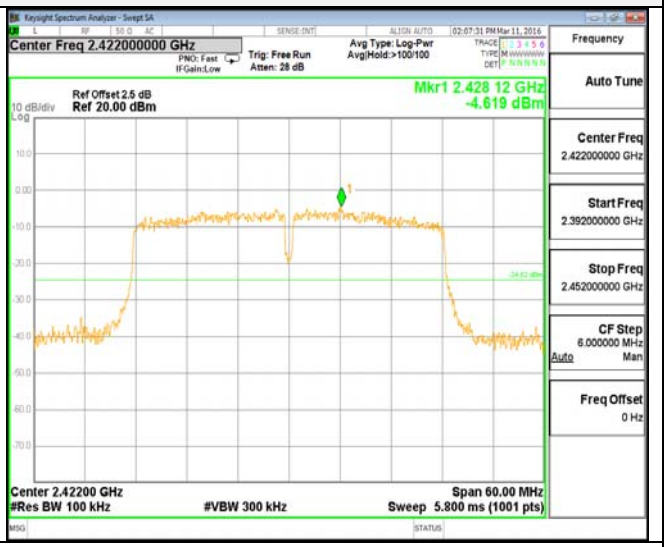
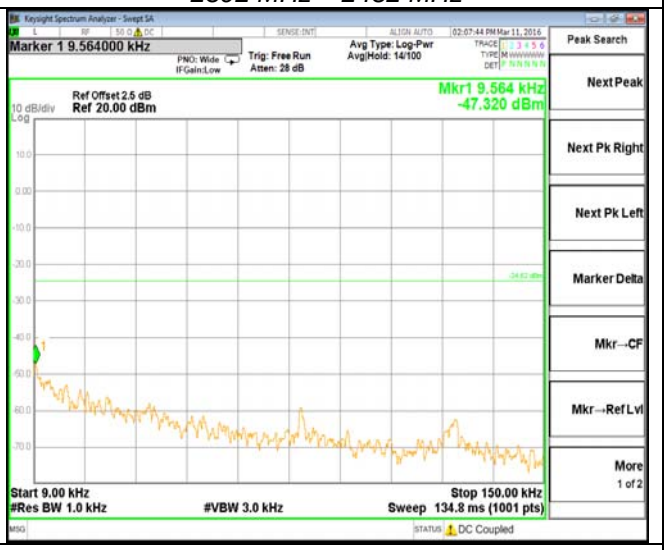
Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 b	*IEEE 802.11 g*
2412 MHz	*2412 MHz*
	
16 GHz – 26.5 GHz	*16 GHz – 26.5 GHz*
2437 MHz	*2437 MHz*
	
2422 MHz – 2452 MHz	*2422 MHz – 2452 MHz*
9 KHz – 150 KHz	*9 KHz – 150 KHz*

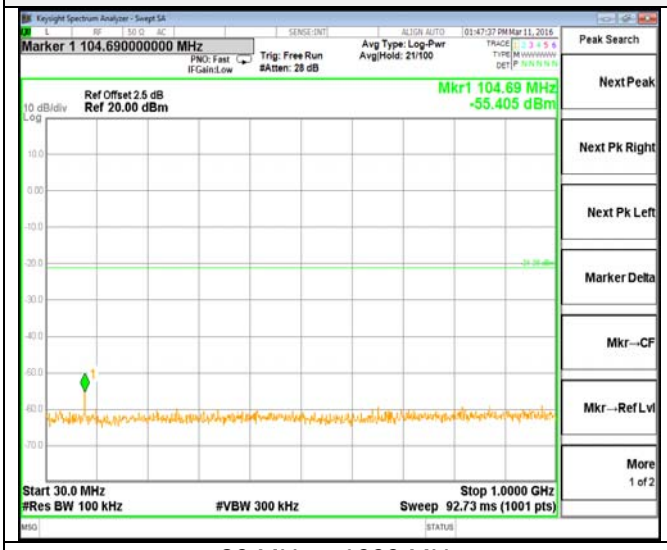
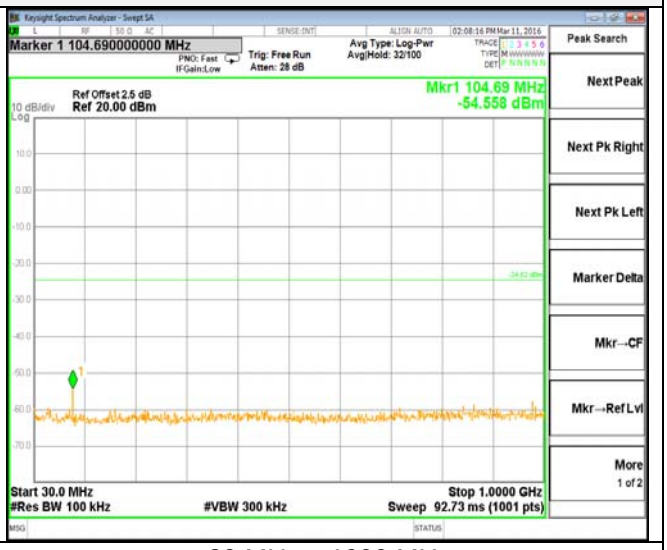
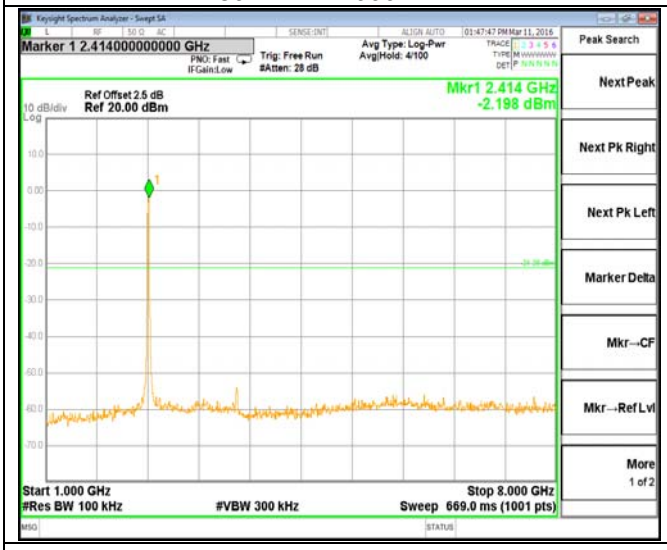
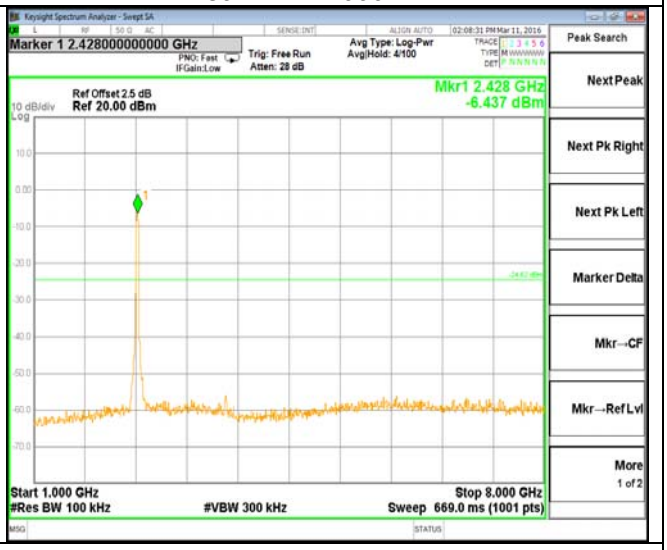
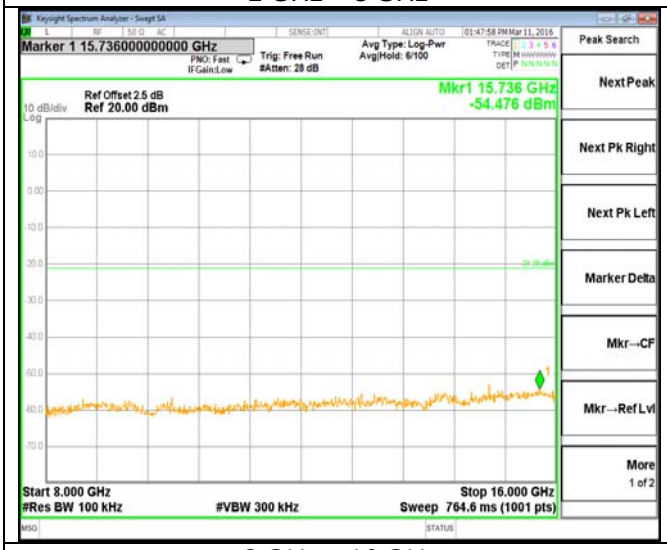
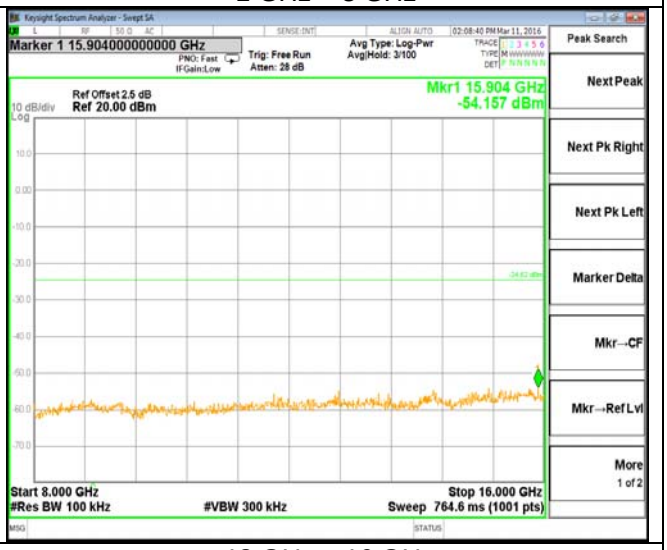
Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 b	*IEEE 802.11 g*
2437 MHz	*2437 MHz*
150 KHz – 30 MHz	*150 KHz – 30 MHz*
	
