ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Applicant:	CASTLES TECHNOLOGY CO., LTD. 6F, NO. 207-5, SEC. 3, BEIXIN RD., XINDIAN DISTRICT, NEW TAIPEI CITY 23143, TAIWAN (R. O. C.)
Product Name:	Mobile POS
Brand Name:	CASTLES TECHNOLOGY
Model No.:	MP200
Model Difference:	N/A
Report Number:	E2/2018/50097
FCC ID:	WIYMP200SERIES
FCC Rule Part:	§15.247, Cat: DTS
Issue Date:	Jul. 13, 2018
Date of Test:	May 31, 2018~ Jul. 05, 2018
Date of EUT Received:	May 31, 2018

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.
The test results of this report relate only to the tested sample identified in this report.

Tested By: Aken Huang

Aken Huang / Engineer

Approved By: Jim Chang

Jim Chang / Manager

Testing Laboratory
0513

Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
E2/2018/50097	Rev.00	Initial creation of document	All	Jul. 13, 2018	Stefanie Yu / Clerk

Contents

1 GENERAL INFORMATION

1.1 Product description

General:

Product Name:	Mobile POS	
Brand Name:	CASTLES TECHNOLOGY	
Model No.:	MP200	
Model Difference:	N/A	
Hardware Version:	MP200-HW-v1.05	
Software Version:	001x-001x-002x-002x-0027	
Test SW Version:	N/A	
RF power setting in TEST SW:	N/A	
Power Supply:	3.75V from rechargeable Li-ion battery or 5V from AC Adapter	
	Battery:	Model No.: MP200, Supplier: KAYO BATTERY CO., LTD.
	Adapter:	Model No.: 1A81-UB, Supplier: Lucent Trans Electronics Co., Ltd.

WLAN 2.4GHz:

Wi-Fi	Frequency Range	Channels	Rated Power	Modulation Technology
11b/g	2412-2462	11	b: 18.53dBm g: 24.93dBm	DSSS, OFDM
11n	HT20 2412-2462	11	23.78dBm	OFDM
Modulation type:		CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM		
Antenna Designation:		PIFA Antenna, Gain: -0.61dBi		
Transition Rate:		802.11 b: 1/2/5.5/11 Mbps 802.11 g: 6/9/12/18/24/36/48/54 Mbps 802.11 n_20MHz: 6.5 – 72.2 Mbps		

1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

KDB 558074 D01 DTS Meas. Guidance v04

ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards

1.3 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803

(TAF code 0513)

FCC Registration Numbers are: 509634 / TW0001

1.4 Special Accessories

There are no special accessories used while test was conducted.

1.5 Equipment Modifications

There was no modification incorporated into the EUT.

2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz,. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Radiated Emissions

The EUT is a placed on as turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.

2.4 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

Note:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission & Conducted (Antenna Port) Emission

Fig. 2-2 AC Power Line Conducted Emission

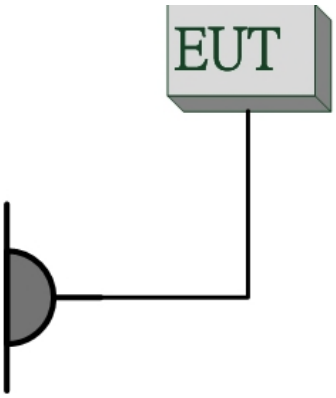


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	WLAN Test Software	N/A	N/A	N/A	N/A	N/A

3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	Peak Output Power	Compliant
§15.247(a)(2)	6dB Emission Bandwidth	Compliant
§15.247(d)	Conducted Band Edge and Spurious Emission	Compliant
§15.247(d)	Radiated Band Edge and Spurious Emission	Compliant
§15.247(e)	Power Spectral Density	Compliant
§15.203 §15.247(b)	Antenna Requirement	Compliant

4 DESCRIPTION OF TEST MODES

4.1 Operated in 2400 ~ 2483.5MHz Band

11 channels are provided for 802.11b, 802.11g and 802.11n_HT20

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
1	2412 MHz	8	2447 MHz
2	2417 MHz	9	2452 MHz
3	2422 MHz	10	2457 MHz
4	2427 MHz	11	2462 MHz
5	2432 MHz		
6	2437 MHz		
7	2442 MHz		

4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case.

RADIATED EMISSION TEST:

RADIATED EMISSION TEST (BELOW 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11g	1 to 11	1, 6, 11	OFDM	6	Main
RADIATED EMISSION TEST (ABOVE 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11b	1 to 11	1, 6, 11	DSSS	1	Main
802.11g	1 to 11	1, 6, 11	OFDM	6	Main
802.11n (HT20)	1 to 11	1, 6, 11	OFDM	MCS 0	Main

Note:

The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for 802.11b/g/n WLAN Transmitter for channel Low, Mid and High, the worst case E1 position was reported.

ANTENNA PORT CONDUCTED MEASUREMENT:

CONDUCTED TEST					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11b	1 to 11	1, 6, 11	DSSS	1	Main
802.11g	1 to 11	1, 6, 11	OFDM	6	Main
802.11n (HT20)	1 to 11	1, 6, 11	OFDM	MCS 0	Main

5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 0.84 dB
6dB Bandwidth	+/- 51.33 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 0.84 dB
Peak Power Density	+/- 1.3 dB
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty (Polarization : **Vertical**)	9kHz-30MHz: +/-2.87dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

Measurement uncertainty (Polarization : **Horizontal**)	9kHz-30MHz: +/-2.87dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

6 CONDUCTED EMISSION TEST

6.1 Standard Applicable

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

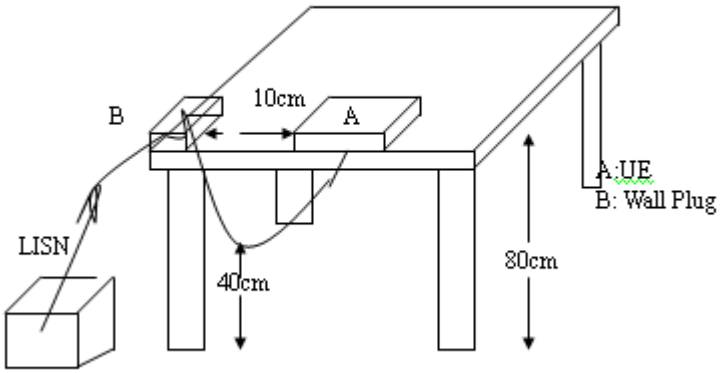
6.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LISN	TESEQ	NNB 51	36076	2018/02/14	2019/2/13
EMI Test Receiver	R&S	ESCI	101300	2017/11/02	2018/11/1
Notebook	Lenovo	L420	S0012467	N/A	N/A

6.3 EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

6.6 Measurement Result

Note: Refer to next page for measurement data and plots.

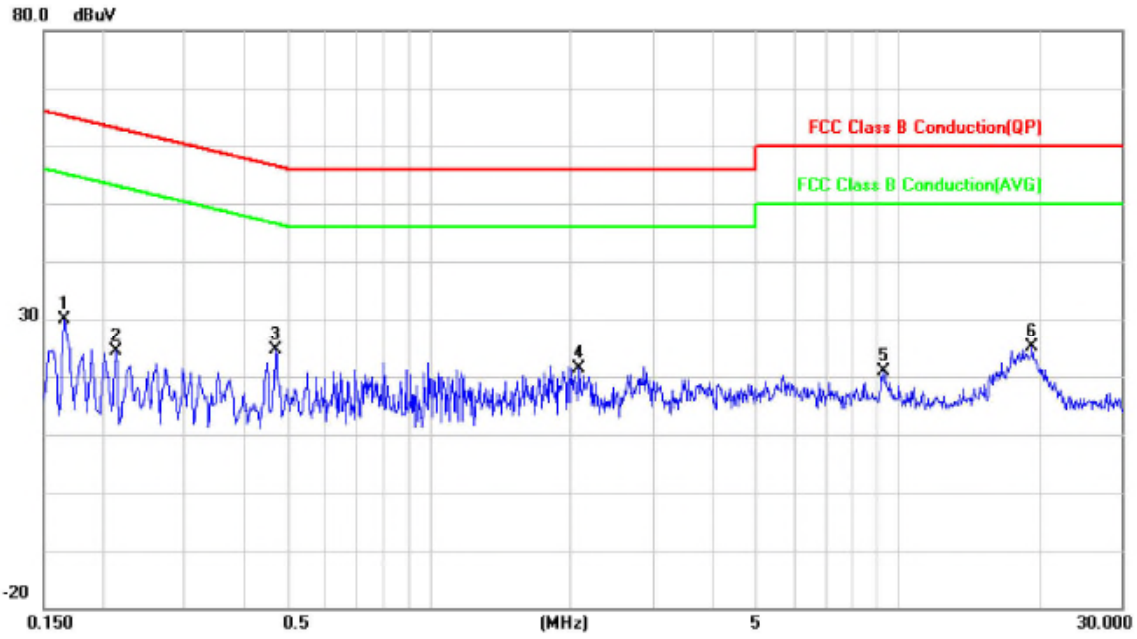
Note2: The * reveals the worst-case results that closet to the limit.

AC POWER LINE CONDUCTED EMISSION TEST DATA

Site :	Conduction Room	Phase:	*L1*	Temperature:	25 ℃
Limit:	FCC Class B Conduction(QP)	Power:	AC 120V/60Hz	Humidity:	65 %
Mode:					
Note:					

Conducted Emission

File :Condution Data :#981 Date: 2018/7/2 Time: 上午 08:55:53

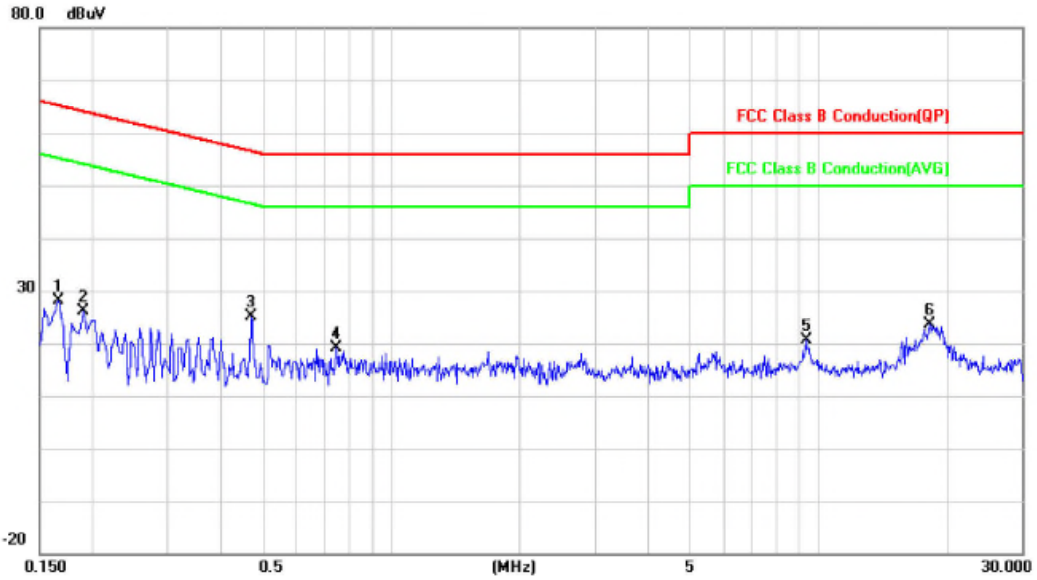


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1660	20.18	9.70	29.88	65.16	-35.28	peak	
2		0.2140	14.60	9.73	24.33	63.05	-38.72	peak	
3	*	0.4700	14.40	10.16	24.56	56.51	-31.95	peak	
4		2.0900	10.79	10.57	21.36	56.00	-34.64	peak	
5		9.3220	10.95	9.91	20.86	60.00	-39.14	peak	
6		19.3500	15.17	9.90	25.07	60.00	-34.93	peak	

Site :	Conduction Room	Phase:	*N*	Temperature:	25 ℃
Limit:	FCC Class B Conduction(QP)	Power:	AC 120V/60Hz	Humidity:	65 %
Mode:					
Note:					

Conducted Emission

File :Condution Data :#982 Date: 2018/7/2 Time: 上午 08:57:02



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1660	18.52	9.70	28.22	65.16	-36.94	peak	
2		0.1900	16.51	9.70	26.21	64.04	-37.83	peak	
3	*	0.4700	15.03	10.16	25.19	56.51	-31.32	peak	
4		0.7460	9.02	10.03	19.05	56.00	-36.95	peak	
5		9.3700	10.66	9.91	20.57	60.00	-39.43	peak	
6		18.2740	13.70	9.90	23.60	60.00	-36.40	peak	

7 DUTY CYCLE OF TEST SIGNAL

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle.

All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

Formula:

Duty Cycle = Ton / (Ton+Toff)

Measurement Procedure:

1. Set span = Zero
2. RBW = 8MHz
3. VBW = 8MHz,
4. Detector = Peak

Duty Cycle:

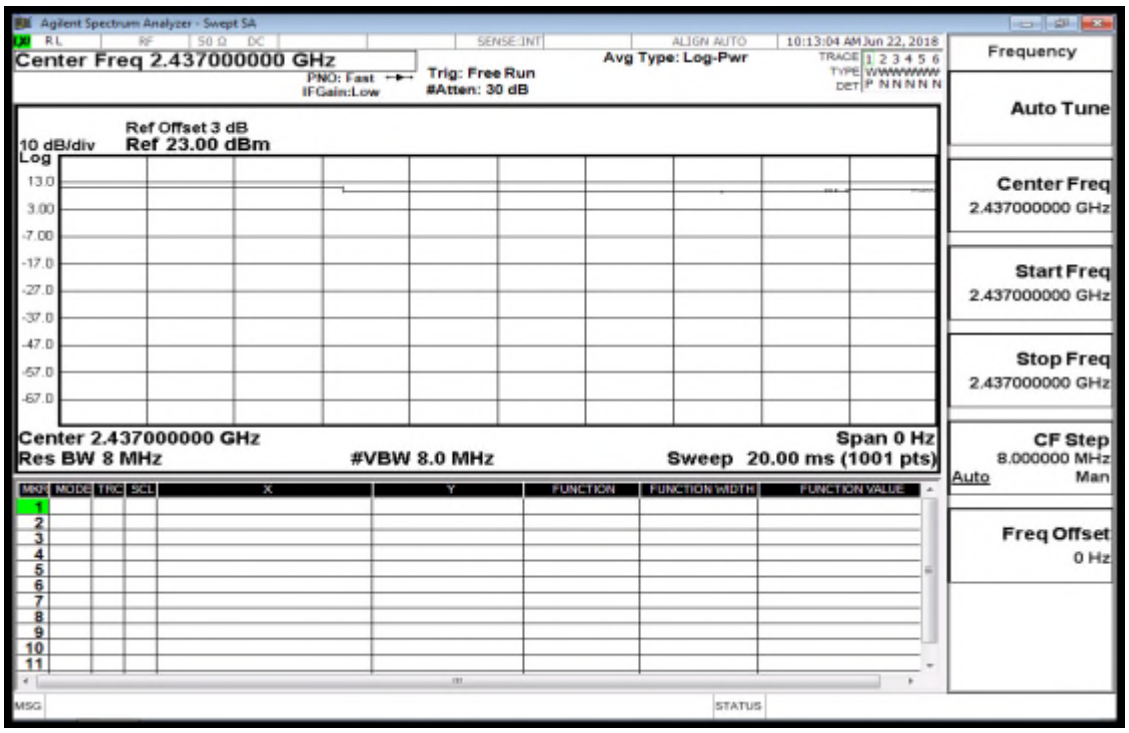
	Duty Cycle (%)	Duty Factor (dB)	1/T (kHz)	VBW setting (kHz)
802.11b	100.00	0.00	0.05	1.00
802.11g	97.94	0.09	0.70	1.00
802.11n_20	97.76	0.10	0.75	1.00

b = 100%, g = 97.94%,n_ht_20 = 97.76%

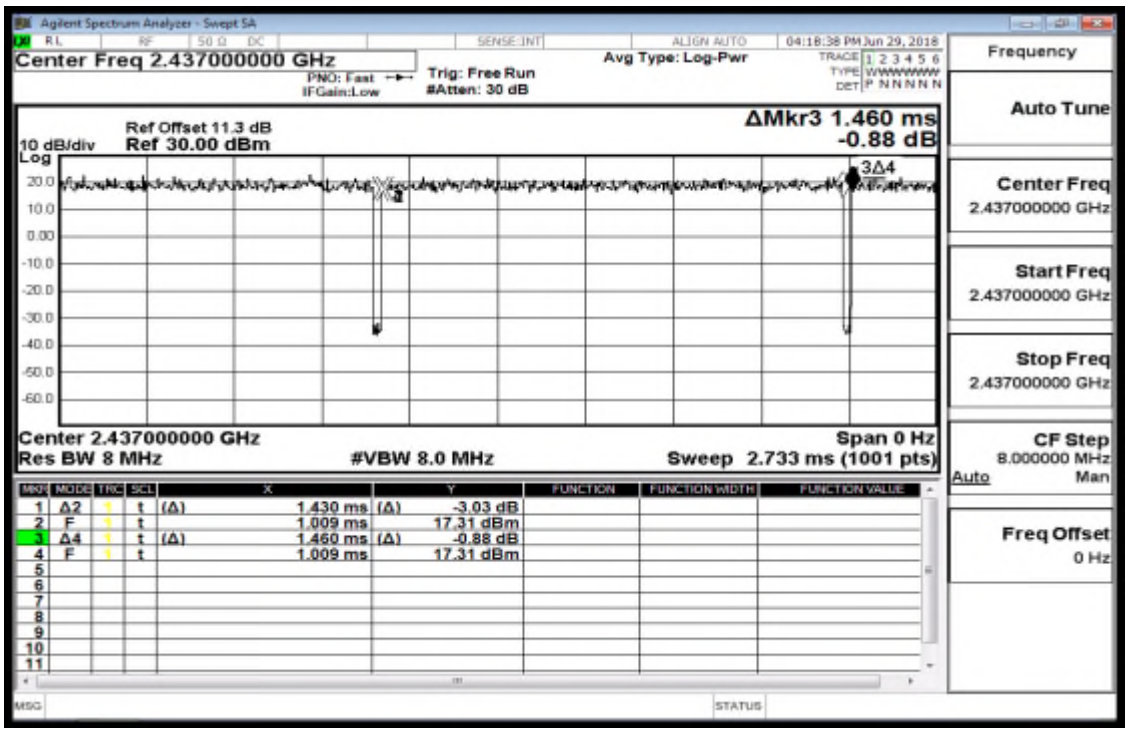
Duty Cycle Factor: 10 * log(1/1) = 0
Duty Cycle Factor: 10 * log(1/0.9794) = 0.09
Duty Cycle Factor: 10 * log(1/0.9776) = 0.1