30 MHz – 1000 MHz	*30 MHz – 1000 MHz*
	
1 GHz – 8 GHz	*1 GHz – 8 GHz*

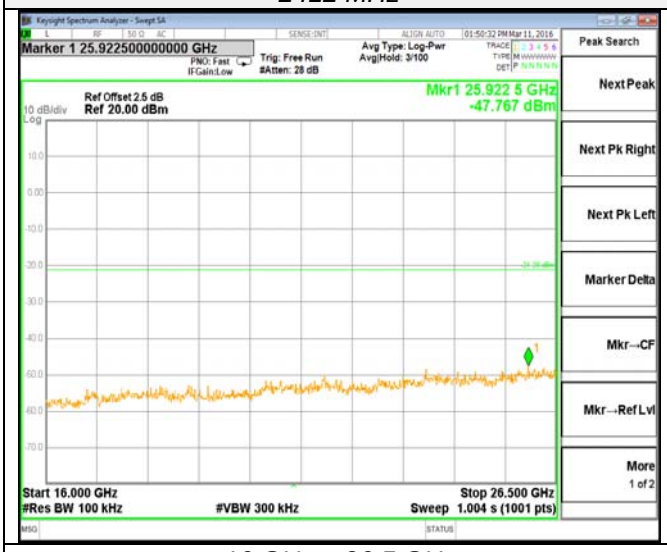
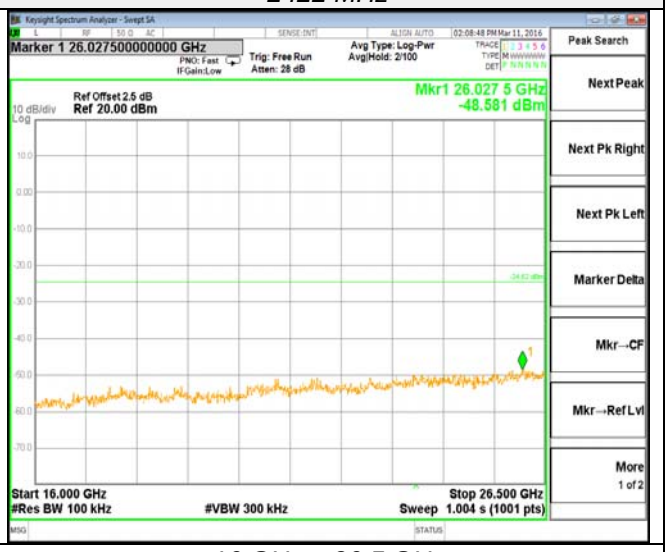
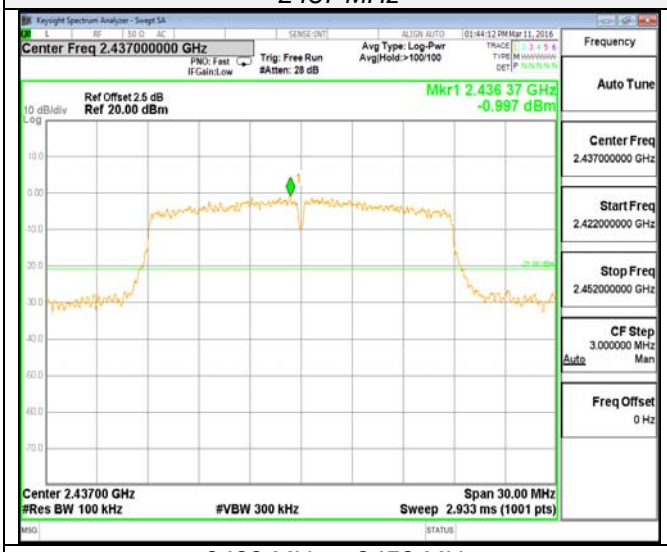
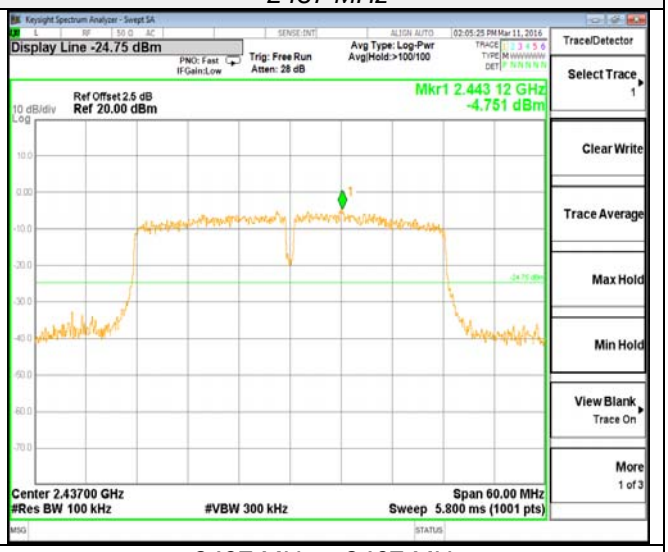
Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 b	*IEEE 802.11 g*
2437 MHz	*2437 MHz*
	
8 GHz – 16 GHz	*8 GHz – 16 GHz*
	
16 GHz – 26.5 GHz	*16 GHz – 26.5 GHz*
2462 MHz	*2462 MHz*
	
2447 MHz – 2477 MHz	*2447 MHz – 2477 MHz*

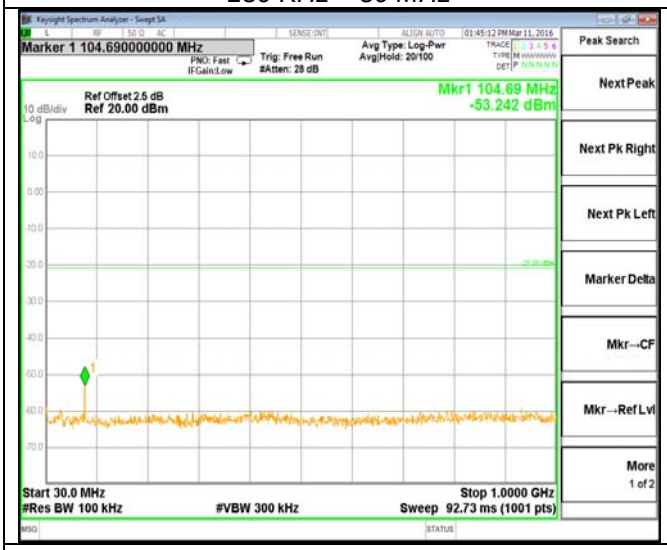
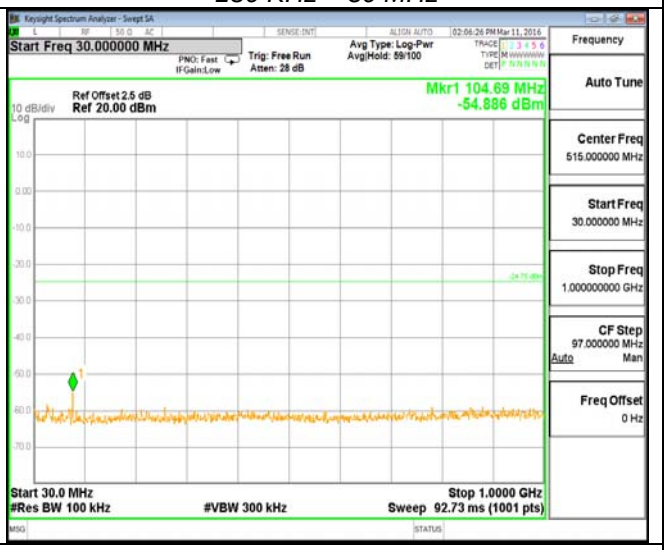
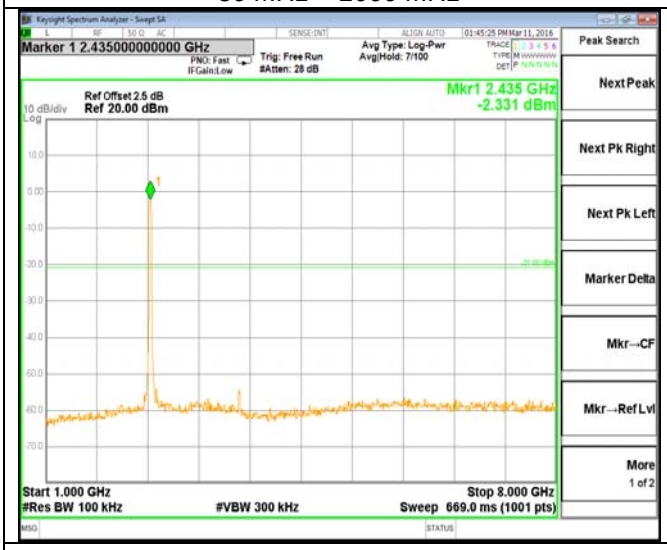
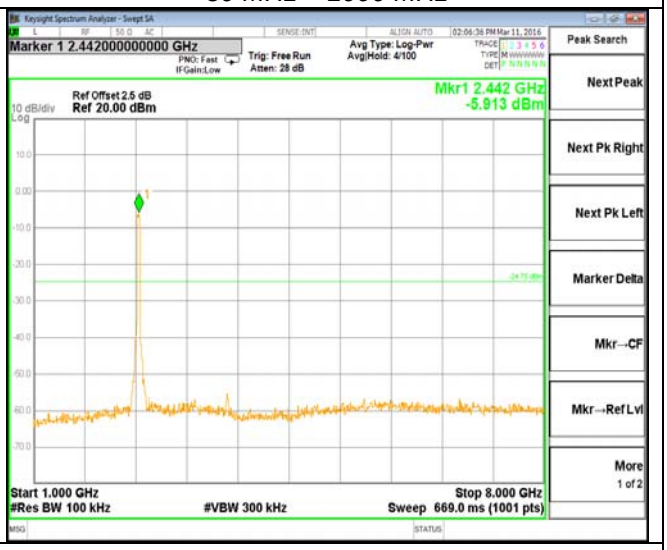
Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 b	*IEEE 802.11 g*
2462 MHz	*2462 MHz*
	
9 KHz – 150 KHz	*9 KHz – 150 KHz*
150 KHz – 30 MHz	*150 KHz – 30 MHz*
	
30 MHz – 1000 MHz	*30 MHz – 1000 MHz*

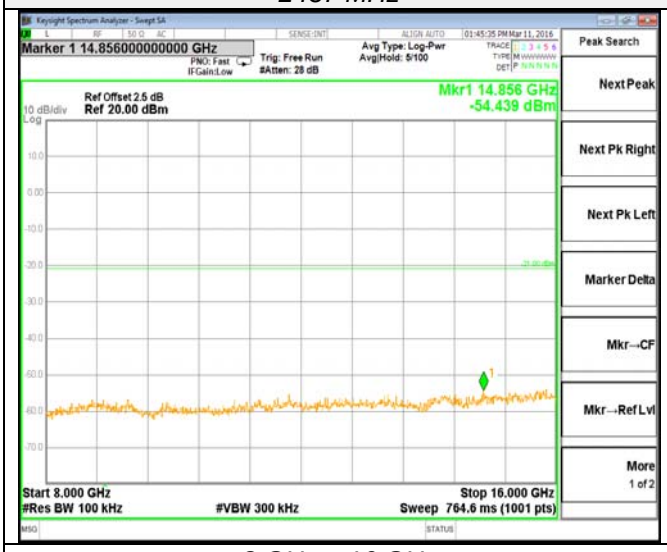
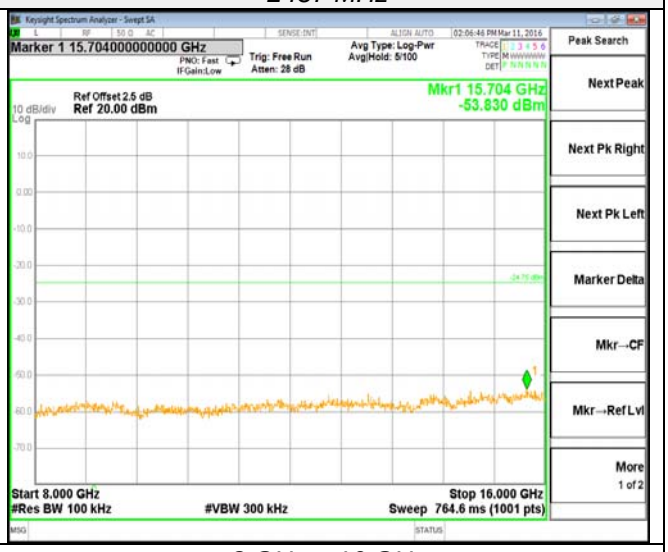
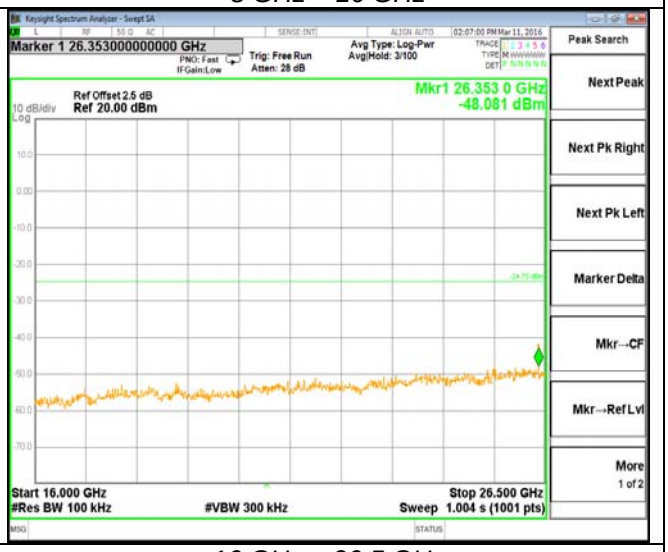
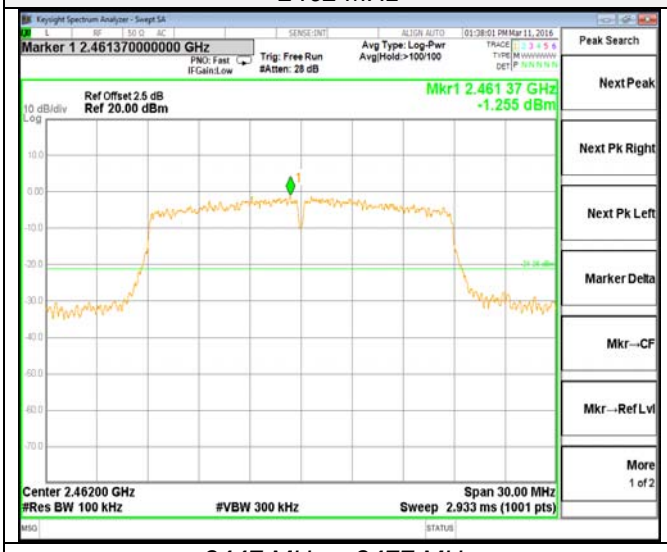
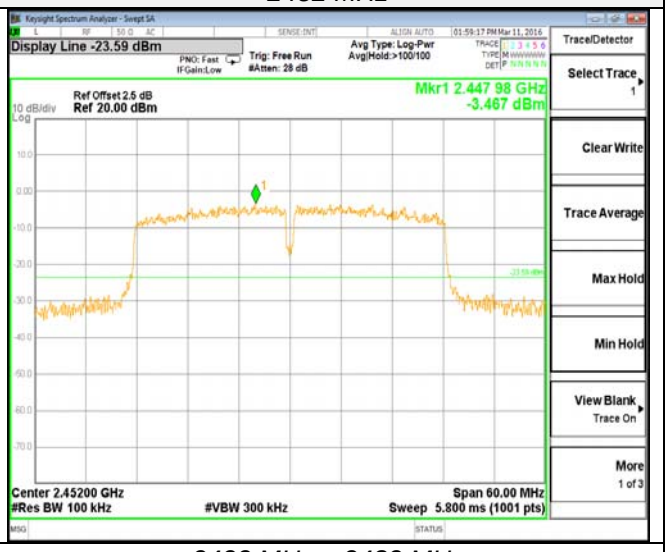
Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 b	*IEEE 802.11 g*
2462 MHz	*2462 MHz*
	