7.1 Duty Cycle Test Signal Measurement Result

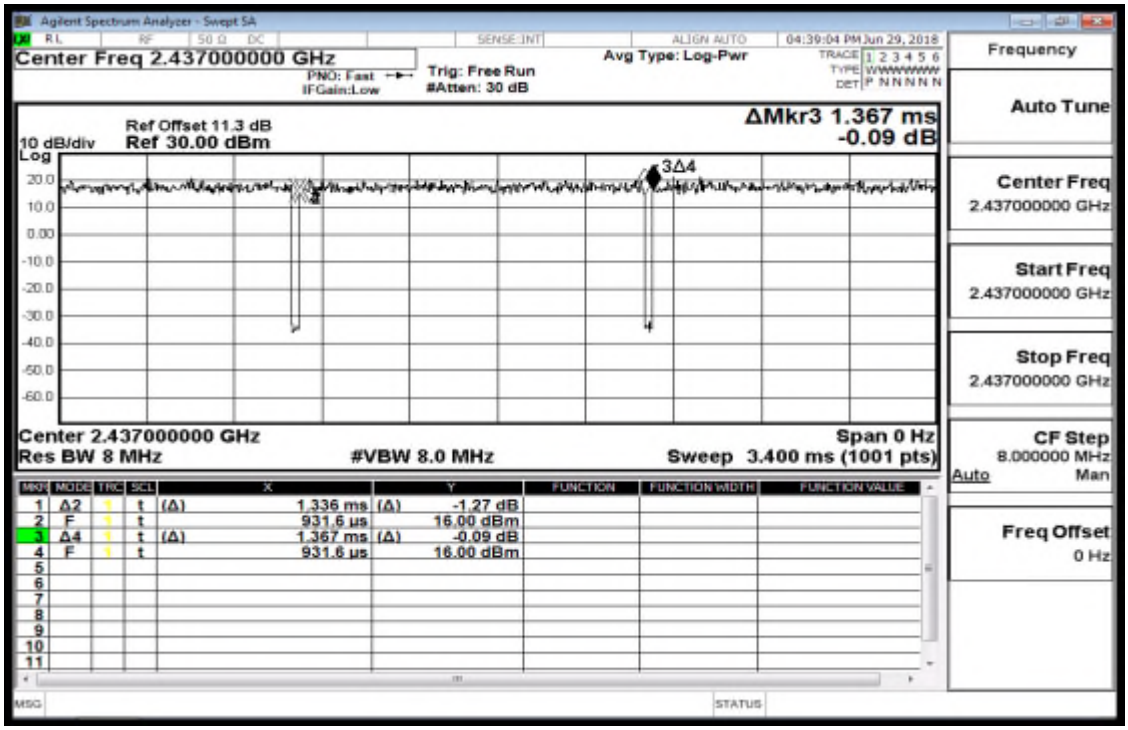
802.11 b



802.11 g



802.11 n_20 MHz



8 PEAK OUTPUT POWER MEASUREMENT

8.1 Standard Applicable

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt.

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

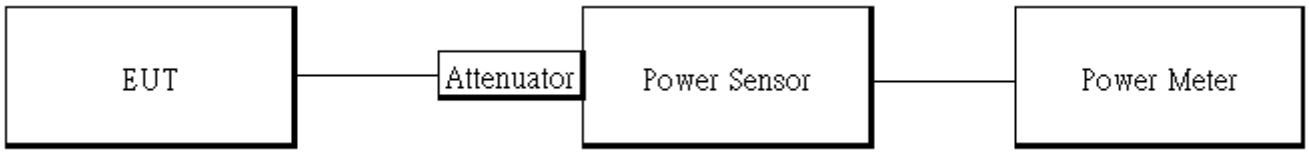
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

Frequency (MHz)	Effective Legacy Gain (dBi)	Conducted Power Limit (dBm)
2412~2462	-0.61	30

8.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1326001	2017/07/26	2018/7/25
Power Sensor	Anritsu	MA2411B	1315048	2017/07/26	2018/7/25
Power Sensor	Anritsu	MA2411B	1315049	2017/07/26	2018/7/25
Attenuator	Marvelous	MVE2213-10	RF30	2017/12/26	2018/12/25
Spectrum Analyzer	Agilent	N9010A	MY51440113	2018/06/20	2019/6/19
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	2017/12/26	2018/12/25

8.3 Test Set-up



8.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.

   Power Meter:

   It is used as the auxiliary test equipment to conduct the output power measurement.
4. Record the max. Reading as observed from Spectrum or Power Meter.

8.5 Measurement Result

802.11b Main								
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit				RESULT
1	2412	1	18.28	1 Watt =	30.00	dBm		PASS
6	2437	1	**18.53**	1 Watt =	30.00	dBm		PASS
11	2462	1	18.14	1 Watt =	30.00	dBm		PASS
802.11b Main								
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit				RESULT
1	2412	1	15.23	1 Watt =	30.00	dBm		PASS
6	2437	1	**15.45**	1 Watt =	30.00	dBm		PASS
11	2462	1	15.17	1 Watt =	30.00	dBm		PASS

802.11g Main								
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit				RESULT
1	2412	6	24.75	1 Watt =	30.00	dBm		PASS
6	2437	6	24.55	1 Watt =	30.00	dBm		PASS
11	2462	6	**24.93**	1 Watt =	30.00	dBm		PASS
802.11g Main								
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit				RESULT
1	2412	6	14.63	1 Watt =	30.00	dBm		PASS
6	2437	6	**14.71**	1 Watt =	30.00	dBm		PASS
11	2462	6	14.69	1 Watt =	30.00	dBm		PASS

802.11n_HT20M Main							
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit			RESULT
1	2412	MCS0	23.44	1 Watt =	30.00	dBm	PASS
6	2437	MCS0	**23.78**	1 Watt =	30.00	dBm	PASS
11	2462	MCS0	23.55	1 Watt =	30.00	dBm	PASS
802.11n_HT20M Main							
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit			RESULT
1	2412	MCS0	**13.49**	1 Watt =	30.00	dBm	PASS
6	2437	MCS0	13.45	1 Watt =	30.00	dBm	PASS
11	2462	MCS0	13.37	1 Watt =	30.00	dBm	PASS

**** Note: The duty cycle factor is compensated to obtain the maximum value of measurement in average.***

9 6DB BANDWIDTH MEASUREMENT

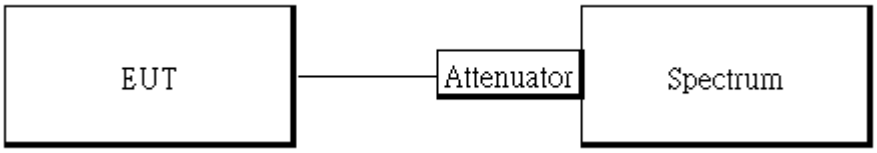
9.1 Standard Applicable

The minimum 6 dB bandwidth shall be at least 500 kHz.

9.2 Measurement Equipment Used

Refer to section 8.2 for details.

9.3 Test Set-up



9.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. For 6dB Bandwidth:

   Set the spectrum analyzer as RBW = 100 kHz, VBW = 3*RBW, Span = 30M/50MHz, Detector=peak, Sweep=auto.
5. Mark the peak frequency and –6dB (upper and lower) frequency.
6. Repeat above procedures until all frequency of interest measured was complete.

9.5 Measurement Result

802.11b Main

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	**8075**	> 500	PASS
2437	7593	> 500	PASS
2462	8074	> 500	PASS

802.11g Main

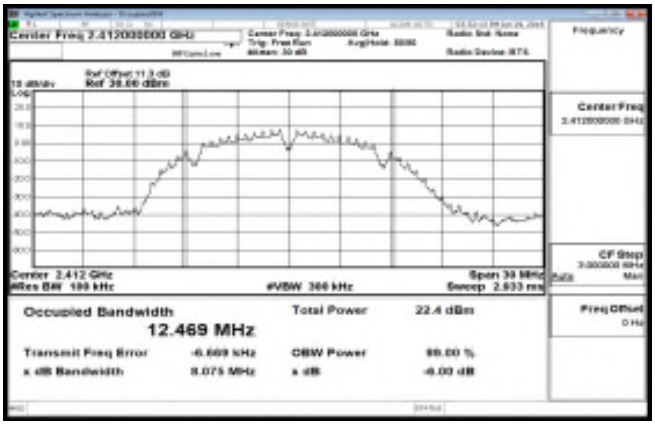
Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	**15355**	> 500	PASS
2437	15134	> 500	PASS
2462	15346	> 500	PASS

802.11_n_HT20 Main

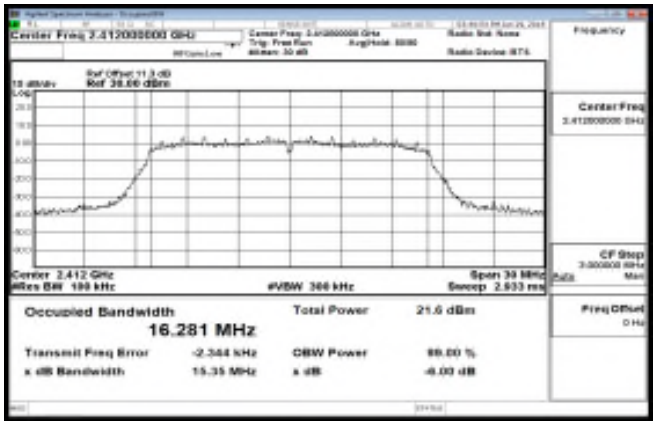
Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	**15143**	> 500	PASS
2437	15142	> 500	PASS
2462	15135	> 500	PASS

Refer to next page for plots

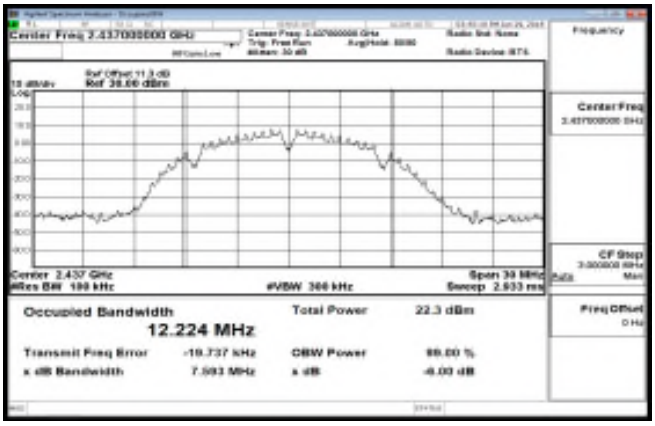
802.11b (Main) CH-Low



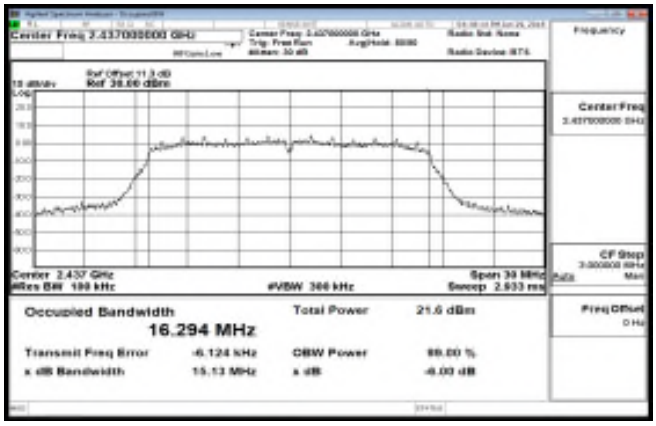
802.11g (Main) CH-Low



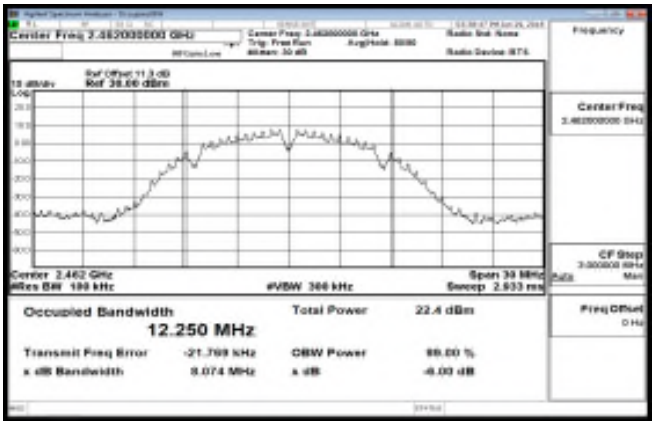
802.11b (Main) CH-Mid



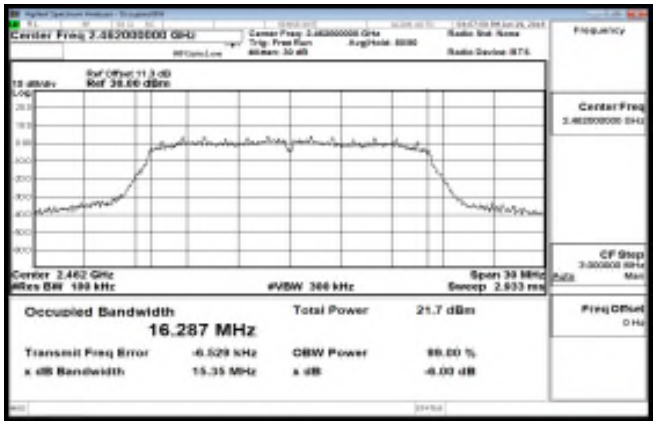
802.11g (Main) CH-Mid



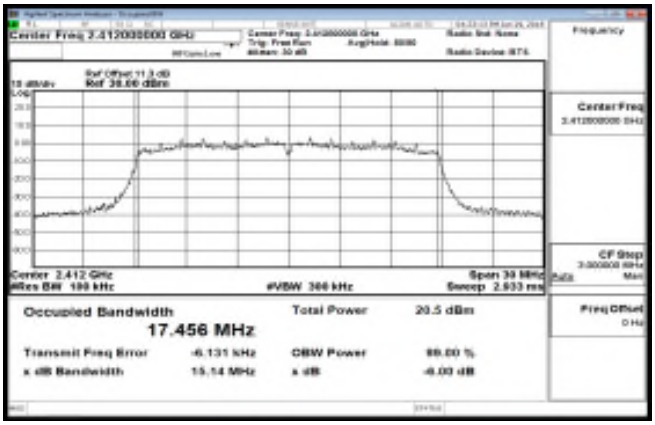
802.11b (Main) CH-High



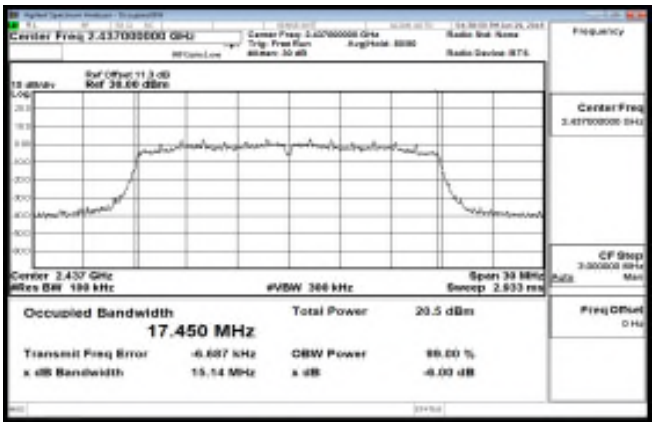
802.11g (Main) CH-High



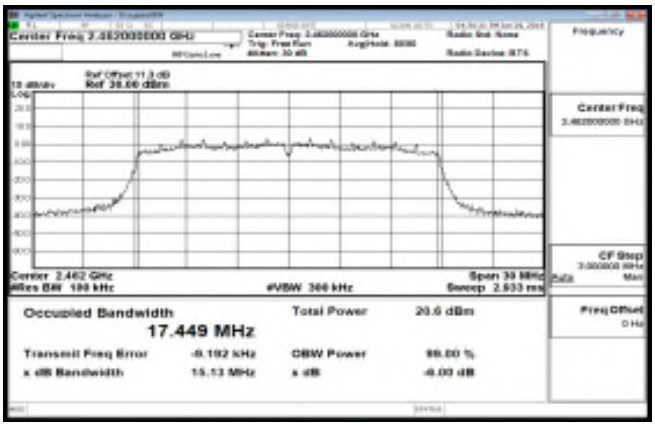
802.11n_20M (Main) CH-Low



802.11n_20M (Main) CH-Mid



802.11n_20M (Main) CH-High



10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

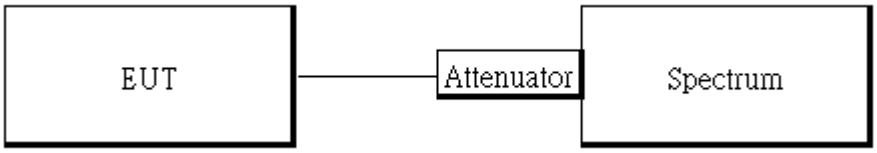
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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.

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).

10.2 Measurement Equipment Used

Refer to section 8.2 for details.

10.3 Test SET-UP



10.4 Measurement Procedure

Reference Level of Emission Calculation:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 100kHz & VBW = 300 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
   Use the peak marker function to determine the maximum amplitude level.

Conducted Band Edge:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
6. Mark the highest reading of the emission as the reference level measurement.
7. Set DL as the limit = reading on marker 1 – 20dBm
8. Marker on frequency, 2.3999GHz and 2.4836GHz, and examine shall 100 kHz immediately outside the authorized (2400~2483.5) be attenuated by 20dB at least relative to the maximum emission of power.
9. Repeat above procedures until all default test channel (low, middle, and high) was complete.

Conducted Spurious Emission:

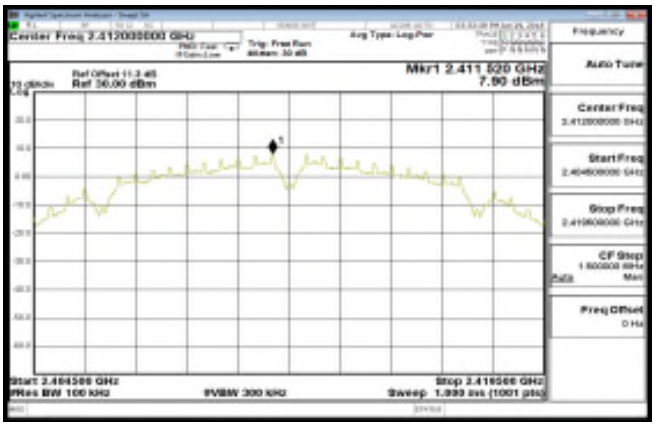
1. To connect Antenna Port of EUT to Spectrum
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set RBW = 100 kHz & VBW= 300 kHz, Detector =Peak, Sweep = Auto.
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.

10.5 Measurement Result:

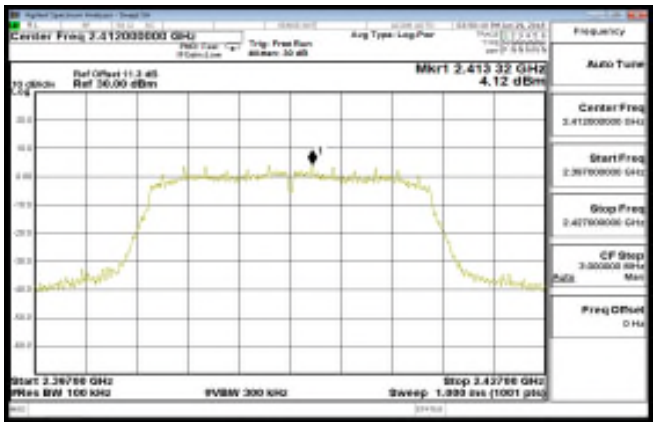
Reference Level of Limit 802.11b mode			Reference Level of Limit 802.11g mode		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)	Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	7.90	-12.10	2412	4.12	-15.88
2462	7.86	-12.14	2462	4.07	-15.93

Reference Level of Limit 802.11n20 mode		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	2.93	-17.07
2462	2.94	-17.06

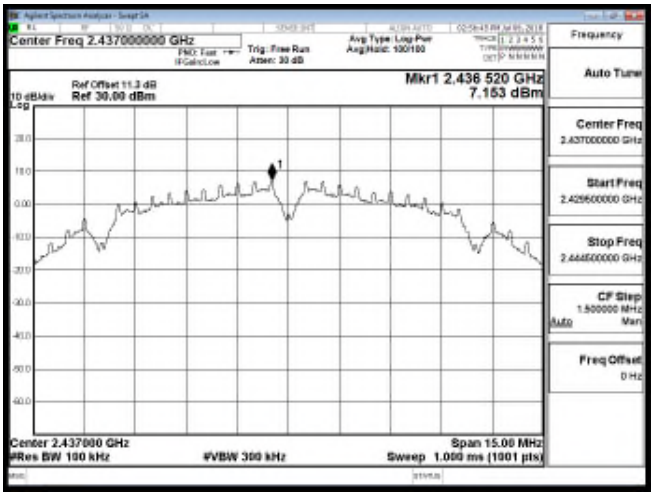
802.11b Reference Level of Emission Limit (CH-Low)



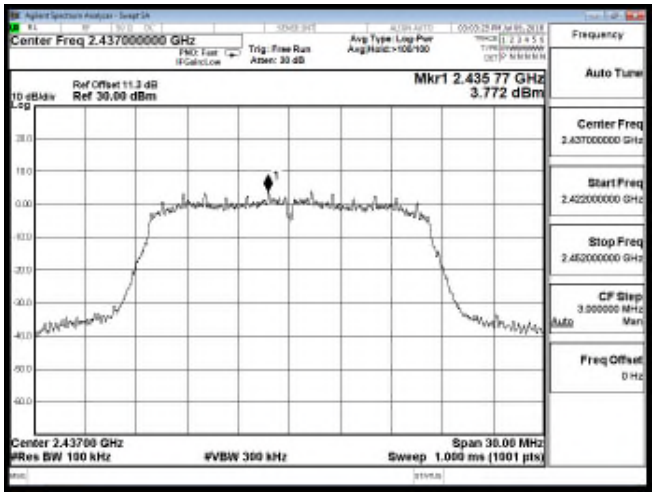
802.11g Reference Level of Emission Limit(CH-Low)



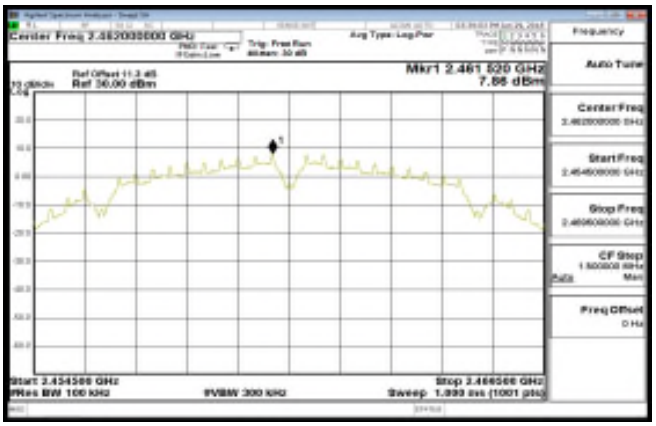
802.11b Reference Level of Emission Limit(CH-Mid)



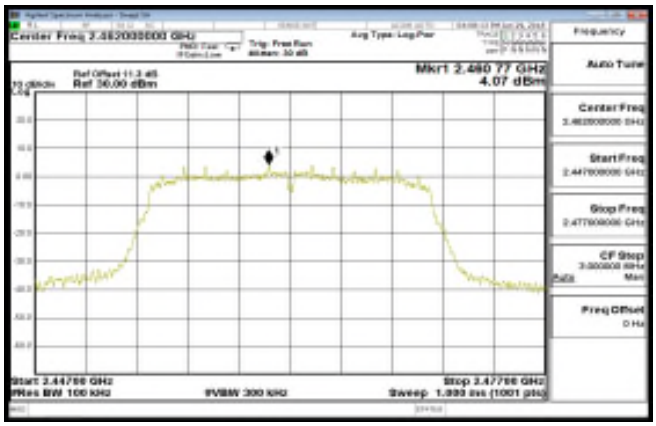
802.11g Reference Level of Emission Limit(CH-Mid)



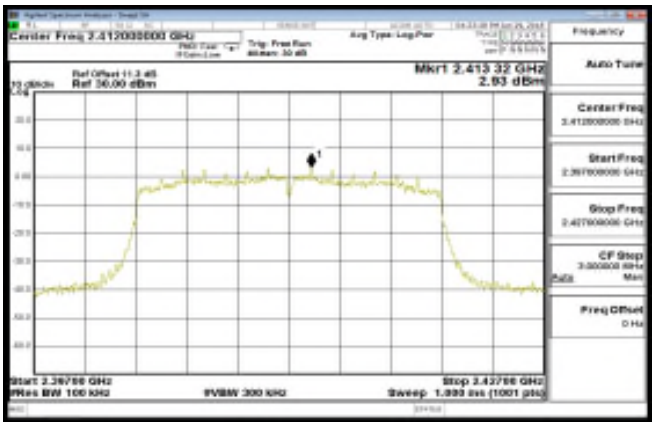
802.11b Reference Level of Emission Limit(CH-High)



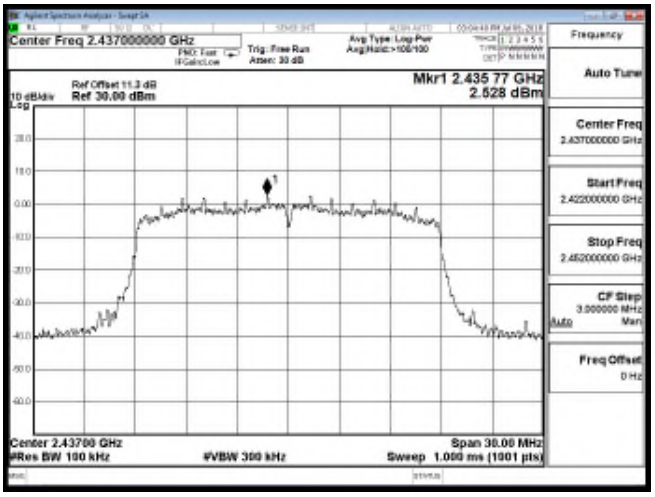
802.11g Reference Level of Emission Limit(CH-High)



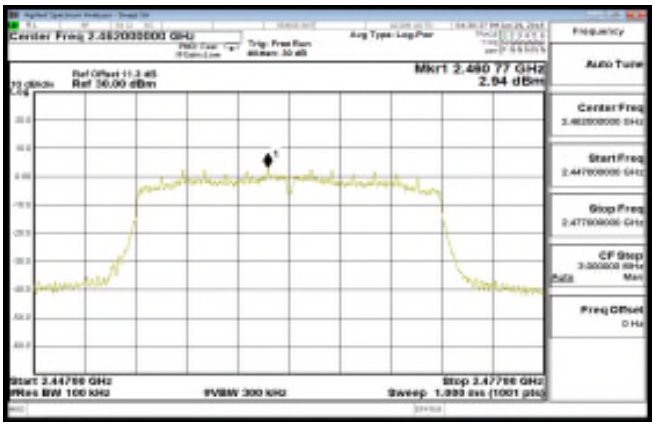
802.11n_HT20 Reference Level of Emission Limit(CH-Low)



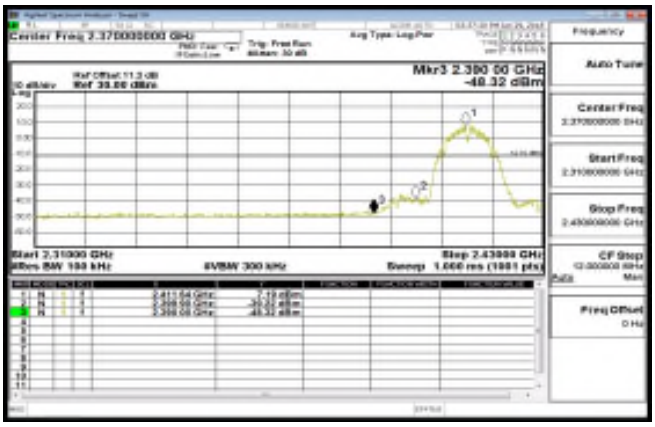
802.11n_HT20 Reference Level of Emission Limit(CH-Mid)



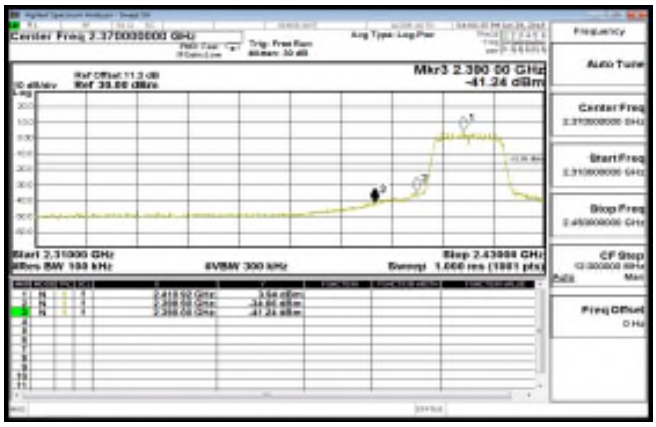
802.11n_HT20 Reference Level of Emission Limit(CH-High)



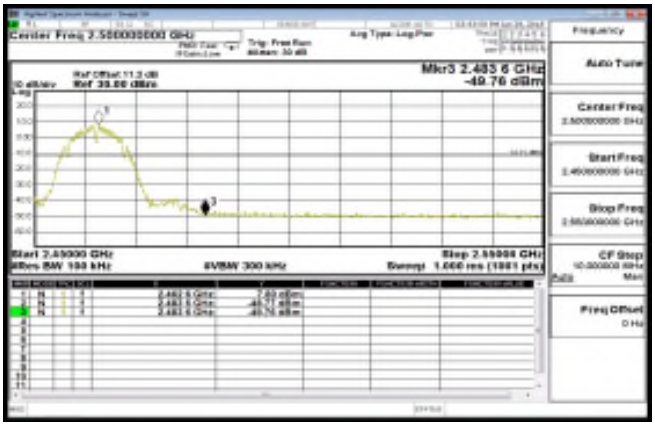
802.11b: Band Edges Test Data CH-Low



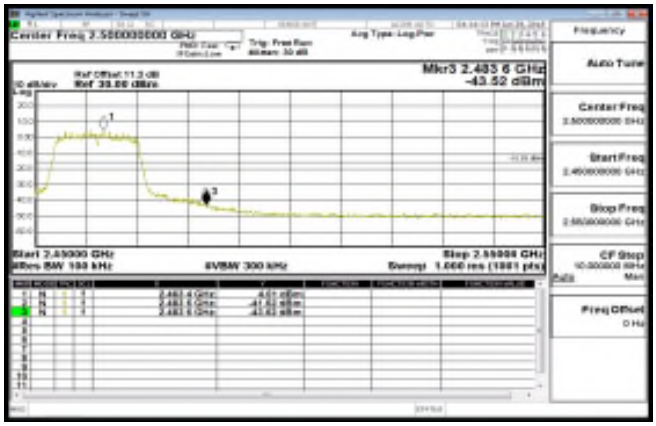
802.11g: Band Edges Test Data CH-Low



802.11b: Band Edges Test Data CH-High

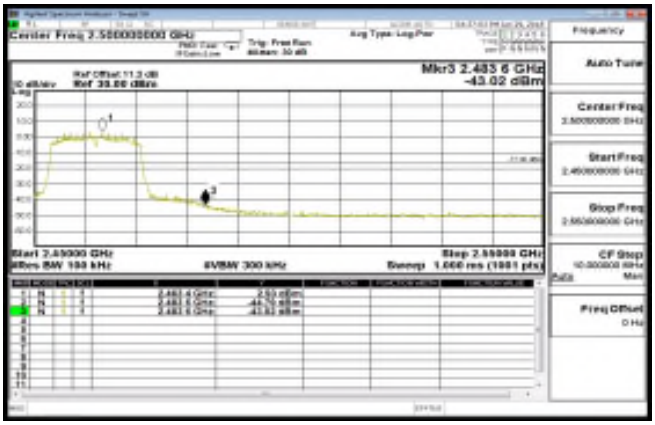


802.11g: Band Edges Test Data CH-High

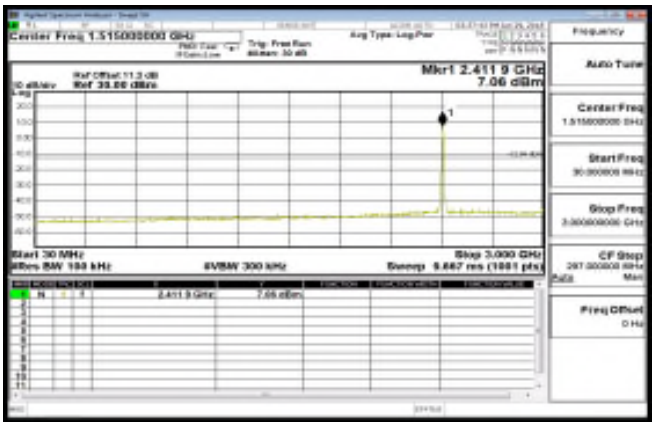


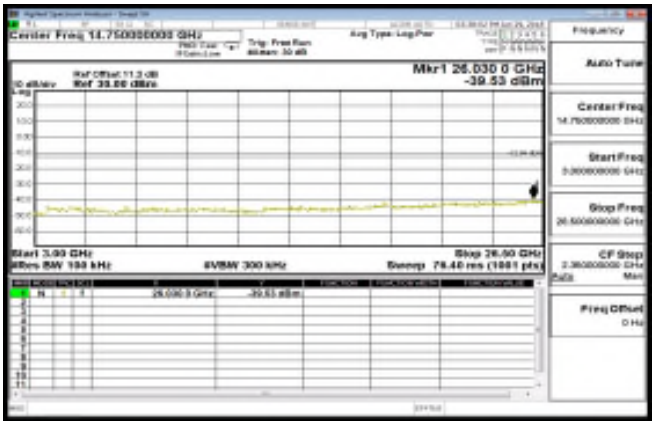
802.11n_HT20: Band Edges Test Data CH-Low

802.11n_HT20: Band Edges Test Data CH-High

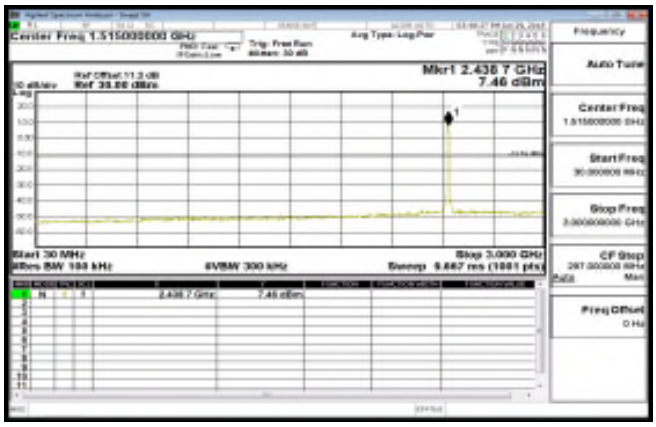


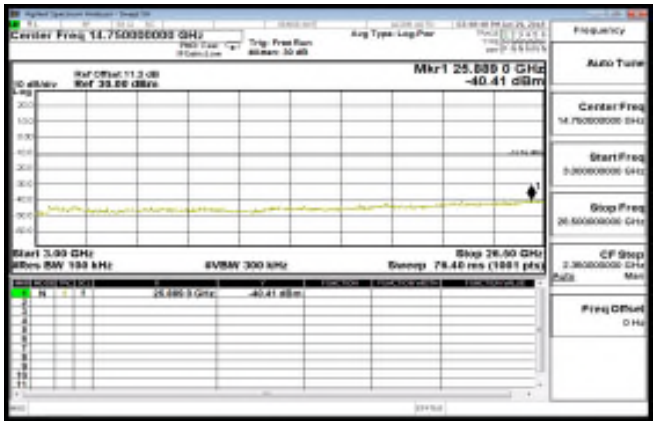
802.11b: Spurious Emission Test Data CH-Low