1 GHz – 8 GHz	*1 GHz – 8 GHz*
	
8 GHz – 16 GHz	*8 GHz – 16 GHz*
	
16 GHz – 26.5 GHz	*16 GHz – 26.5 GHz*

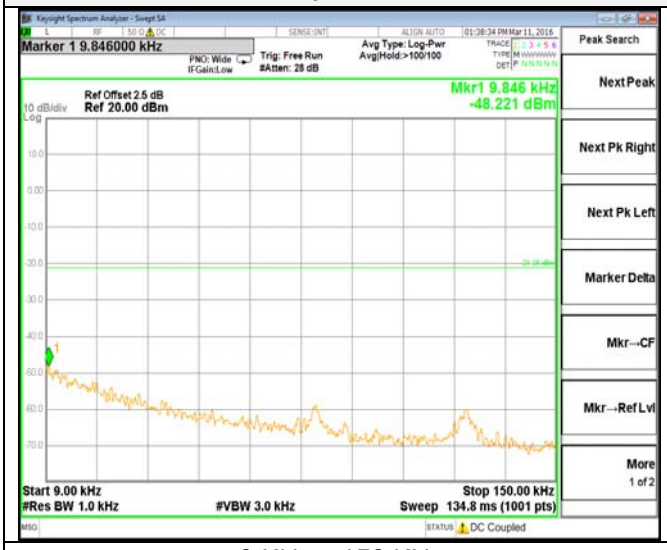
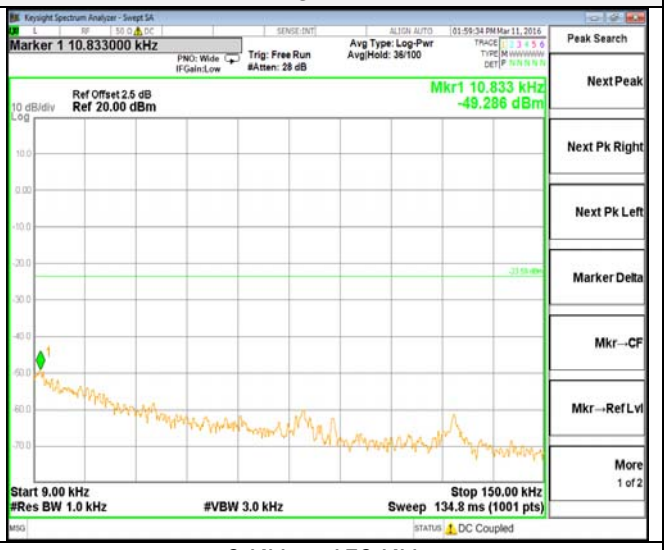
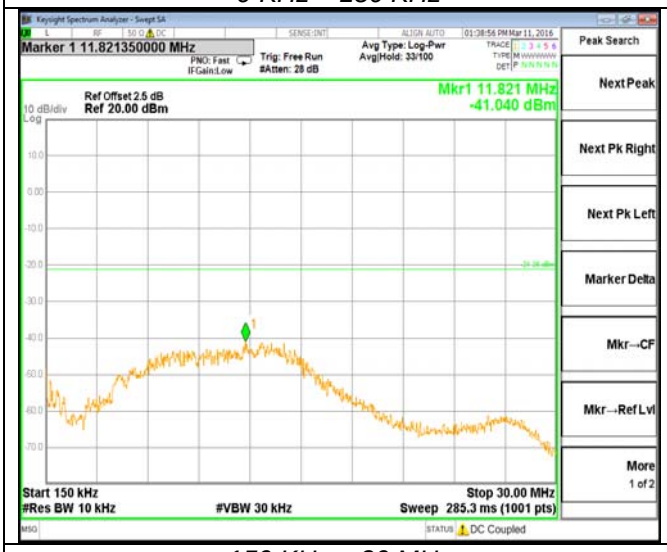
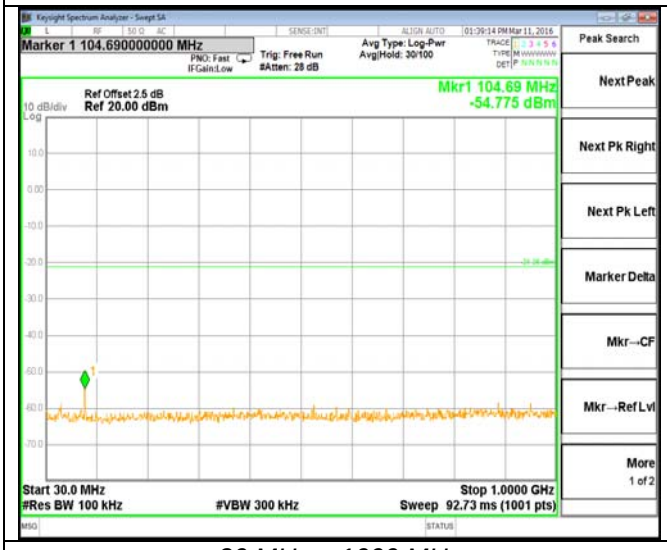
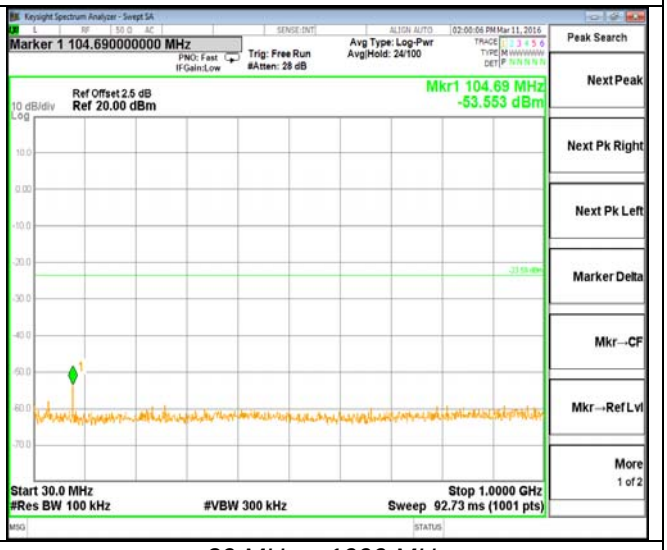
Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 n HT20	*IEEE 802.11 n HT40*
2412 MHz	*2422 MHz*
	
2397 MHz – 2427 MHz	*2392 MHz – 2452 MHz*
	
9 KHz – 150 KHz	*9 KHz – 150 KHz*
150 KHz – 30 MHz	*150 KHz – 30 MHz*

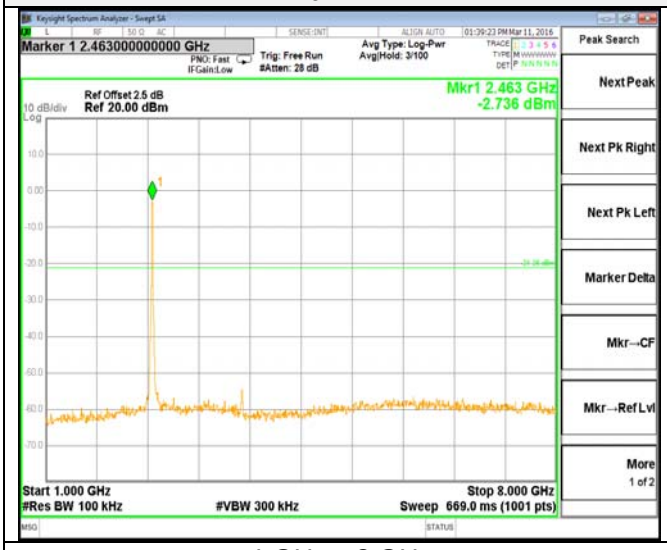
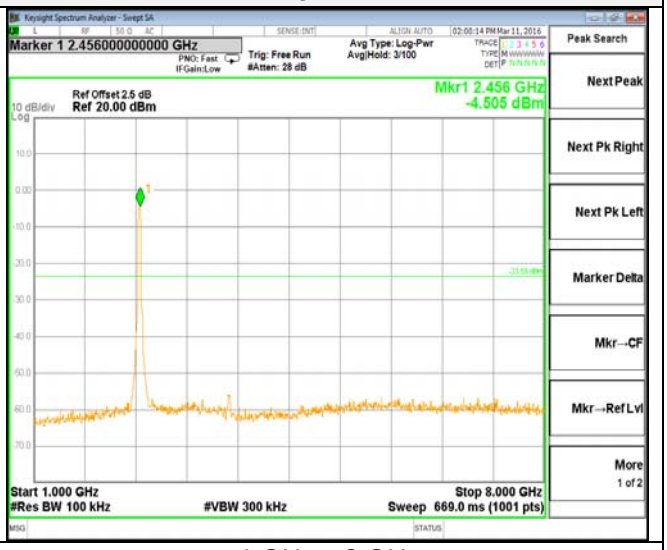
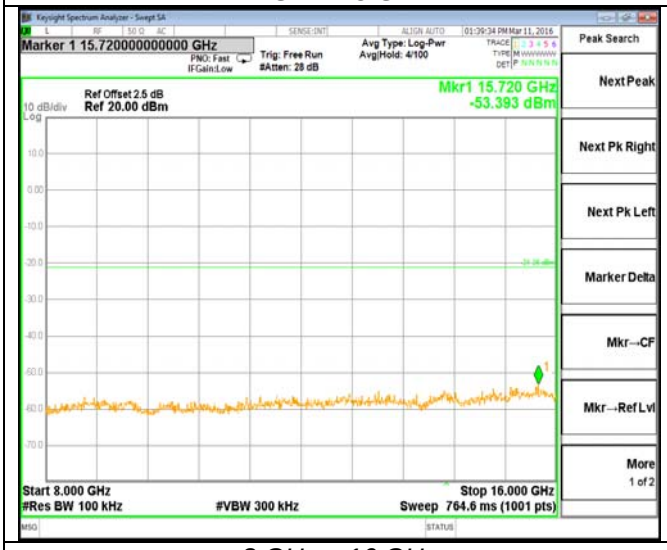
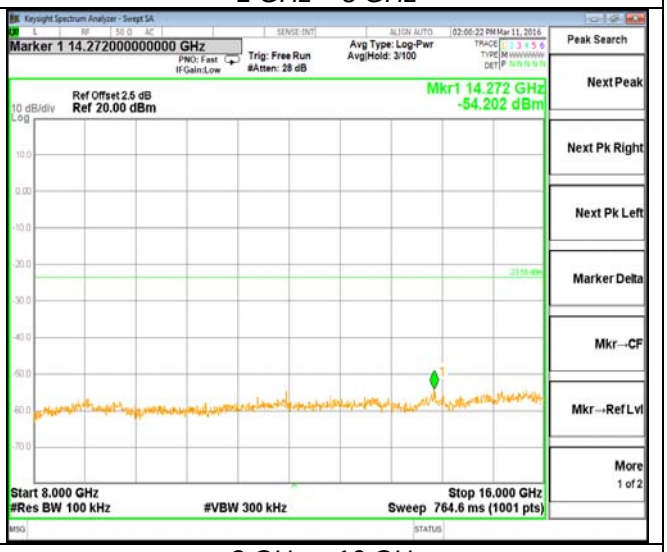
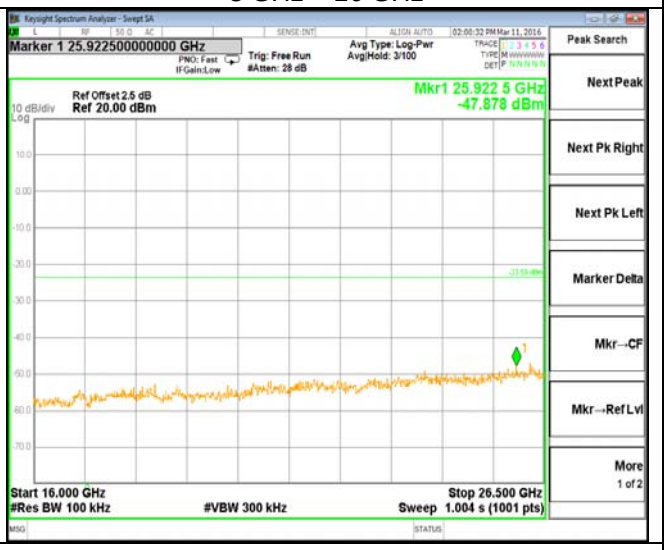
Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 n HT20	*IEEE 802.11 n HT40*
2412 MHz	*2422 MHz*
	