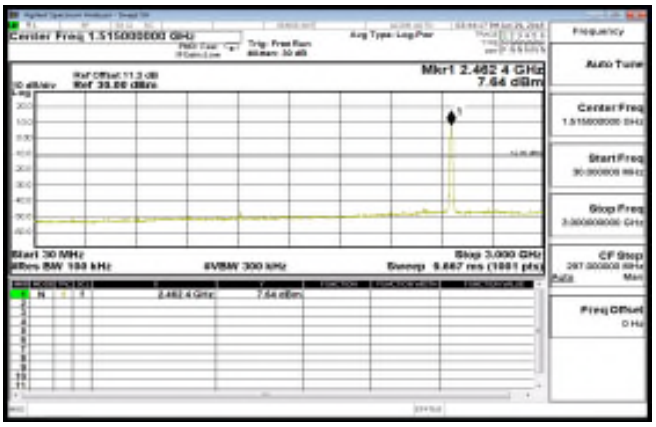


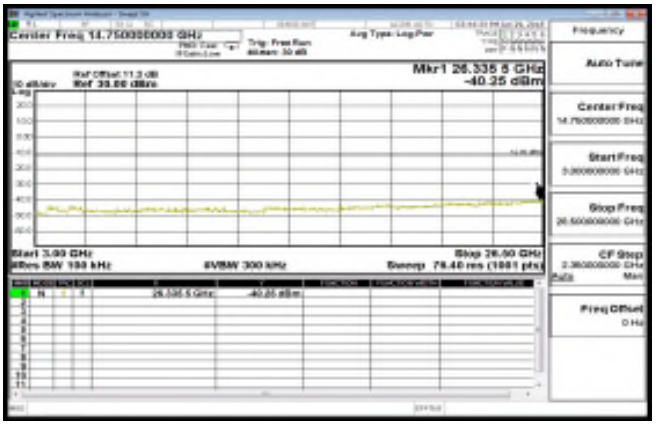
802.11b: Spurious Emission Test Data CH-Mid



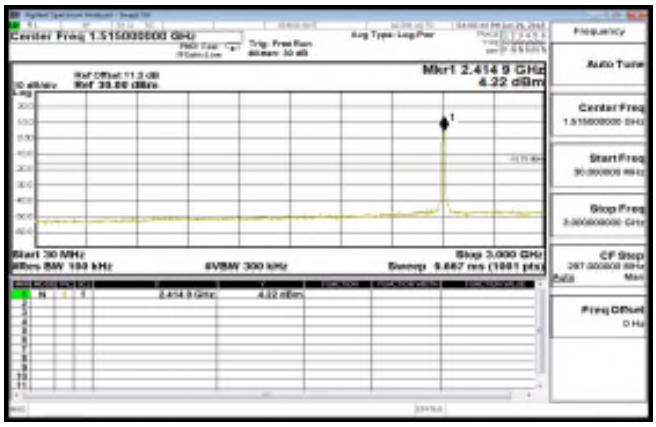


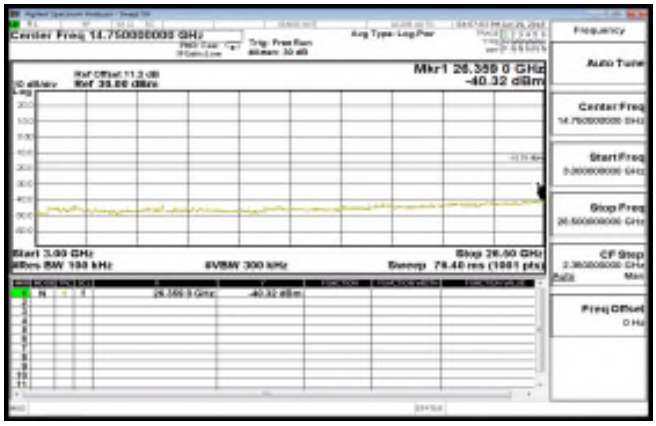
802.11b: Spurious Emission Test Data CH-High



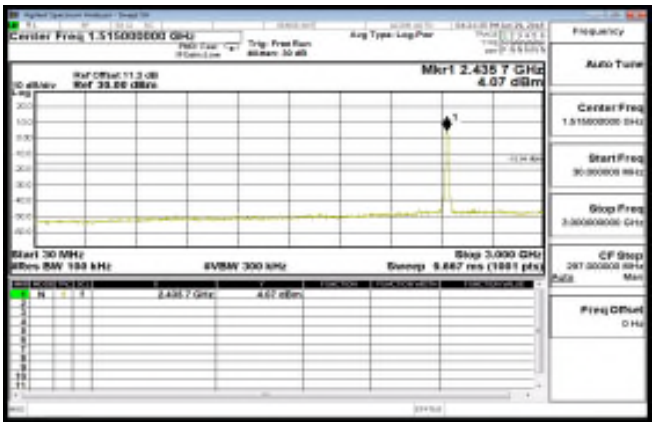


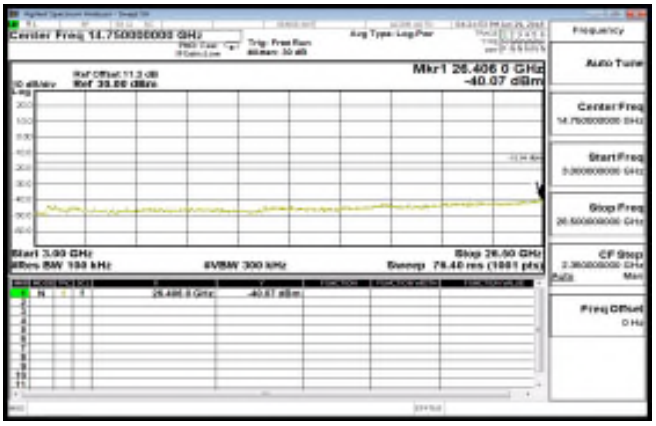
802.11g: Spurious Emission Test Data CH-Low



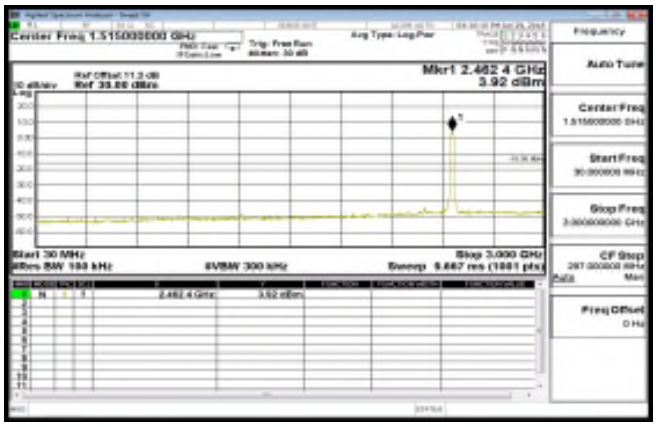


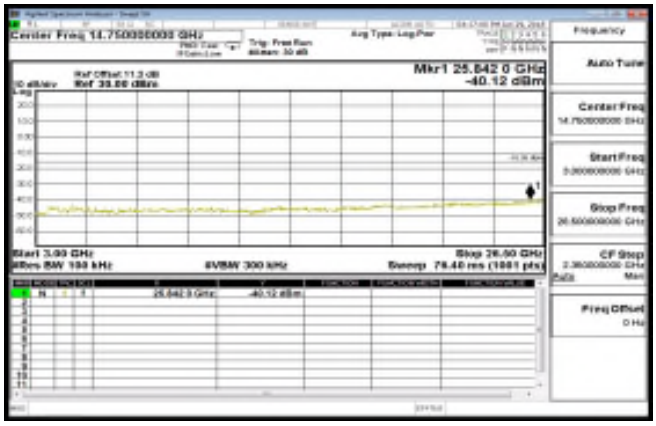
802.11g: Spurious Emission Test Data CH-Mid



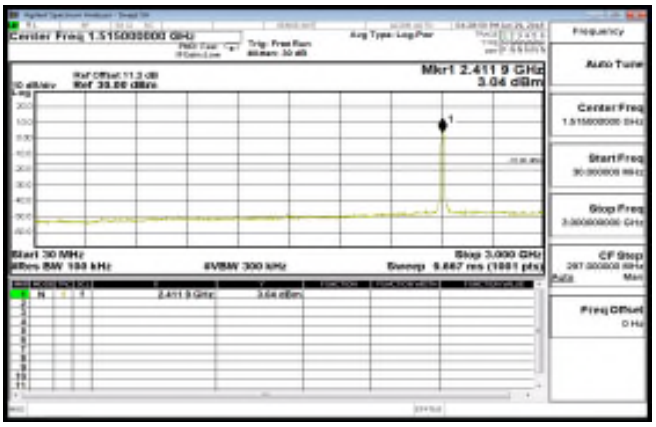


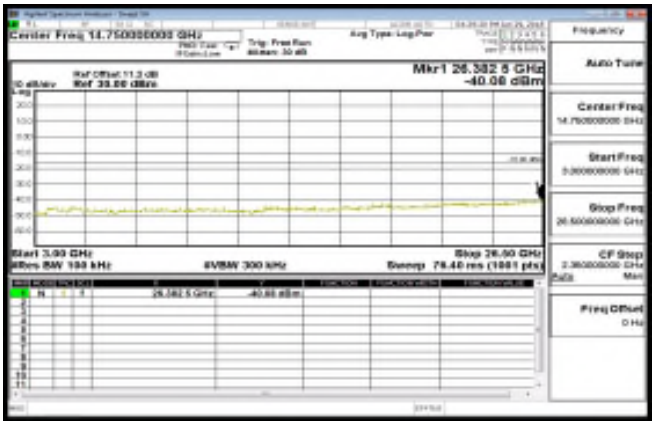
802.11g: Spurious Emission Test Data CH-High



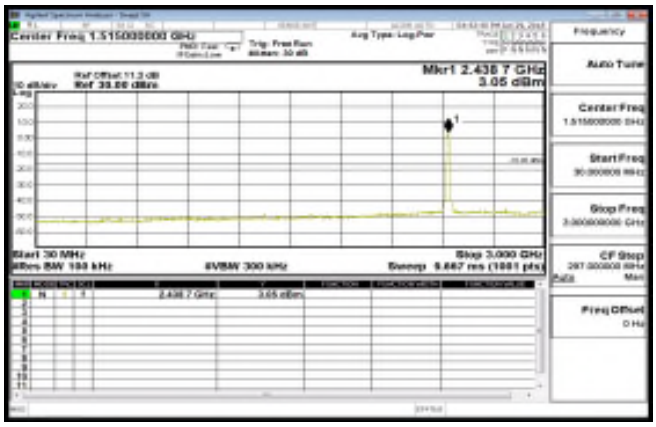


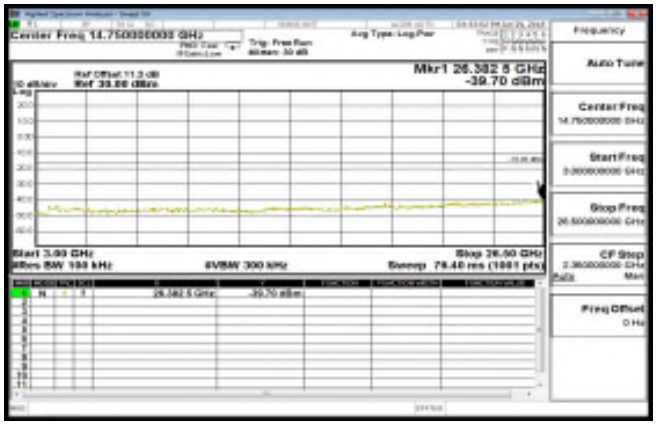
802.11n_HT20: Spurious Emission Test Data CH-Low



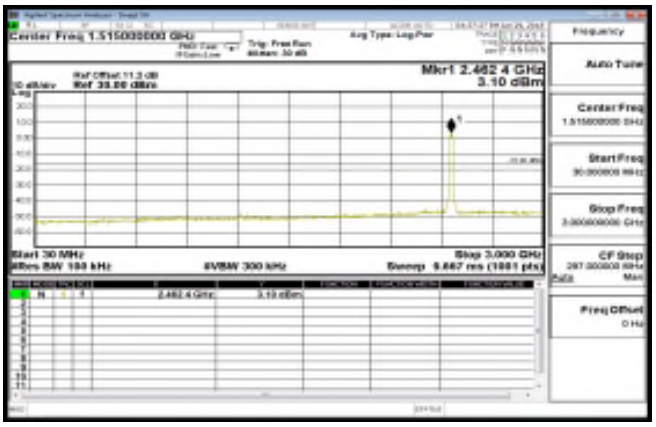


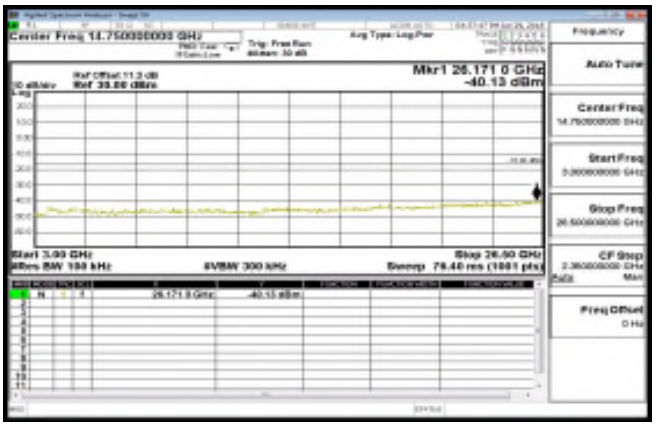
802.11n_HT20: Spurious Emission Test Data CH-Mid





802.11n_HT20: Spurious Emission Test Data CH-High





11 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

11.1 Standard Applicable

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. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.

And according to §15.33(a) (1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (dBμV/m)

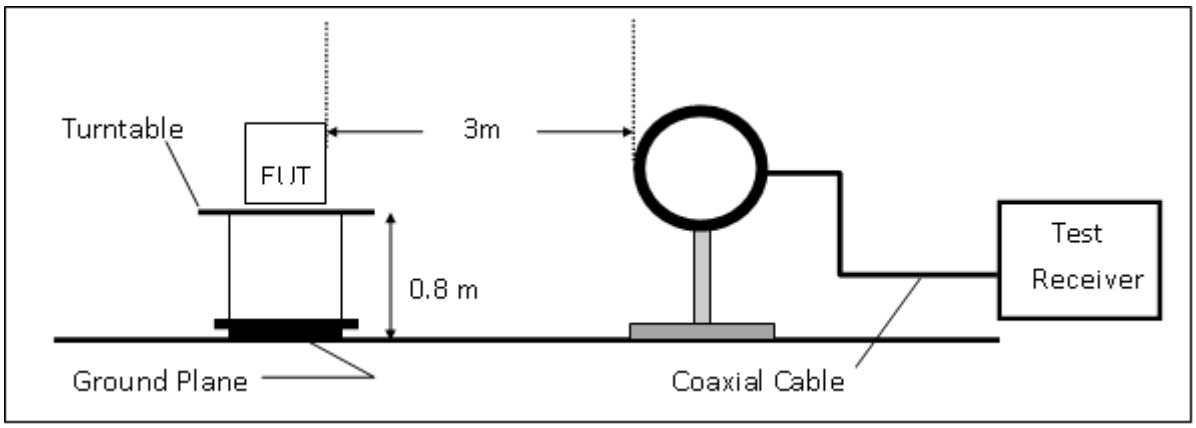
11.2 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	SCHWAZBECK	VULB 9168	9168-617	2017/10/27	2018/10/26
Horn Antenna	Schwarzbeck	BBHA9120D	1341	2018/06/07	2019/6/6
Loop Antenna	ETS.LINDGREN	6502	148045	2017/09/26	2018/9/25
3m Site NSA	SGS	966 chamber D	N/A	2018/07/06	2019/7/5
EMI Test Receiver	R&S	ESU 40	100363	2018/04/11	2019/4/10
Pre-Amplifier	EMC Instruments	EMC184045B	980135	2017/10/27	2018/10/26
Pre-Amplifier	EMC Instruments	EMC9135	980234	2017/12/26	2018/12/25
Pre-Amplifier	EMC Instruments	EMC12630SE	980271	2017/12/26	2018/12/25
Attenuator	Marvelous	WATT-218FS-10	RF246	2017/12/26	2018/12/25
Highpass Filter	Micro Tronics	BRM50701-01	G008	2017/12/26	2018/12/25
Coaxial Cable	Huber Suhner	EMC106-SM-SM-7200	150703	2017/12/26	2018/12/25
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	2017/12/26	2018/12/25

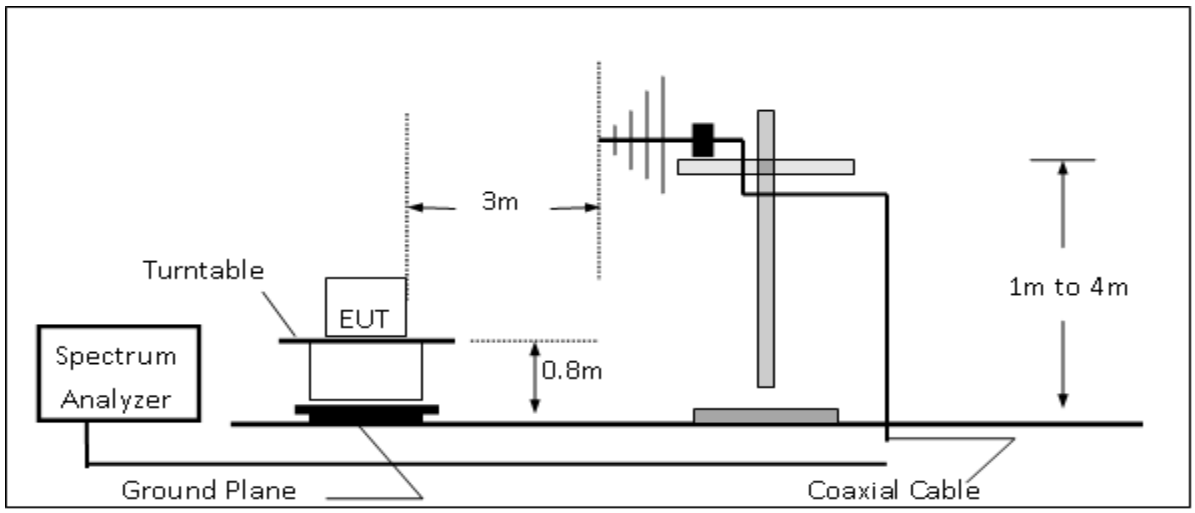
NOTE: N.C.R refers to Not Calibrated Required.

11.3 Test SET-UP

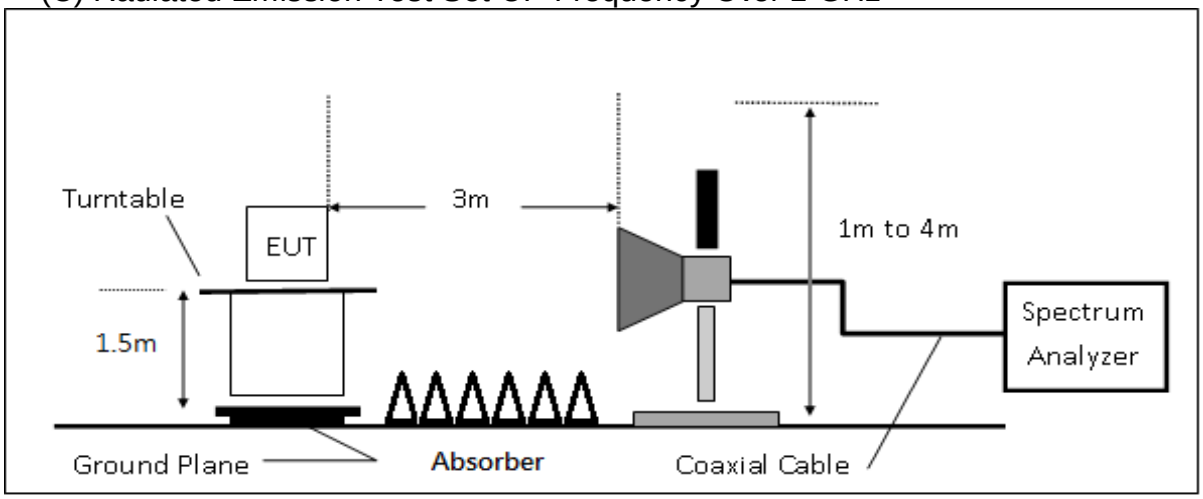
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-Up, Frequency form 30MHz to 1000MHz



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



11.4 Measurement Procedure

1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m for frequency> 1GHz above ground plane.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
6. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
7. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
8. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
9. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
10. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
11. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
12. Repeat above procedures until all default test channel measured were complete.

11.5 Field Strength Calculation

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	

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note :

"**F**" : denotes Fundamental Frequency. ; "**H**" : denotes Harmonic Frequency.

"**E**" : denotes Band Edge Frequency. ; "**S**" : denotes Spurious Frequency.

11.6 Test Results of Radiated Spurious Emissions form 9 kHz to 30 MHz

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site. And there is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

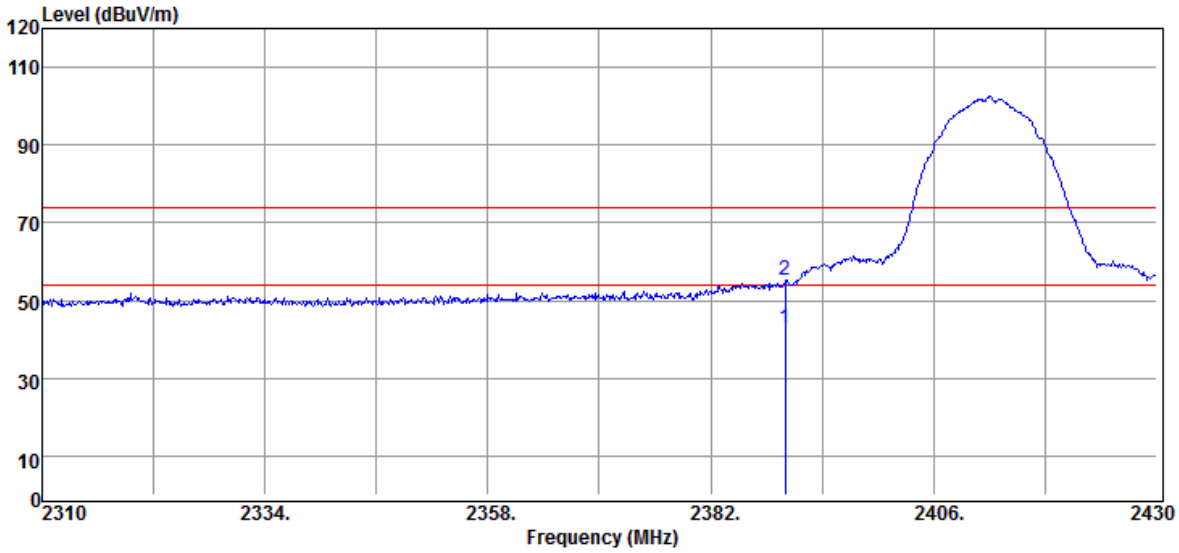
After Pre-scanned the low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

11.7 Measurement Result

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

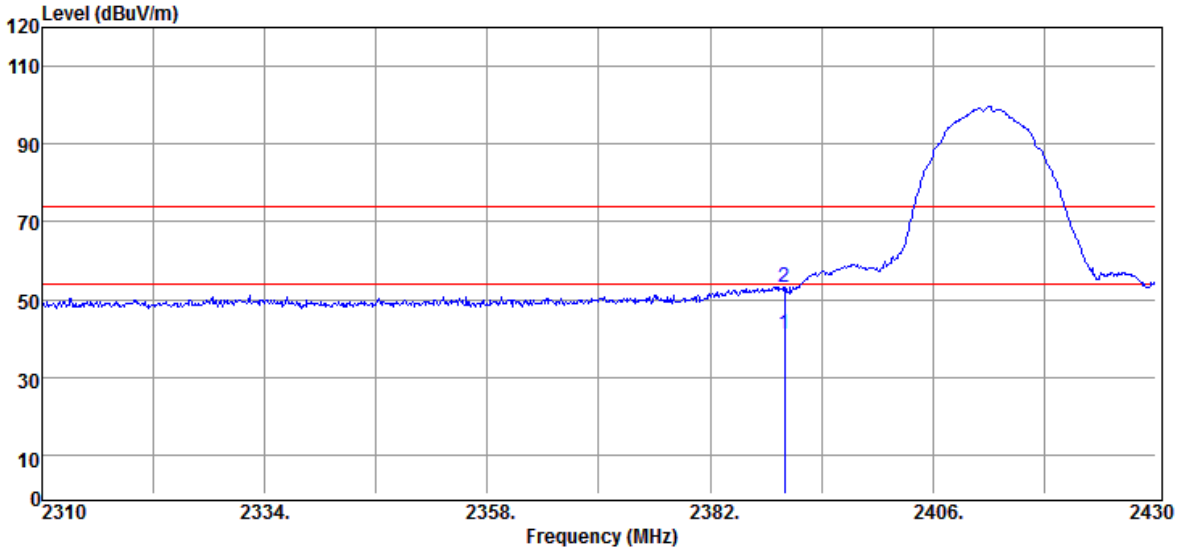
Radiated Band Edge Measurement Result (802.11b)

Operation Mode	:802.11b	Test Date	:2018-06-29
Test Mode	:BE CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2412 MHz	Engineer	:Jerry



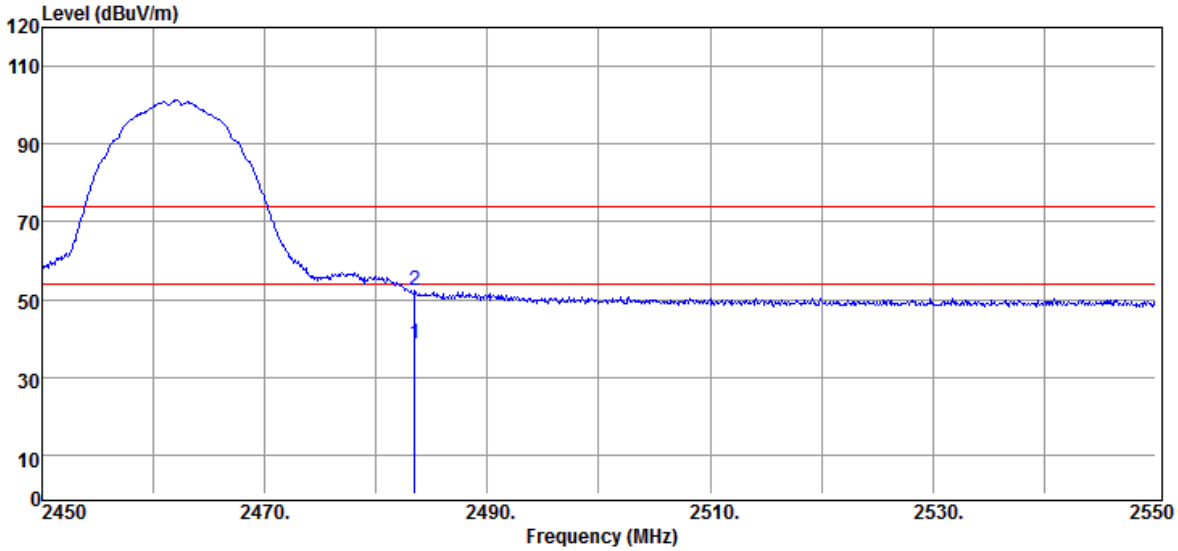
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	48.52	-5.57	42.95	54.00	-11.05
2390.00	Peak	60.93	-5.57	55.36	74.00	-18.64

Operation Mode	:802.11b	Test Date	:2018-06-29
Test Mode	:BE CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2412 MHz	Engineer	:Jerry



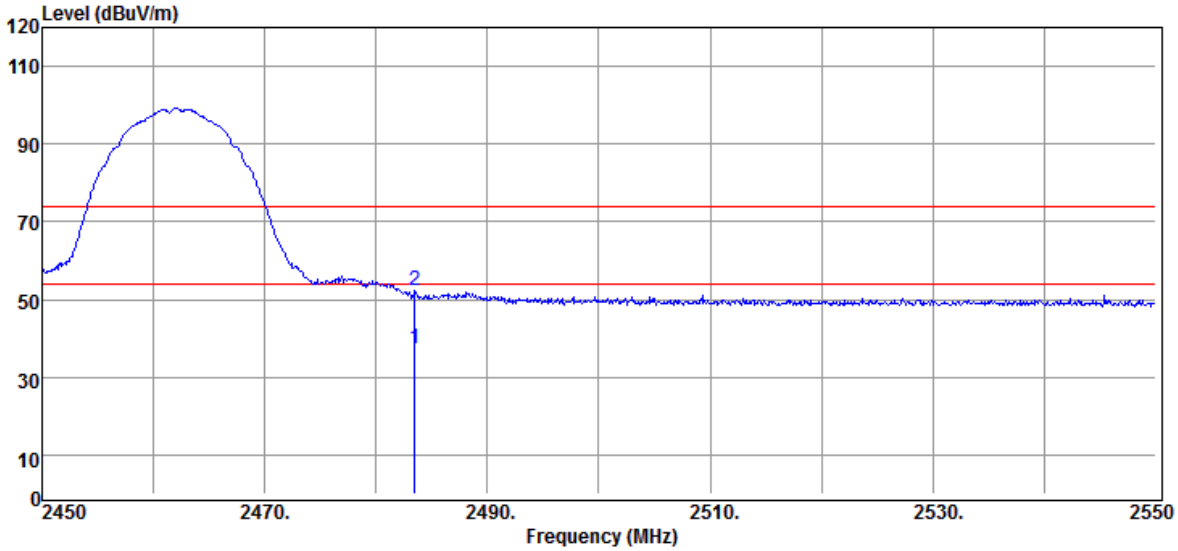
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	46.68	-5.57	41.11	54.00	-12.89
2390.00	Peak	58.80	-5.57	53.23	74.00	-20.77

Operation Mode	:802.11b	Test Date	:2018-06-29
Test Mode	:BE CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2462 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	43.32	-4.90	38.42	54.00	-15.58
2483.50	Peak	57.09	-4.90	52.19	74.00	-21.81

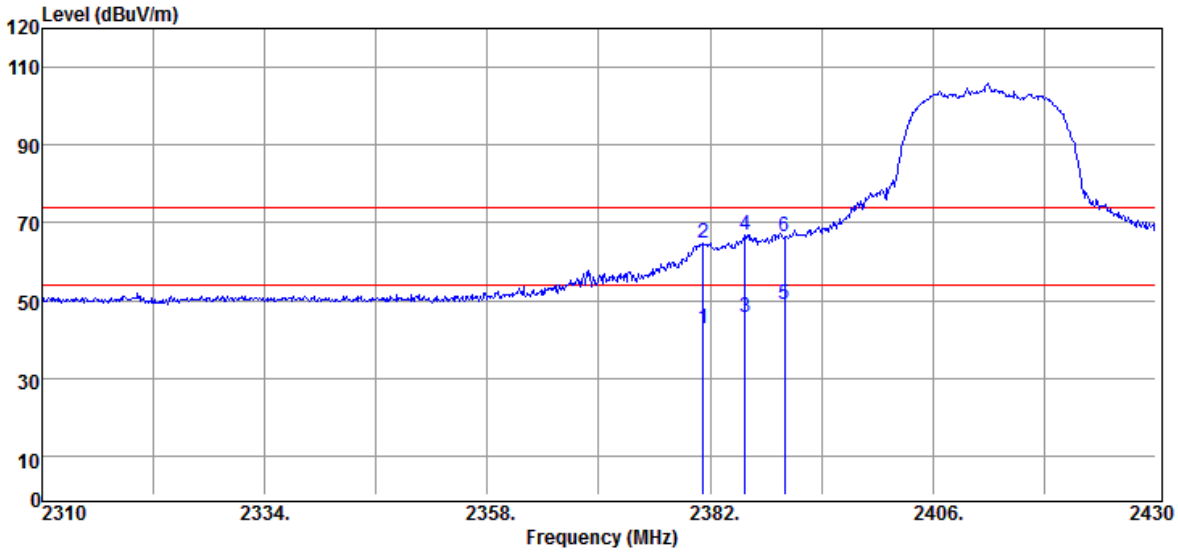
Operation Mode	:802.11b	Test Date	:2018-06-29
Test Mode	:BE CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2462 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	42.42	-4.90	37.52	54.00	-16.48
2483.50	Peak	57.08	-4.90	52.18	74.00	-21.82

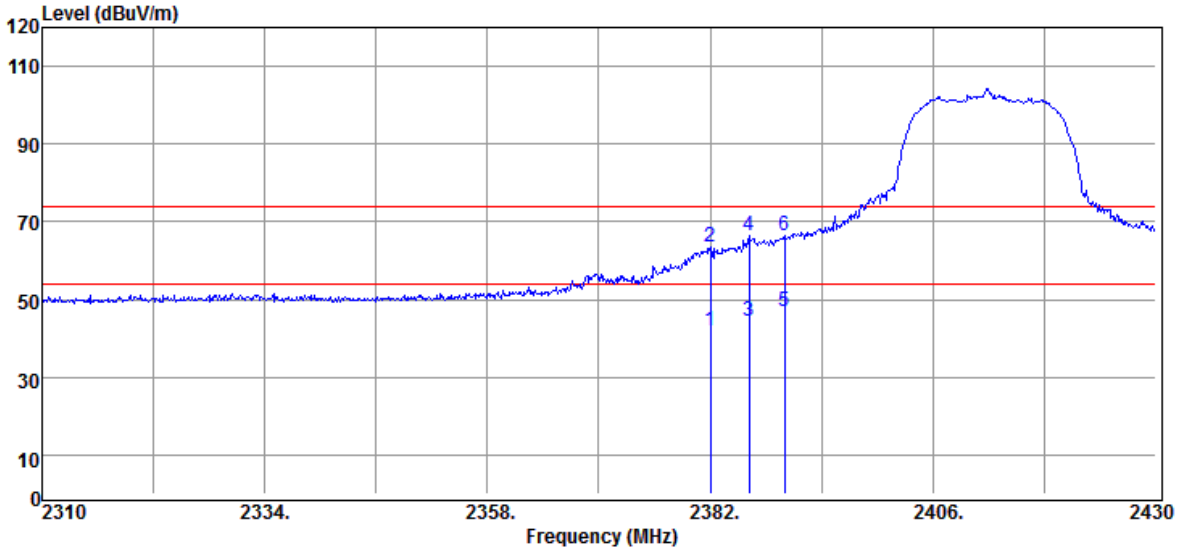
Radiated Band Edge Measurement Result (802.11g)

Operation Mode	:802.11g	Test Date	:2018-06-29
Test Mode	:BE CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2412 MHz	Engineer	:Jerry



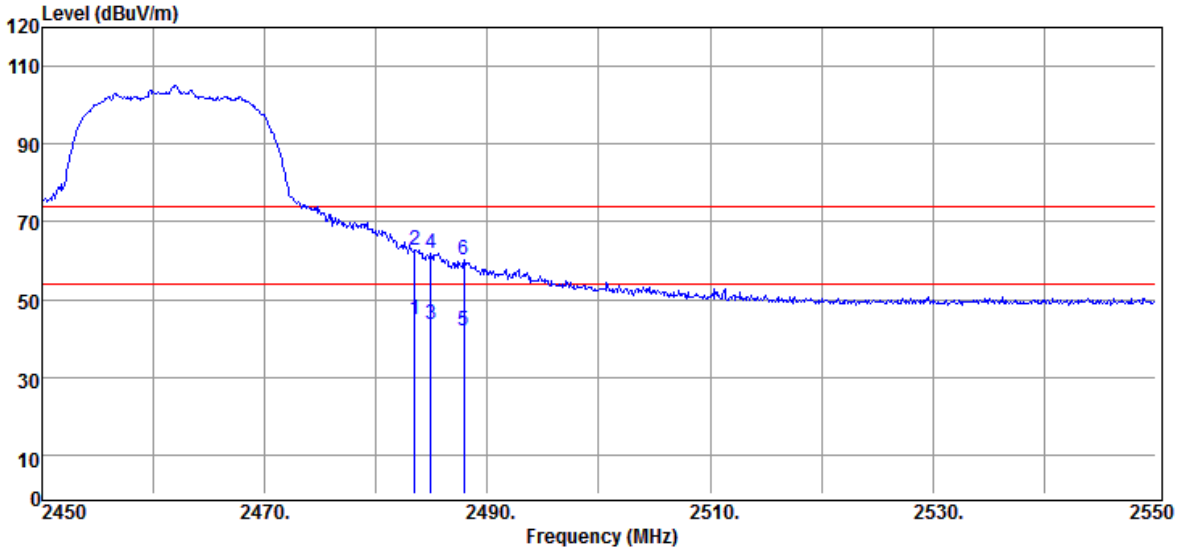
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2381.28	Average	48.31	-5.57	42.74	54.00	-11.26
2381.28	Peak	70.48	-5.57	64.91	74.00	-9.09
2385.72	Average	51.06	-5.57	45.49	54.00	-8.51
2385.72	Peak	72.47	-5.57	66.90	74.00	-7.10
2390.00	Average	54.53	-5.57	48.96	54.00	-5.04
2390.00	Peak	71.93	-5.57	66.36	74.00	-7.64