30 MHz – 1000 MHz	*30 MHz – 1000 MHz*
	
1 GHz – 8 GHz	*1 GHz – 8 GHz*
	
8 GHz – 16 GHz	*18 GHz – 16 GHz*

Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 n HT20	IEEE 802.11 n HT40
2412 MHz	2422 MHz
	
16 GHz – 26.5 GHz	16 GHz – 26.5 GHz
2437 MHz	2437 MHz
	
2422 MHz – 2452 MHz	2407 MHz – 2467 MHz
9 KHz – 150 KHz	9 KHz – 150 KHz

Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 n HT20	*IEEE 802.11 n HT40*
2437 MHz	*2437 MHz*
150 KHz – 30 MHz	*150 KHz – 30 MHz*
	
30 MHz – 1000 MHz	*30 MHz – 1000 MHz*
	
1 GHz – 8 GHz	*1 GHz – 8 GHz*

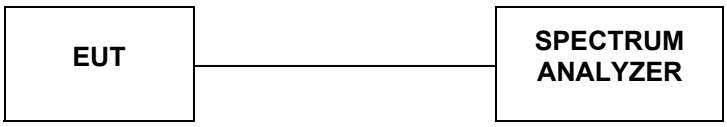
Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 n HT20	*IEEE 802.11 n HT40*
2437 MHz	*2437 MHz*
	
8 GHz – 16 GHz	*8 GHz – 16 GHz*
	
16 GHz – 26.5 GHz	*16 GHz – 26.5 GHz*
2462 MHz	*2452 MHz*
	
2447 MHz – 2477 MHz	*2422 MHz – 2482 MHz*

Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 n HT20	*IEEE 802.11 n HT40*
2462 MHz	*2452 MHz*
	
9 KHz – 150 KHz	*9 KHz – 150 KHz*
	
150 KHz – 30 MHz	*150 KHz – 30 MHz*
	
30 MHz – 1000 MHz	*30 MHz – 1000 MHz*

Band-edge Masurements for RF Conducted Emissions	
IEEE 802.11 n HT20	*IEEE 802.11 n HT40*
2462 MHz	*2452 MHz*
	
1 GHz – 8 GHz	*1 GHz – 8 GHz*
	
8 GHz – 16 GHz	*8 GHz – 16 GHz*
	
16 GHz – 26.5 GHz	*16 GHz – 26.5 GHz*

4.7 6dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=100 KHz and VBW=300KHz.
The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.
According to KDB558074 D01 V03 for one of the following procedures may be used to determine the modulated DTS device signal bandwidth.
1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

LIMIT

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

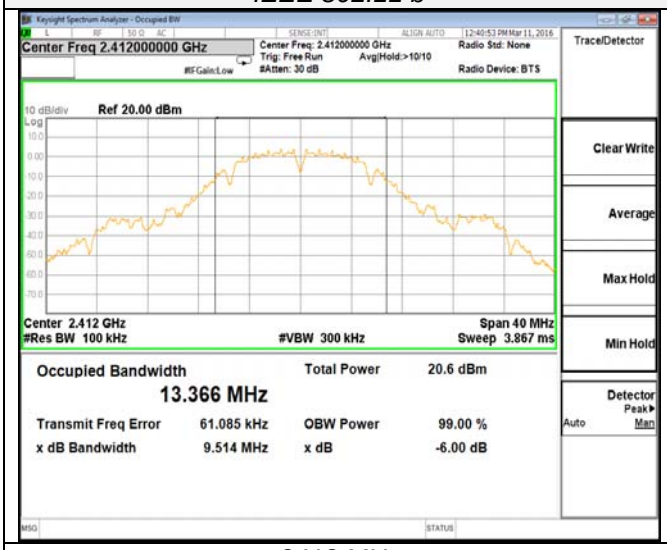
TEST RESULTS

Test Mode	Channel	Frequency (MHz)	Measured 6 dB Bandwidth (MHz)	Limits (MHz)	Verdict
IEEE 802.11 b	1	2412	9.514	≥0.5000	PASS
	6	2437	9.189		
	11	2462	9.167		
IEEE 802.11 g	1	2412	16.45	≥0.5000	PASS
	6	2437	16.41		
	11	2462	16.42		
IEEE 802.11 n HT20	1	2412	17.63	≥0.5000	PASS
	6	2437	17.63		
	11	2462	17.62		
IEEE 802.11 n HT40	3	2422	36.26	≥0.5000	PASS
	6	2437	36.37		
	9	2452	36.34		

Remark:
1. *Measured output power at difference data rate for each mode and recorded woest case for each mode.*
2. *Test results including cable loss;*
3. *Worst case data at 1Mbps at IEEE 802.11 b; 6Mbps at IEEE 802.11 g; 6.5Mbps at IEEE 802.11 n HT20; 13.5Mbps at IEEE 802.11 n HT40;*
4. *please refer to following plots;*