Operation Mode	:802.11g	Test Date	:2018-06-29
Test Mode	:BE CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2412 MHz	Engineer	:Jerry



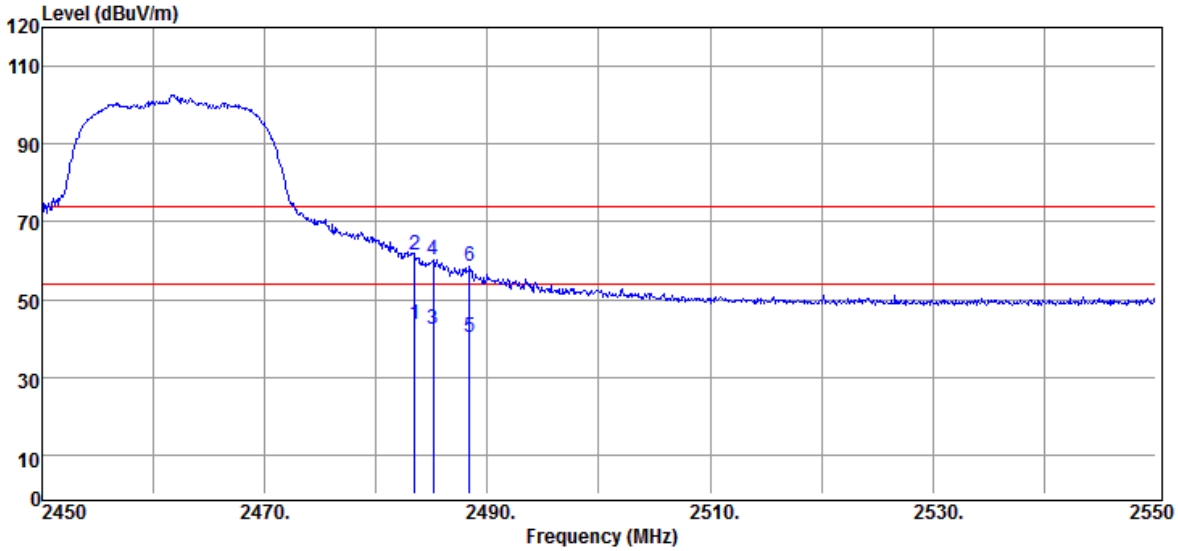
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2382.00	Average	47.58	-5.56	42.02	54.00	-11.98
2382.00	Peak	69.20	-5.56	63.64	74.00	-10.36
2386.20	Average	49.82	-5.57	44.25	54.00	-9.75
2386.20	Peak	71.87	-5.57	66.30	74.00	-7.70
2390.00	Average	52.65	-5.57	47.08	54.00	-6.92
2390.00	Peak	71.92	-5.57	66.35	74.00	-7.65

Operation Mode	:802.11g	Test Date	:2018-06-29
Test Mode	:BE CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2462 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	49.85	-4.90	44.95	54.00	-9.05
2483.50	Peak	67.58	-4.90	62.68	74.00	-11.32
2484.90	Average	48.65	-4.90	43.75	54.00	-10.25
2484.90	Peak	66.85	-4.90	61.95	74.00	-12.05
2487.90	Average	46.98	-4.86	42.12	54.00	-11.88
2487.90	Peak	65.06	-4.86	60.20	74.00	-13.80

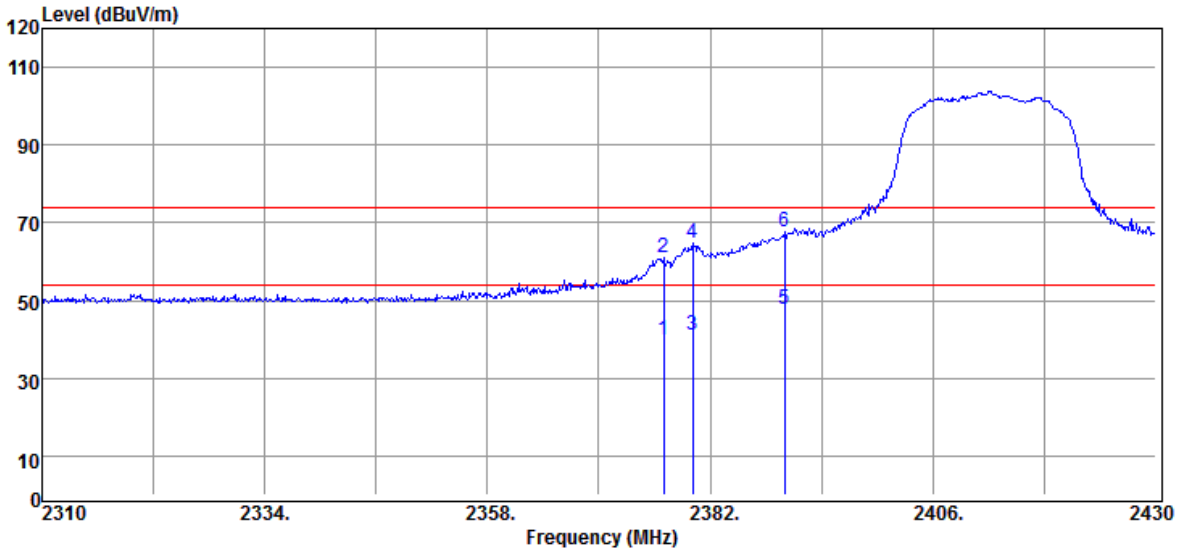
Operation Mode	:802.11g	Test Date	:2018-06-29
Test Mode	:BE CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2462 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	48.32	-4.90	43.42	54.00	-10.58
2483.50	Peak	66.32	-4.90	61.42	74.00	-12.58
2485.10	Average	47.36	-4.89	42.47	54.00	-11.53
2485.10	Peak	65.28	-4.89	60.39	74.00	-13.61
2488.40	Average	45.15	-4.85	40.30	54.00	-13.70
2488.40	Peak	63.30	-4.85	58.45	74.00	-15.55

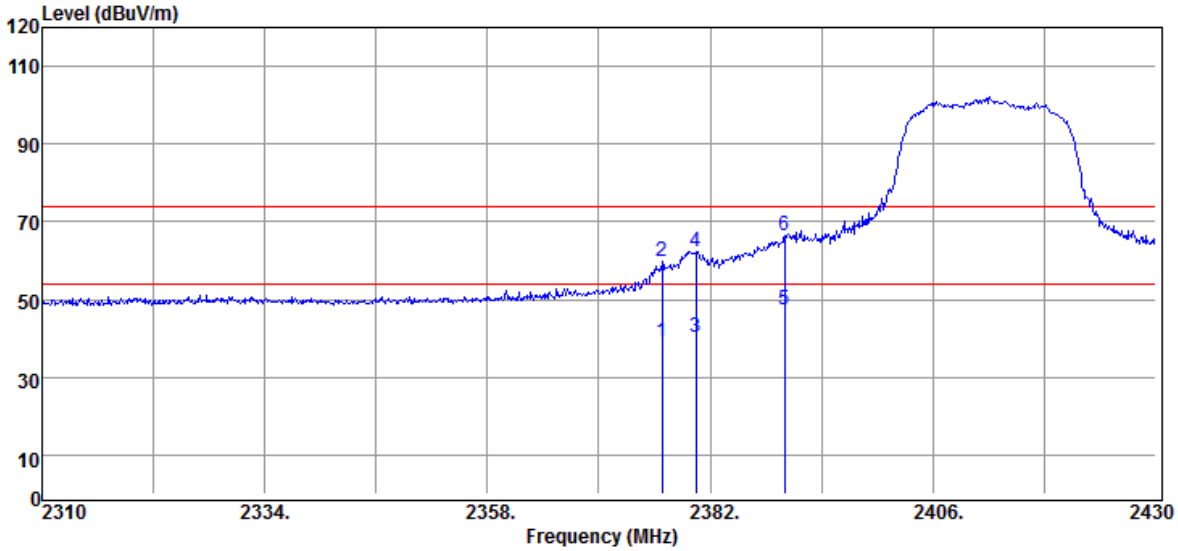
Radiated Band Edge Measurement Result (802.11_HT20)

Operation Mode	:802.11n20	Test Date	:2018-06-29
Test Mode	:BE CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2412 MHz	Engineer	:Jerry



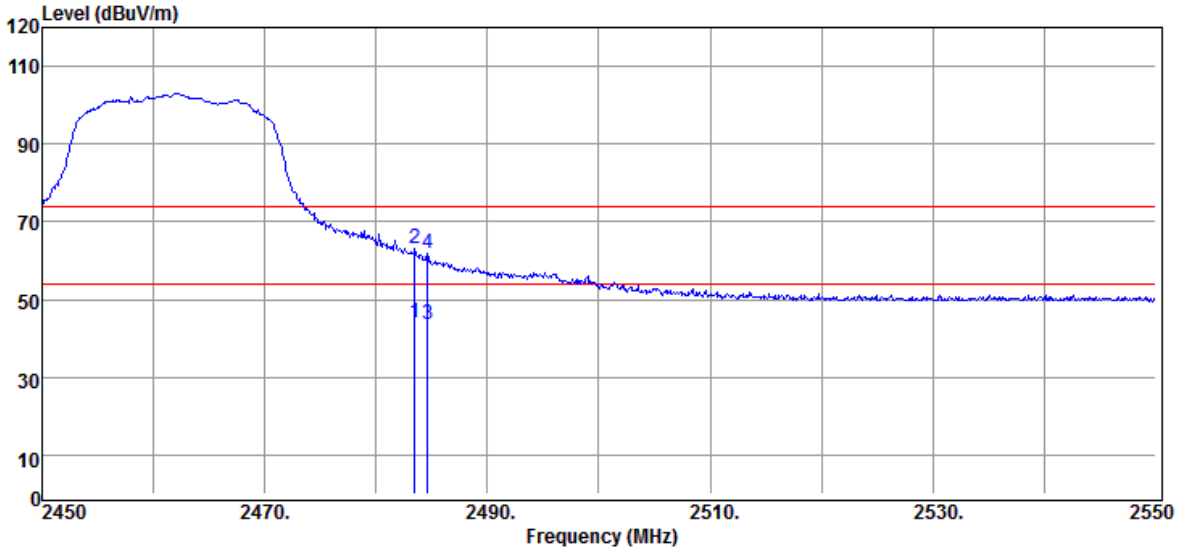
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2376.96	Average	45.56	-5.57	39.99	54.00	-14.01
2376.96	Peak	66.59	-5.57	61.02	74.00	-12.98
2380.08	Average	46.67	-5.57	41.10	54.00	-12.90
2380.08	Peak	70.39	-5.57	64.82	74.00	-9.18
2390.00	Average	53.39	-5.57	47.82	54.00	-6.18
2390.00	Peak	73.31	-5.57	67.74	74.00	-6.26

Operation Mode	:802.11n20	Test Date	:2018-06-29
Test Mode	:BE CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2412 MHz	Engineer	:Jerry



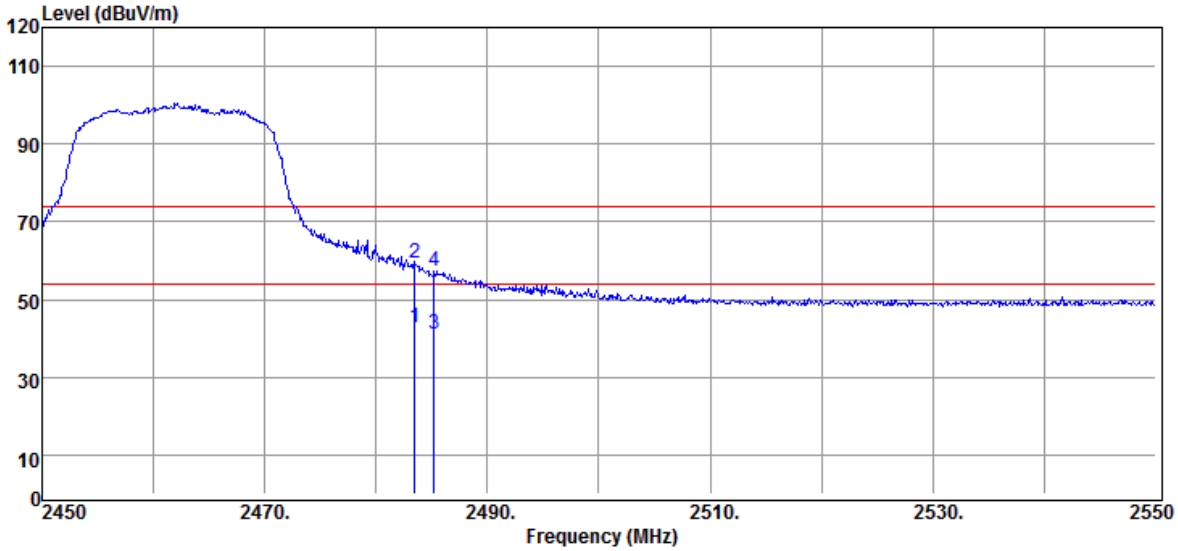
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2376.84	Average	44.58	-5.57	39.01	54.00	-14.99
2376.84	Peak	65.22	-5.57	59.65	74.00	-14.35
2380.44	Average	45.87	-5.57	40.30	54.00	-13.70
2380.44	Peak	68.00	-5.57	62.43	74.00	-11.57
2390.00	Average	52.75	-5.57	47.18	54.00	-6.82
2390.00	Peak	71.80	-5.57	66.23	74.00	-7.77

Operation Mode	:802.11n20	Test Date	:2018-06-29
Test Mode	:BE CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2462 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	48.95	-4.90	44.05	54.00	-9.95
2483.50	Peak	67.89	-4.90	62.99	74.00	-11.01
2484.60	Average	48.52	-4.90	43.62	54.00	-10.38
2484.60	Peak	66.80	-4.90	61.90	74.00	-12.10

Operation Mode	:802.11n20	Test Date	:2018-06-29
Test Mode	:BE CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2462 MHz	Engineer	:Jerry

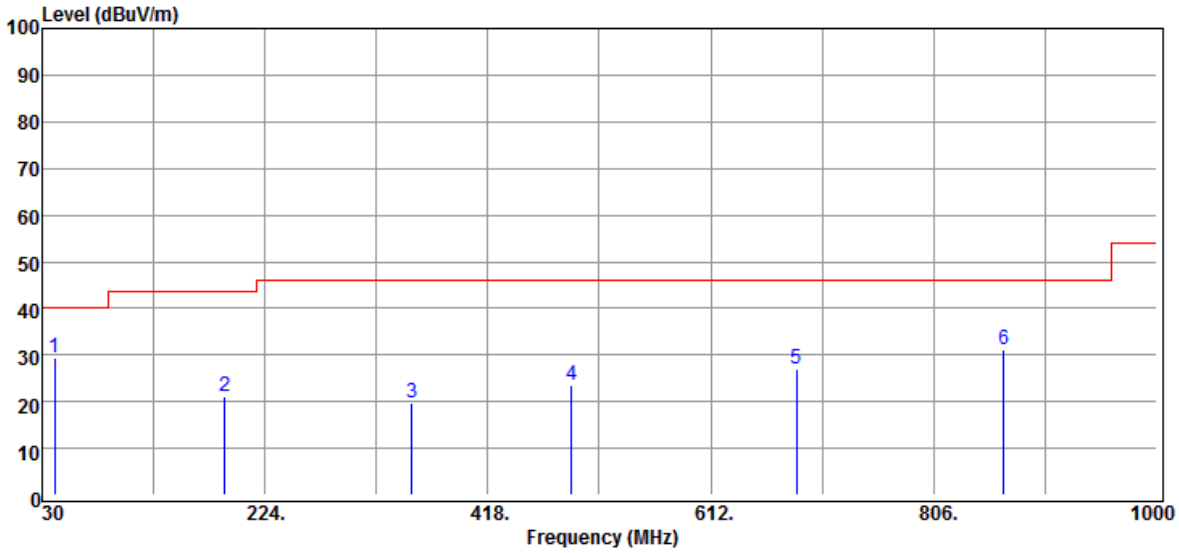


Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	47.57	-4.90	42.67	54.00	-11.33
2483.50	Peak	64.14	-4.90	59.24	74.00	-14.76
2485.20	Average	46.14	-4.89	41.25	54.00	-12.75
2485.20	Peak	62.23	-4.89	57.34	74.00	-16.66

Below 1GHz Worst-Case Data:

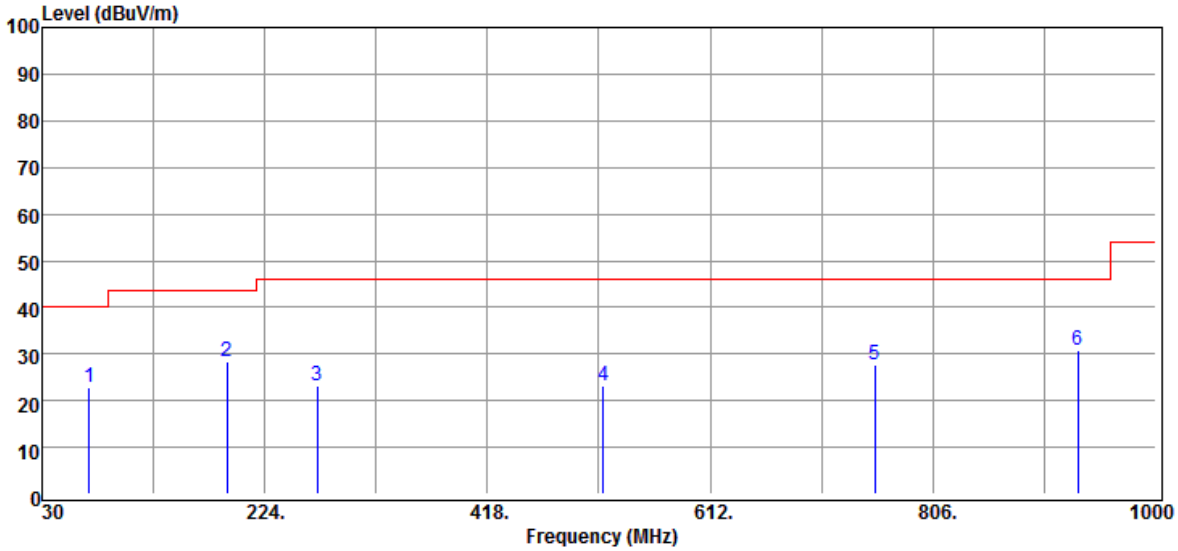
Radiated Spurious Emission Measurement Result (802.11 g)

Operation Mode	:802.11g	Test Date	:2018-06-22
Test Mode	:Tx CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2412 MHz	Engineer	:Jerry



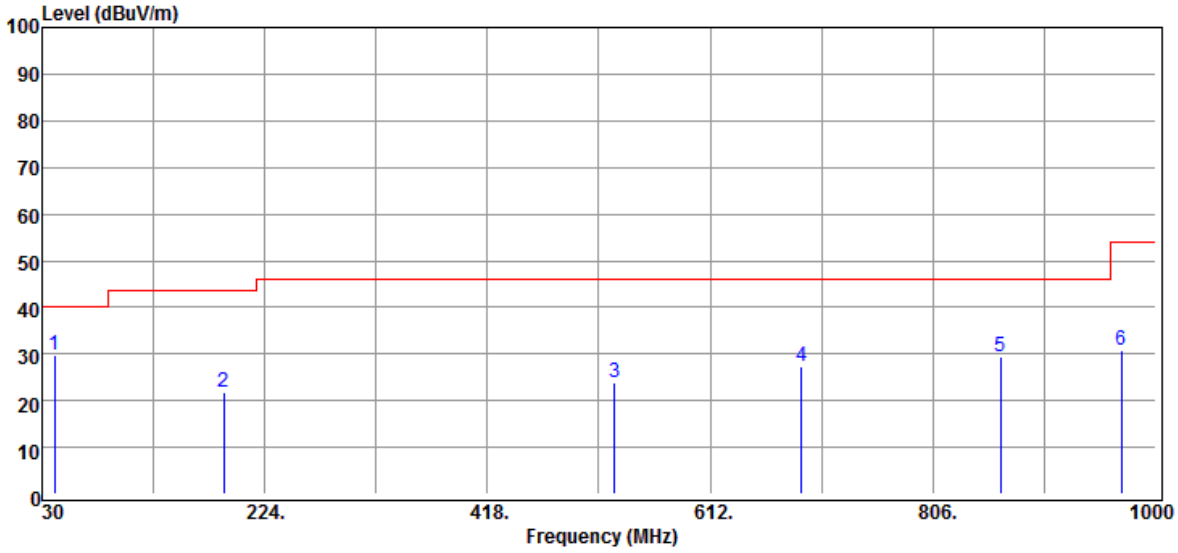
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
40.67	Peak	46.98	-17.42	29.56	40.00	-10.44
189.08	Peak	39.52	-18.24	21.28	43.50	-22.22
352.04	Peak	33.47	-13.91	19.56	46.00	-26.44
490.75	Peak	34.61	-11.09	23.52	46.00	-22.48
686.69	Peak	34.56	-7.56	27.00	46.00	-19.00
867.11	Peak	36.25	-5.01	31.24	46.00	-14.76

Operation Mode	:802.11g	Test Date	:2018-06-22
Test Mode	:Tx CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2412 MHz	Engineer	:Jerry



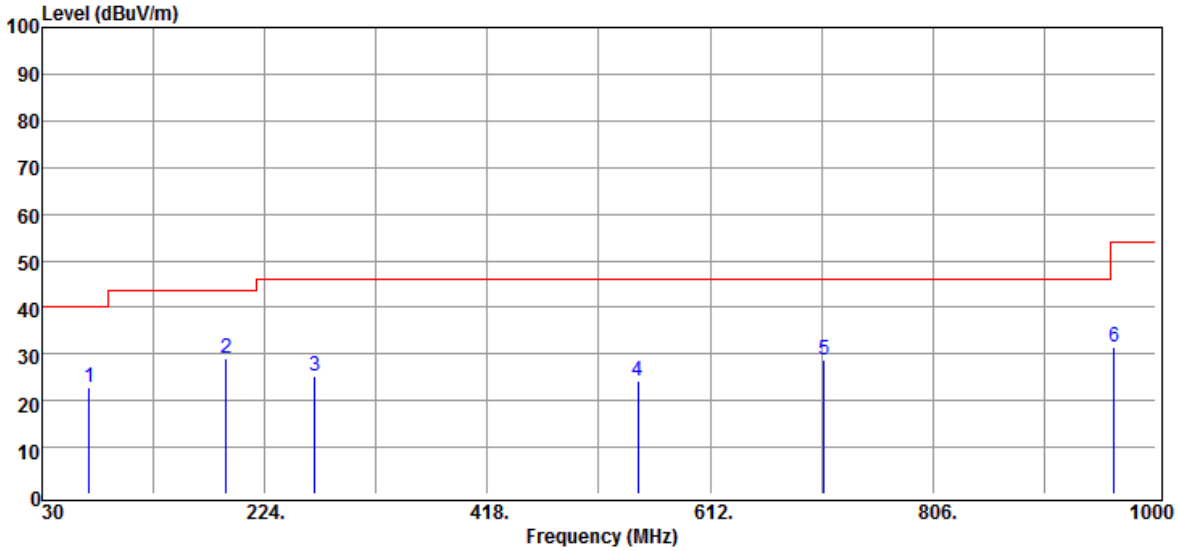
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
70.74	Peak	42.87	-20.13	22.74	40.00	-17.26
191.02	Peak	47.24	-18.94	28.30	43.50	-15.20
269.59	Peak	39.50	-16.26	23.24	46.00	-22.76
518.88	Peak	33.85	-10.68	23.17	46.00	-22.83
755.56	Peak	34.44	-6.78	27.66	46.00	-18.34
932.10	Peak	35.11	-4.45	30.66	46.00	-15.34

Operation Mode	:802.11g	Test Date	:2018-06-22
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2437 MHz	Engineer	:Jerry



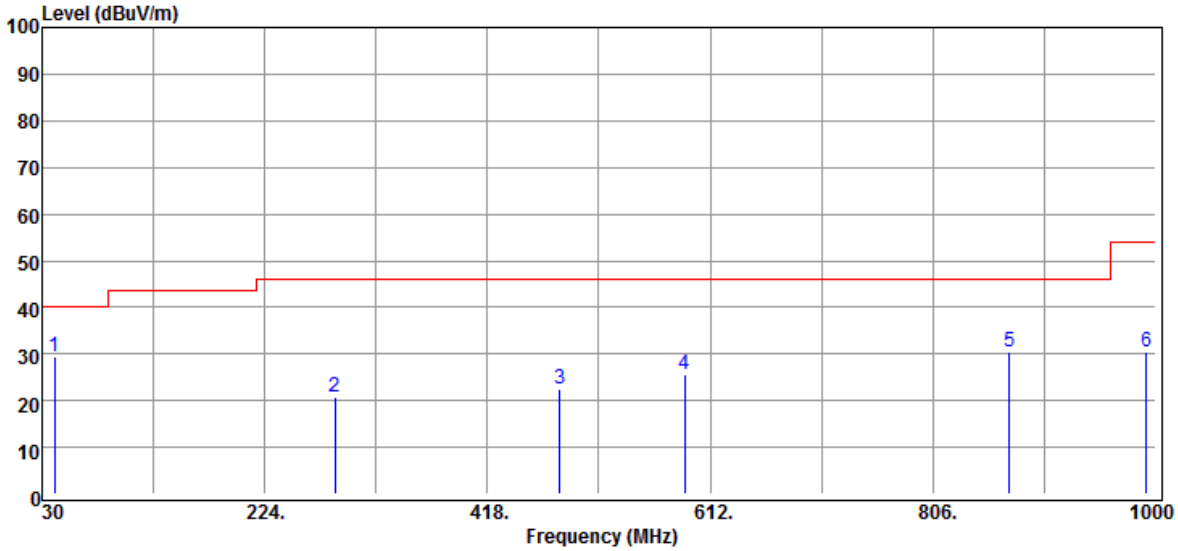
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
40.67	Peak	47.02	-17.42	29.60	40.00	-10.40
188.11	Peak	39.83	-18.15	21.68	43.50	-21.82
528.58	Peak	34.05	-10.12	23.93	46.00	-22.07
691.54	Peak	34.74	-7.44	27.30	46.00	-18.70
865.17	Peak	34.57	-5.12	29.45	46.00	-16.55
969.93	Peak	33.98	-3.30	30.68	54.00	-23.32

Operation Mode	:802.11g	Test Date	:2018-06-22
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2437 MHz	Engineer	:Jerry



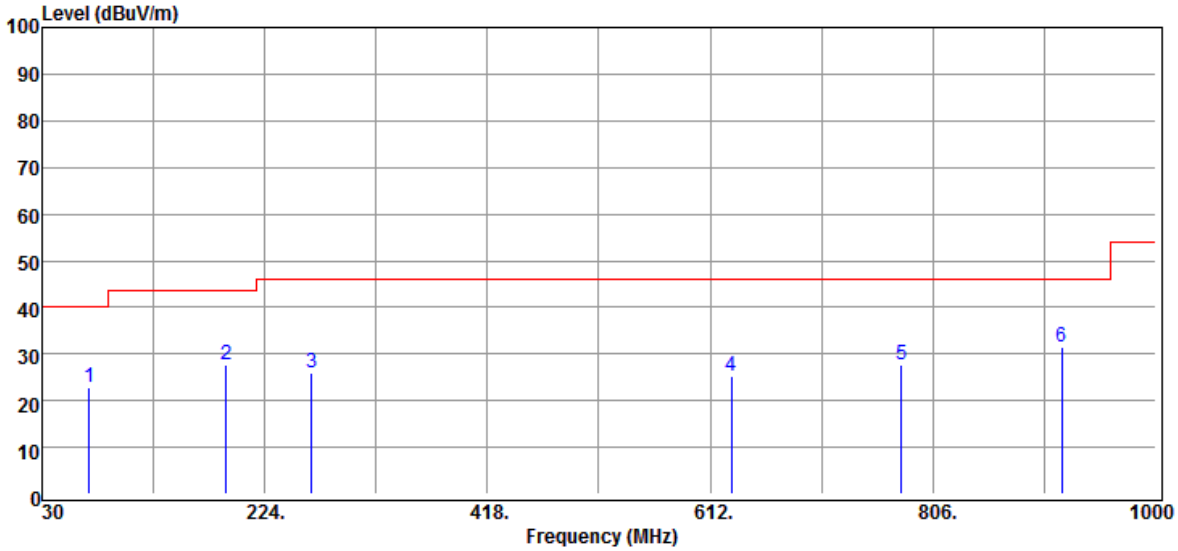
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
70.74	Peak	42.83	-20.13	22.70	40.00	-17.30
190.05	Peak	47.43	-18.36	29.07	43.50	-14.43
267.65	Peak	41.45	-16.34	25.11	46.00	-20.89
548.95	Peak	34.46	-10.33	24.13	46.00	-21.87
710.94	Peak	36.90	-8.02	28.88	46.00	-17.12
964.11	Peak	35.35	-3.77	31.58	54.00	-22.42

Operation Mode	:802.11g	Test Date	:2018-06-22
Test Mode	:Tx CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2462 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
40.67	Peak	46.89	-17.42	29.47	40.00	-10.53
285.11	Peak	36.40	-15.62	20.78	46.00	-25.22
481.05	Peak	33.65	-11.04	22.61	46.00	-23.39
589.69	Peak	34.17	-8.73	25.44	46.00	-20.56
872.93	Peak	35.55	-5.02	30.53	46.00	-15.47
992.24	Peak	34.35	-3.85	30.50	54.00	-23.50

Operation Mode	:802.11g	Test Date	:2018-06-22
Test Mode	:Tx CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2462 MHz	Engineer	:Jerry

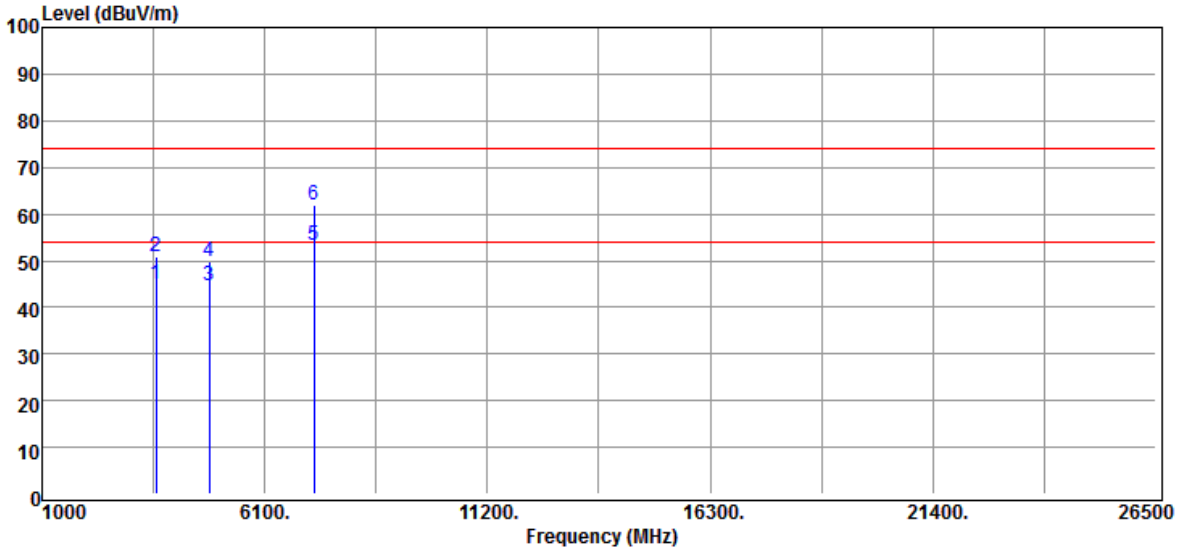


Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
70.74	Peak	42.86	-20.13	22.73	40.00	-17.27
190.05	Peak	46.16	-18.36	27.80	43.50	-15.70
264.74	Peak	42.48	-16.47	26.01	46.00	-19.99
630.43	Peak	33.53	-8.13	25.40	46.00	-20.60
778.84	Peak	34.76	-7.08	27.68	46.00	-18.32
918.52	Peak	36.05	-4.45	31.60	46.00	-14.40

Above 1GHz Data:

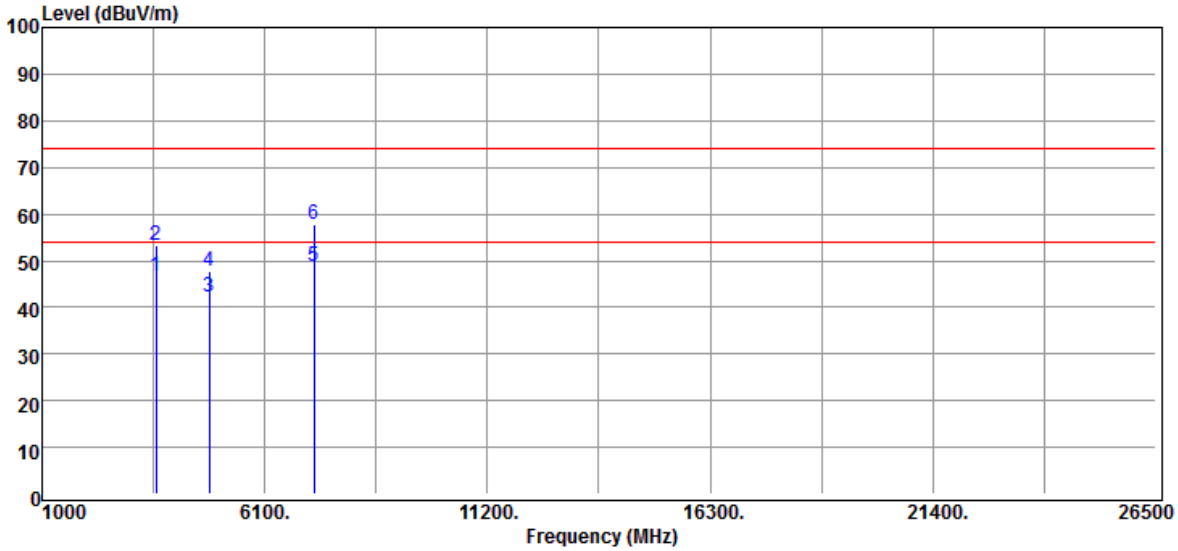
Radiated Spurious Emission Measurement Result (802.11 b)

Operation Mode	:802.11b	Test Date	:2018-06-29
Test Mode	:Tx CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2412 MHz	Engineer	:Jerry



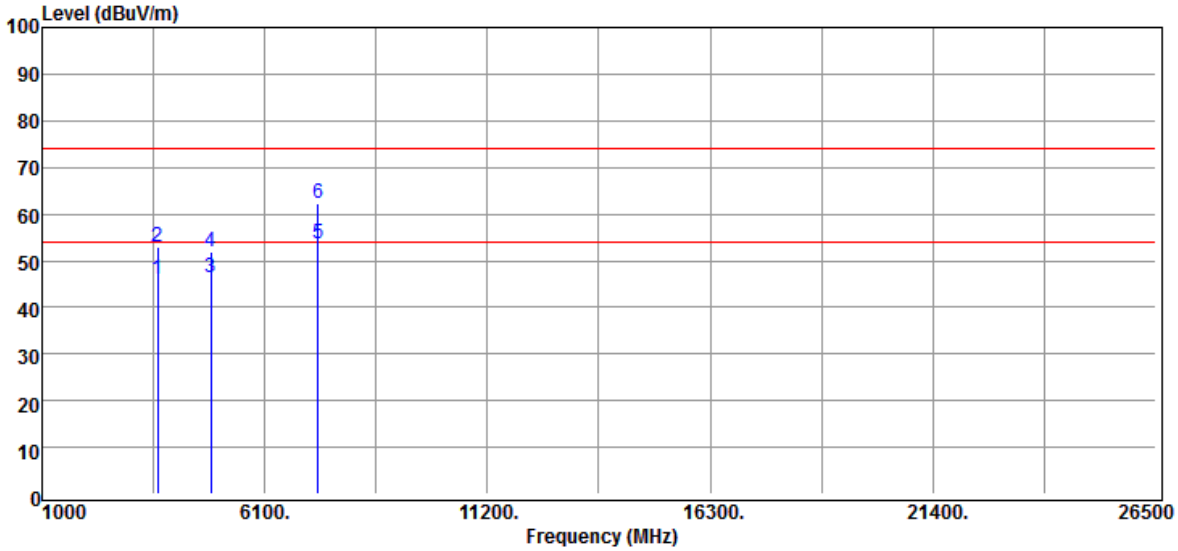
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3618.00	Average	47.37	-2.33	45.04	54.00	-8.96
3618.00	Peak	53.10	-2.33	50.77	74.00	-23.23
4824.00	Average	44.26	0.38	44.64	54.00	-9.36
4824.00	Peak	49.37	0.38	49.75	74.00	-24.25
7236.00	Average	47.31	6.06	53.37	54.00	-0.63
7236.00	Peak	55.72	6.06	61.78	74.00	-12.22