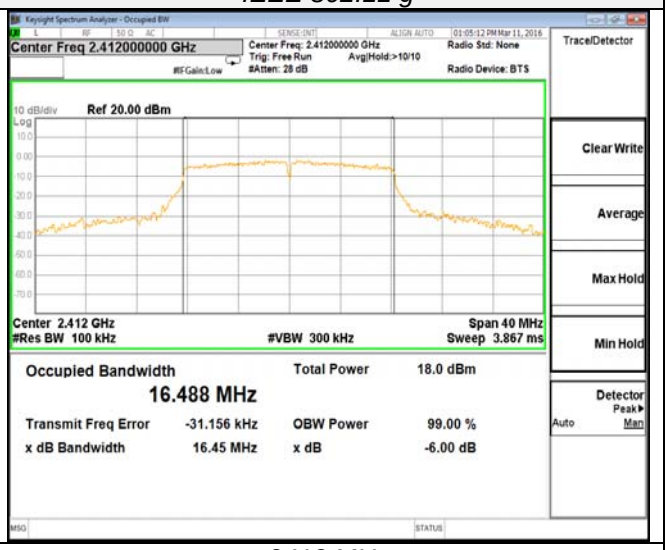
6 dB Bandwidth

IEEE 802.11 b

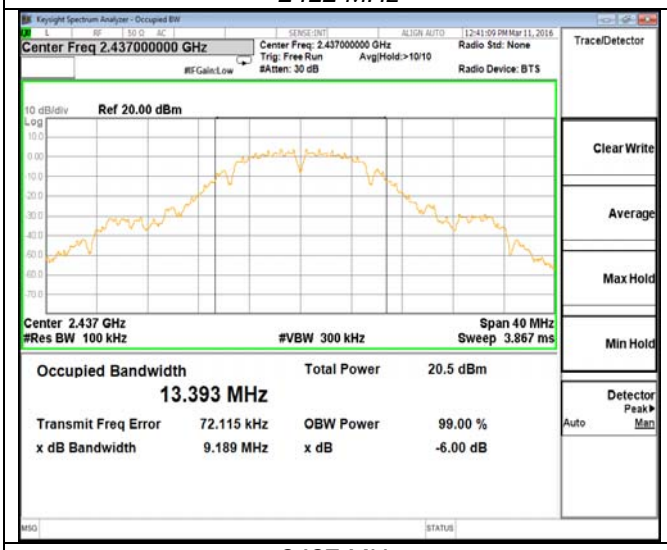


2412 MHz

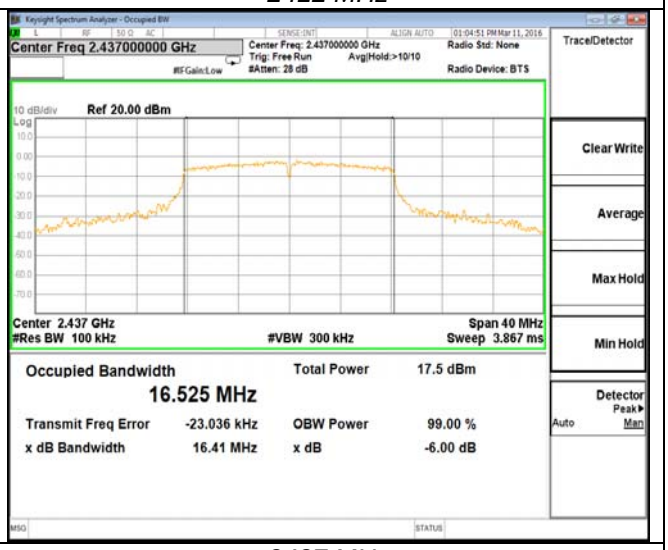
IEEE 802.11 g



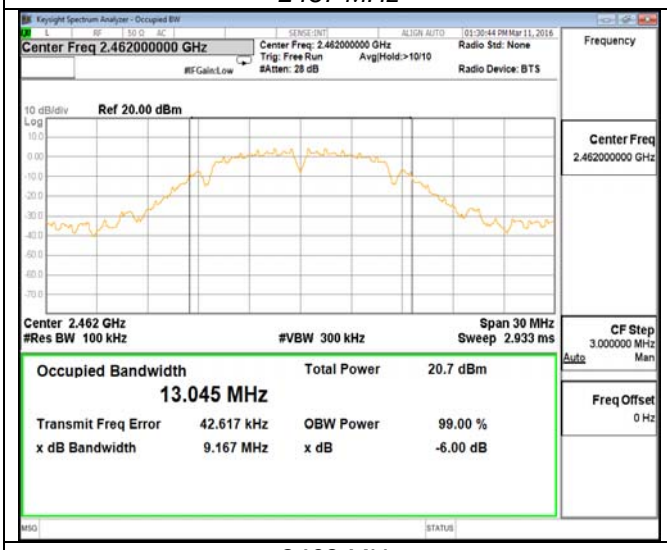
2412 MHz



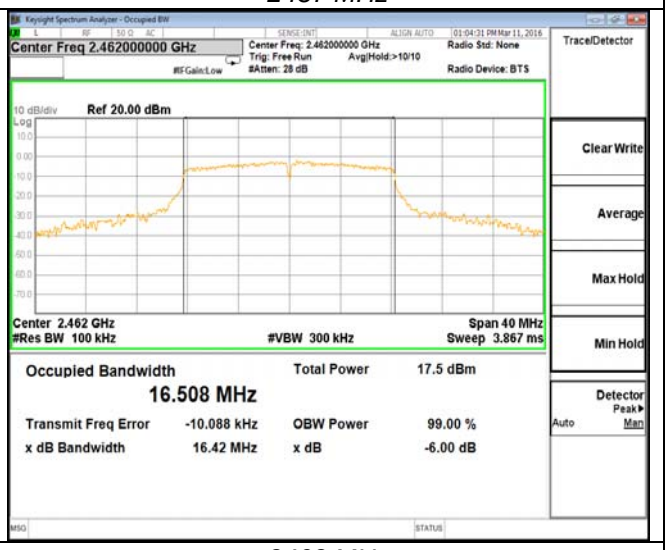
2437 MHz



2437 MHz



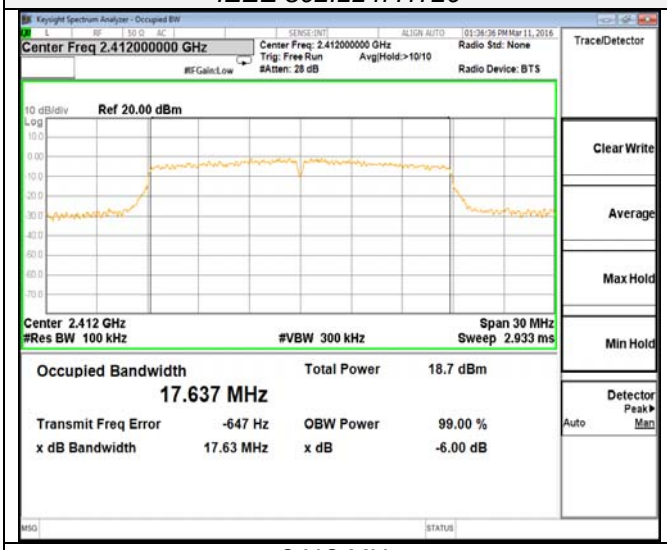
2462 MHz



2462 MHz

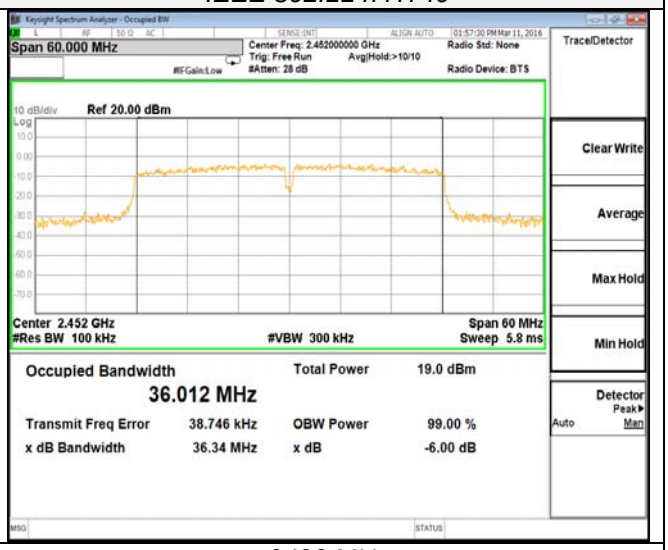
6 dB Bandwidth

IEEE 802.11 n HT20

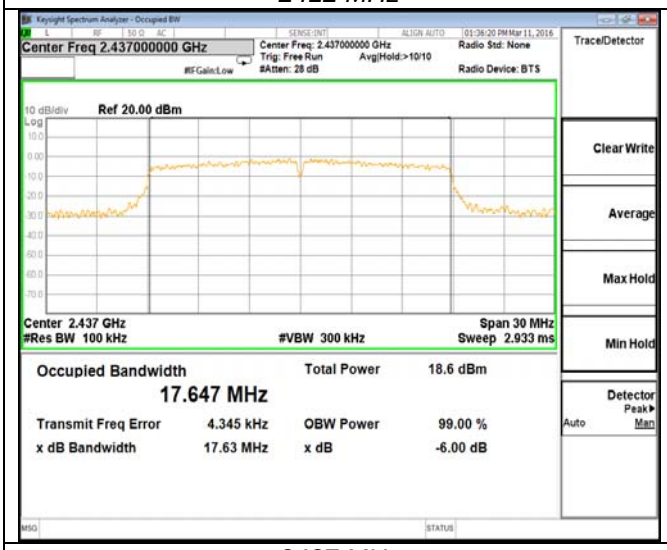


2412 MHz

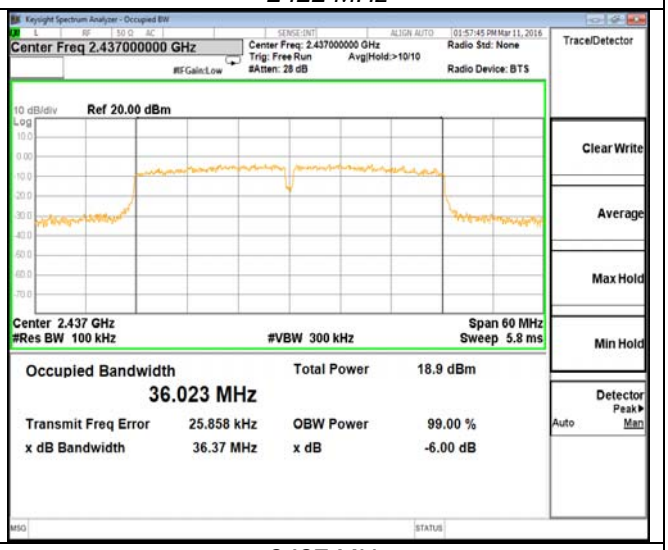
IEEE 802.11 n HT40



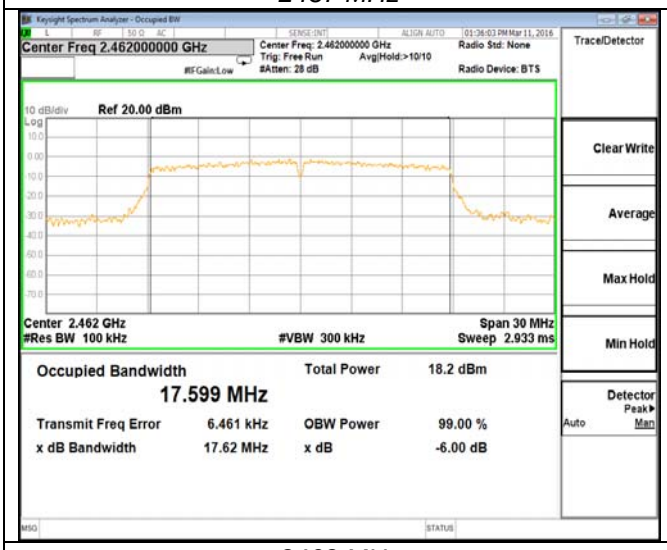
2422 MHz



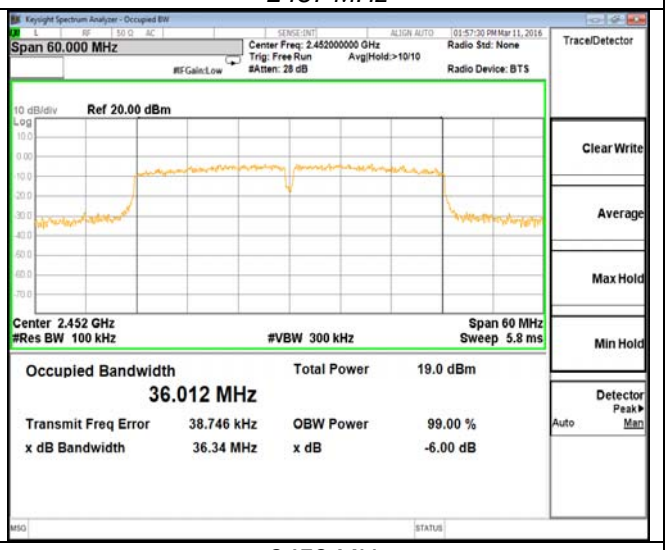
2437 MHz



2437 MHz



2462 MHz



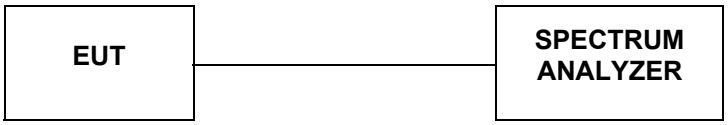
2452 MHz

4.8 Band-edge Measurements for Radiated Emissions

TEST REQUIREMENT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST CONFIGURATION



TEST PROCEDURE

According to KDB 558074 D01 V03 for Antenna-port conducted measurement. Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, for Radiated emissions restricted band RBW=1MHz, VBW=3MHz for peak detector and RBW=1MHz, VBW=10Hz for Peak detector.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.
6. Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency (see 12.2.2, 12.2.3, and 12.2.4 for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
7. Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)
8. Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).
9. For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
10. Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:
    $E = EIRP – 20\log D + 104.8$

where:
E = electric field strength in dBμV/m,
EIRP = equivalent isotropic radiated power in dBm
D = specified measurement distance in meters.

11. Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.
12. Compare the resultant electric field strength level to the applicable regulatory limit.

13. Perform radiated spurious emission test dures until all measured frequencies were complete.

LIMIT

Below -20dB of the highest emission level in operating band.
Radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)

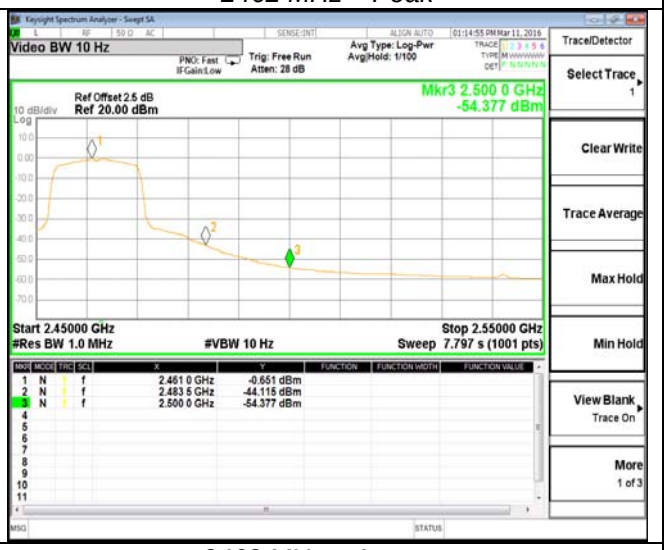
TEST RESULTS

IEEE 802.11 b							
Frequency (MHz)	**Conducted Power (dBm)**	**Antenna Gain (dBi)**	**Ground Reflection Factor (dB)**	**Covert Radiated E Level At 3m (dBuV/m)**	**Detector**	**Limit (dBuV/m)**	**Verdict**
2386.16	-38.742	1.00	0.00	58.518	Peak	74.00	PASS
2387.48	-44.855	1.00	0.00	52.405	AV	54.00	PASS
2410.52	11.246	1.00	0.00	108.506	Peak	---	PASS
2410.52	7.325	1.00	0.00	104.585	AV	---	PASS
2460.60	7.202	1.00	0.00	104.462	Peak	---	PASS
2460.60	3.331	1.00	0.00	100.591	AV	---	PASS
2483.50	-45.560	1.00	0.00	51.700	Peak	74.00	PASS
2484.80	-52.656	1.00	0.00	44.604	AV	54.00	PASS
IEEE 802.11 g							
Frequency (MHz)	**Conducted Power (dBm)**	**Antenna Gain (dBi)**	**Ground Reflection Factor (dB)**	**Covert Radiated E Level At 3m (dBuV/m)**	**Detector**	**Limit (dBuV/m)**	**Verdict**
2390.000	-27.994	1.00	0.00	69.266	Peak	74.00	PASS
2390.000	-43.849	1.00	0.00	53.411	AV	54.00	PASS
2411.069	9.312	1.00	0.00	106.572	Peak	---	PASS
2411.069	-0.259	1.00	0.00	97.001	AV	---	PASS
2461.000	10.472	1.00	0.00	107.732	Peak	---	PASS
2461.000	-0.651	1.00	0.00	96.609	AV	---	PASS
2483.500	-25.351	1.00	0.00	71.909	Peak	74.00	PASS
2483.500	-44.115	1.00	0.00	53.145	AV	54.00	PASS
IEEE 802.11 n HT20							
Frequency (MHz)	**Conducted Power (dBm)**	**Antenna Gain (dBi)**	**Ground Reflection Factor (dB)**	**Covert Radiated E Level At 3m (dBuV/m)**	**Detector**	**Limit (dBuV/m)**	**Verdict**
2390.000	-28.810	1.00	0.00	68.450	Peak	74.00	PASS
2390.000	-44.198	1.00	0.00	53.062	AV	54.00	PASS
2413.212	8.542	1.00	0.00	105.802	Peak	---	PASS
2413.212	-1.308	1.00	0.00	95.952	AV	---	PASS
2463.300	7.873	1.00	0.00	105.133	Peak	---	PASS
2463.500	-2.025	1.00	0.00	95.235	AV	---	PASS
2484.900	-25.672	1.00	0.00	71.588	Peak	74.00	PASS
2483.500	-45.957	1.00	0.00	51.303	AV	54.00	PASS
IEEE 802.11 n HT40							
Frequency (MHz)	**Conducted Power (dBm)**	**Antenna Gain (dBi)**	**Ground Reflection Factor (dB)**	**Covert Radiated E Level At 3m (dBuV/m)**	**Detector**	**Limit (dBuV/m)**	**Verdict**
2388.260	-28.174	1.00	0.00	69.086	Peak	74.00	PASS
2390.000	-47.264	1.00	0.00	49.996	AV	54.00	PASS
2424.120	5.726	1.00	0.00	102.986	Peak	---	PASS
2424.120	-6.744	1.00	0.00	90.516	AV	---	PASS
2461.680	4.134	1.00	0.00	101.394	Peak	---	PASS
2454.840	-6.753	1.00	0.00	90.507	AV	---	PASS
2487.580	-25.367	1.00	0.00	71.893	Peak	74.00	PASS
2487.580	-47.623	1.00	0.00	49.637	AV	54.00	PASS

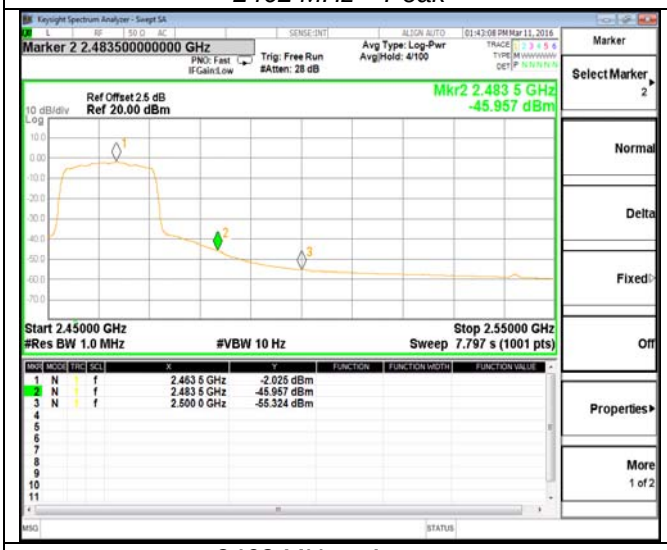
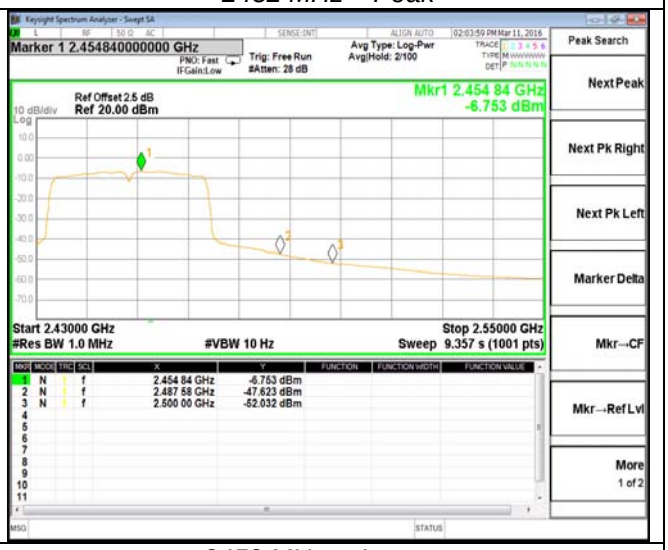
Remark:

1. *Measured output power at difference data rate for each mode and recorded woest case for each mode.*
2. *Test results including cable loss;*
3. *Worst case data at 1Mbps at IEEE 802.11 b; 6Mbps at IEEE 802.11 g; 6.5Mbps at IEEE 802.11 n HT20; 13.5Mbps at IEEE 802.11 n HT40;*
4. *"---" means that the fundamental frequency not for 15.209 limits requirement.*
5. *please refer to following plots;*

Band-edge Measurements for Radiated Emissions	
IEEE 802.11 b	*IEEE 802.11 g*
2412 MHz – Peak	*2412 MHz – Peak*
2412 MHz – Average	*2412 MHz – Average*

Band-edge Measurements for Radiated Emissions	
IEEE 802.11 b	*IEEE 802.11 g*
2462 MHz – Peak	*2462 MHz – Peak*
	
2462 MHz – Average	*2462 MHz – Average*

Band-edge Measurements for Radiated Emissions	
IEEE 802.11 n HT20	*IEEE 802.11 n HT40*
2412 MHz – Peak	*2422 MHz – Peak*
2412 MHz – Average	*2422 MHz – Average*

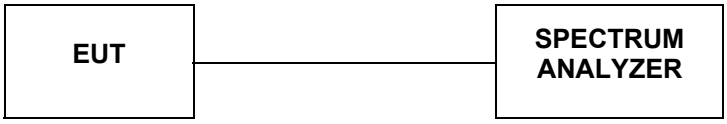
Band-edge Measurements for Radiated Emissions	
IEEE 802.11 n HT20	*IEEE 802.11 n HT40*
2462 MHz – Peak	*2452 MHz – Peak*
	
2462 MHz – Average	*2452 MHz – Average*

4.9 Band-edge Measurements for RF Conducted Emissions

LIMIT

1. Below -20dB of the highest emission level in operating band.
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.

TEST CONFIGURATION



TEST PROCEDURE

According to KDB 558074 D01 V03 for Antenna-port conducted measurement.

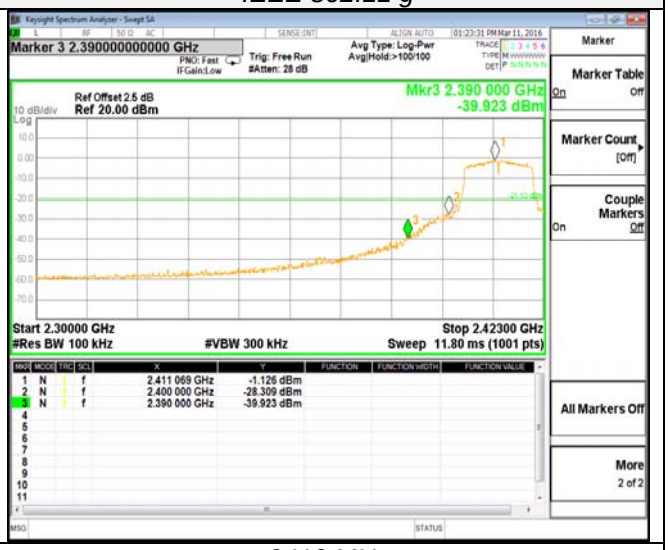
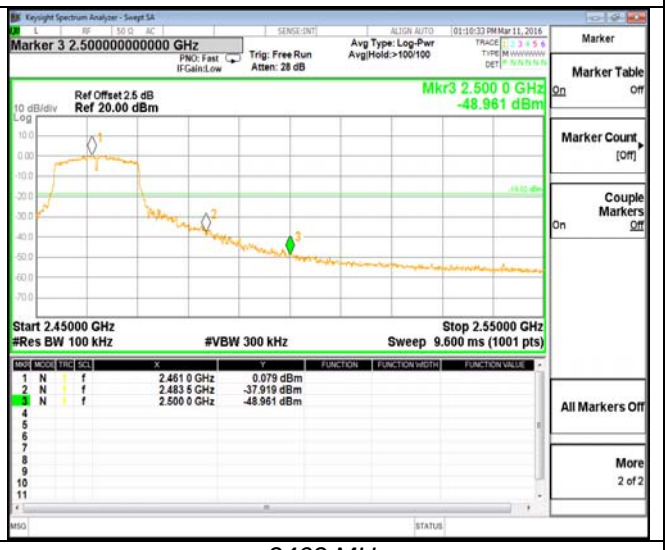
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge,
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.
6. Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency (see 12.2.2, 12.2.3, and 12.2.4 for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).

TEST RESULTS

Test Mode	Channel	Frequency (MHz)	Conductd Band-edge Emission (dBc)	Limits (dBc)	Verdict
IEEE 802.11 b	1	2412	<-20dBc	-20	PASS
	11	2462	<-20dBc	-20	
IEEE 802.11 g	1	2412	<-20dBc	-20	PASS
	11	2462	<-20dBc	-20	
IEEE 802.11 n HT20	1	2412	<-20dBc	-20	PASS
	11	2462	<-20dBc	-20	
IEEE 802.11 n HT40	3	2422	<-20dBc	-20	PASS
	9	2452	<-20dBc	-20	

Remark:

1. *Measured output power at difference data rate for each mode and recorded woest case for each mode.*
2. *Test results including cable loss;*
3. *Worst case data at 1Mbps at IEEE 802.11 b; 6Mbps at IEEE 802.11 g; 6.5Mbps at IEEE 802.11 n HT20; 13.5Mbps at IEEE 802.11 n HT40;*
4. *"---" means that the fundamental frequency not for 15.209 limits requirement.*
5. *please refer to following plots;*

Band-edge Measurements for RF Conducted Emissions	
IEEE 802.11 b	*IEEE 802.11 g*
	
2412 MHz	*2412 MHz*
	
2462 MHz	*2462 MHz*

Band-edge Measurements for RF Conducted Emissions	
IEEE 802.11 n HT20	IEEE 802.11 n HT40
2412 MHz	2422 MHz
2462 MHz	2452 MHz

4.10 Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Refer to statement below for compliance.

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

Measurement

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.For normal WLAN devices, the DSSS mode is used.

Conducted power refer ANSI C63.10 :2009 Section 11.9 Output power test procedure for DTS devices
Radiated power refer to ANSI C63.10 :2009 Section 6.6.4 Radiated emissions tests.

Measurement parameters

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1MHz
Video bandwidth:	3MHz
Trace-Mode:	Max hold

Limits

FCC	IC
Antenna Gain	
6 dBi	

Results

T_{nom}	V_{nom}	Lowest Channel 2412 MHz	Middle Channel 2437 MHz	Highest Channel 2462 MHz
Conducted power [dBm] Measured with DSSS modulation		9.612	9.515	8.990
Radiated power [dBm] Measured with DSSS modulation		9.059	10.121	9.344
Gain [dBi] Calculated		-0.553	0.606	0.354
Measurement uncertainty		± 0.6 dB (cond.) / ± 2.56 dB (rad.)		

5 Test Setup Photos of the EUT

Please refer to separated files for Test Setup Photos of the EUT.

6 External Photos of the EUT

Please refer to separated files for External Photos of the EUT.

7 Internal Photos of the EUT

Please refer to separated files for Internal Photos of the EUT.

.....End of Report.....