Operation Mode	:802.11b	Test Date	:2018-06-29
Test Mode	:Tx CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2412 MHz	Engineer	:Jerry



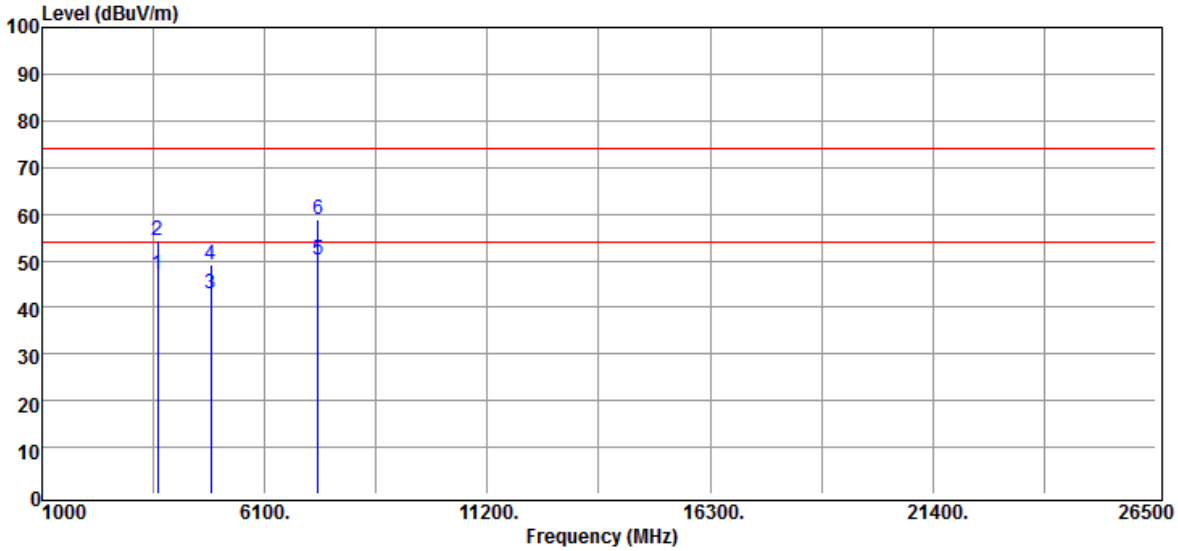
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3618.00	Average	48.96	-2.33	46.63	54.00	-7.37
3618.00	Peak	55.67	-2.33	53.34	74.00	-20.66
4824.00	Average	41.93	0.38	42.31	54.00	-11.69
4824.00	Peak	47.37	0.38	47.75	74.00	-26.25
7236.00	Average	42.87	6.06	48.93	54.00	-5.07
7236.00	Peak	51.69	6.06	57.75	74.00	-16.25

Operation Mode	:802.11b	Test Date	:2018-06-29
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2437 MHz	Engineer	:Jerry



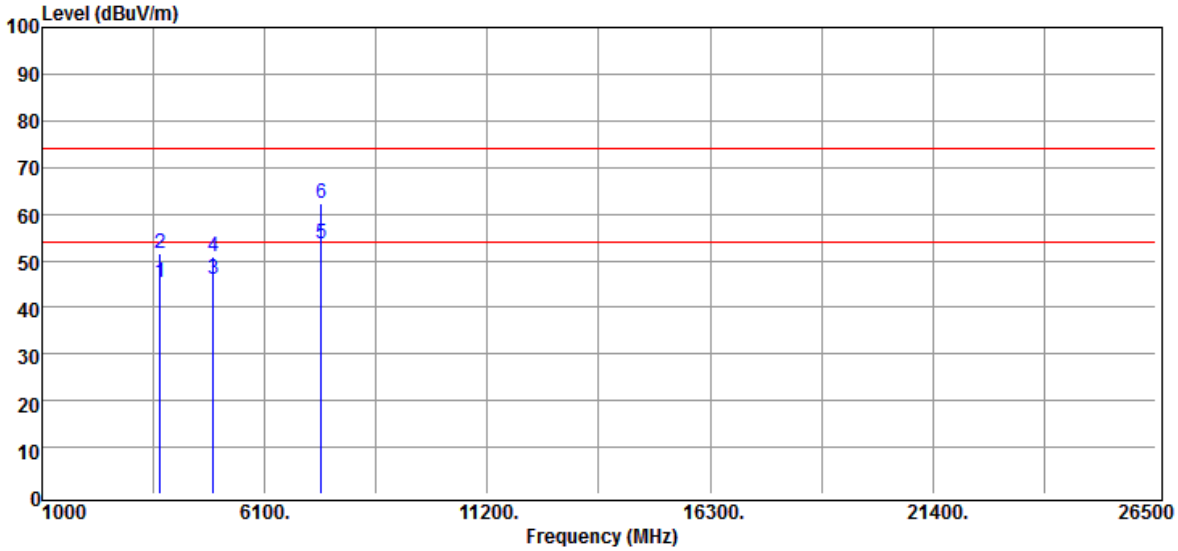
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3653.00	Average	48.36	-2.36	46.00	54.00	-8.00
3653.00	Peak	55.19	-2.36	52.83	74.00	-21.17
4874.00	Average	45.69	0.66	46.35	54.00	-7.65
4874.00	Peak	51.25	0.66	51.91	74.00	-22.09
7311.00	Average	47.19	6.54	53.73	54.00	-0.27
7311.00	Peak	55.69	6.54	62.23	74.00	-11.77

Operation Mode	:802.11b	Test Date	:2018-06-29
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2437 MHz	Engineer	:Jerry



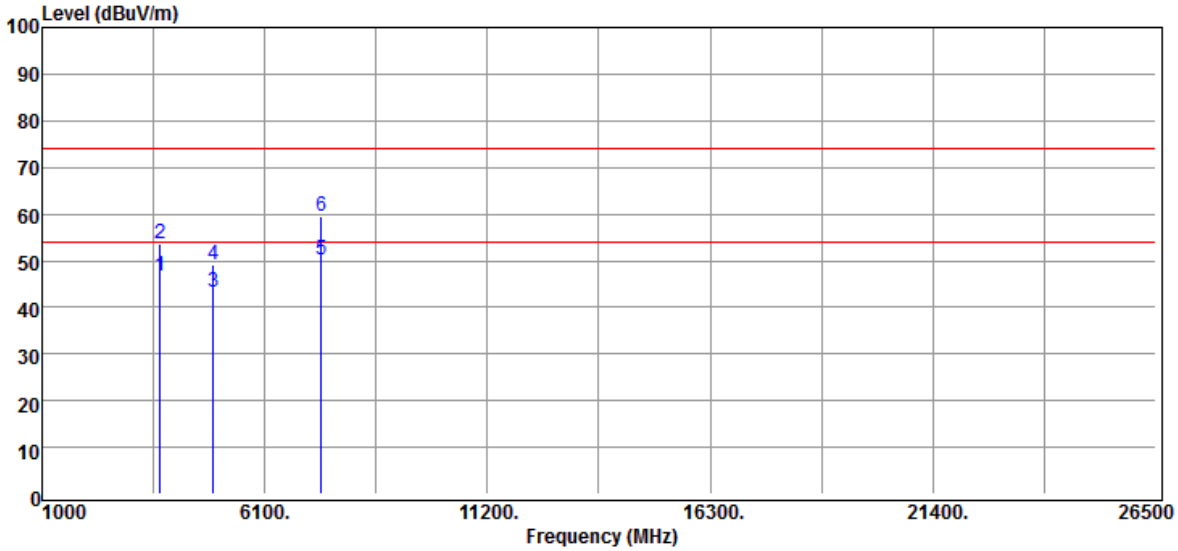
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3653.00	Average	49.37	-2.36	47.01	54.00	-6.99
3653.00	Peak	56.82	-2.36	54.46	74.00	-19.54
4874.00	Average	42.39	0.66	43.05	54.00	-10.95
4874.00	Peak	48.55	0.66	49.21	74.00	-24.79
7311.00	Average	43.59	6.54	50.13	54.00	-3.87
7311.00	Peak	52.36	6.54	58.90	74.00	-15.10

Operation Mode	:802.11b	Test Date	:2018-06-29
Test Mode	:Tx CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2462 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3695.00	Average	47.70	-2.41	45.29	54.00	-8.71
3695.00	Peak	53.87	-2.41	51.46	74.00	-22.54
4924.00	Average	45.06	0.97	46.03	54.00	-7.97
4924.00	Peak	50.06	0.97	51.03	74.00	-22.97
7386.00	Average	46.37	7.19	53.56	54.00	-0.44
7386.00	Peak	54.94	7.19	62.13	74.00	-11.87

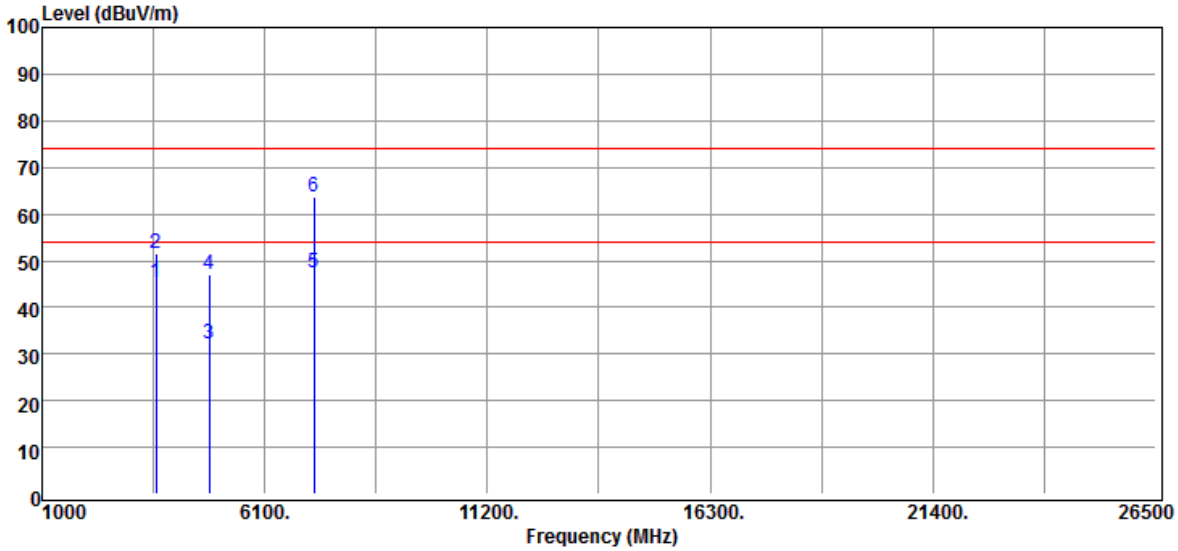
Operation Mode	:802.11b	Test Date	:2018-06-29
Test Mode	:Tx CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2462 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3695.00	Average	49.21	-2.41	46.80	54.00	-7.20
3695.00	Peak	56.14	-2.41	53.73	74.00	-20.27
4924.00	Average	42.38	0.97	43.35	54.00	-10.65
4924.00	Peak	48.22	0.97	49.19	74.00	-24.81
7386.00	Average	43.14	7.19	50.33	54.00	-3.67
7386.00	Peak	52.35	7.19	59.54	74.00	-14.46

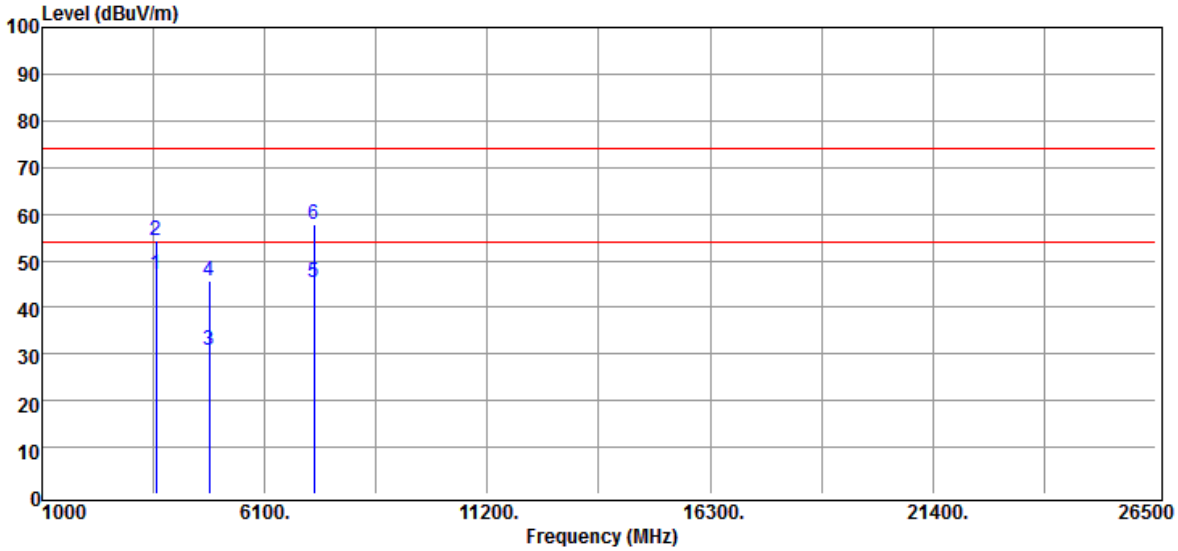
Radiated Spurious Emission Measurement Result (802.11 g)

Operation Mode	:802.11g	Test Date	:2018-06-29
Test Mode	:Tx CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2412 MHz	Engineer	:Jerry



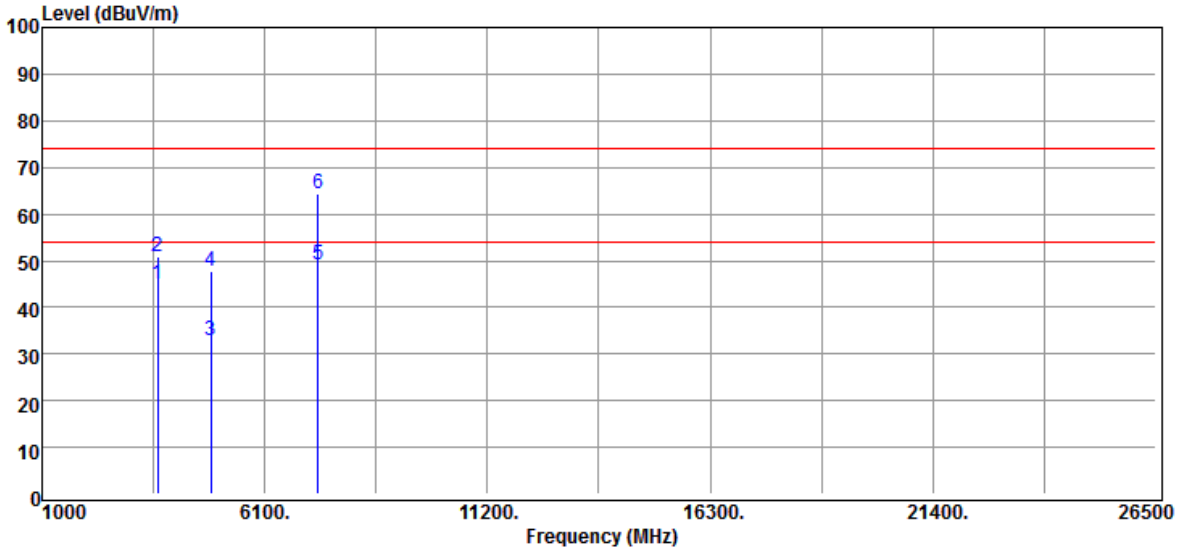
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3618.00	Average	47.73	-2.33	45.40	54.00	-8.60
3618.00	Peak	53.82	-2.33	51.49	74.00	-22.51
4824.00	Average	31.78	0.38	32.16	54.00	-21.84
4824.00	Peak	46.71	0.38	47.09	74.00	-26.91
7236.00	Average	41.29	6.06	47.35	54.00	-6.65
7236.00	Peak	57.65	6.06	63.71	74.00	-10.29

Operation Mode	:802.11g	Test Date	:2018-06-29
Test Mode	:Tx CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2412 MHz	Engineer	:Jerry



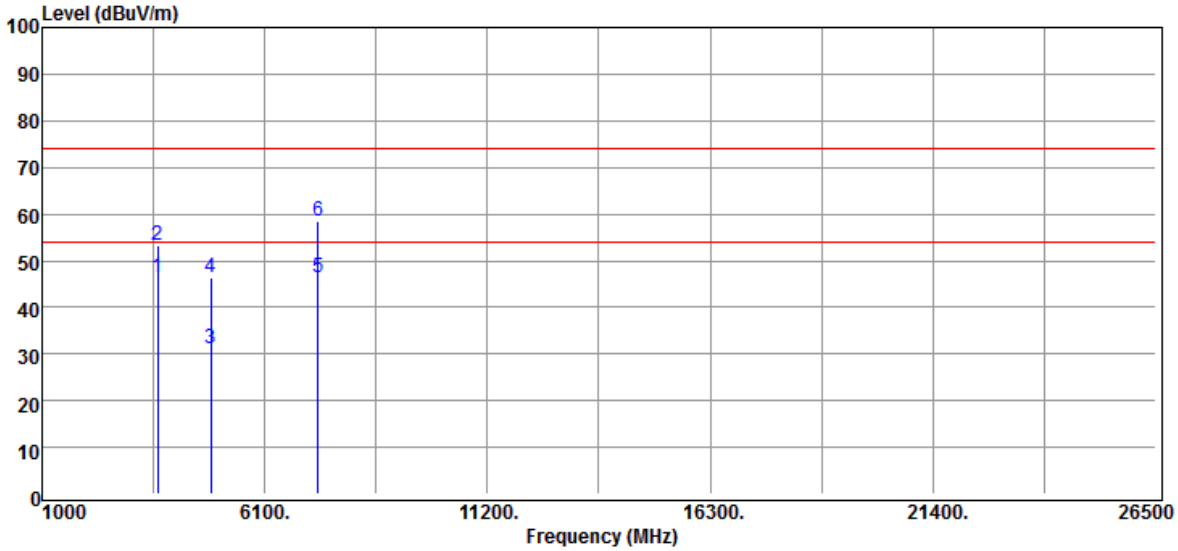
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3618.00	Average	49.32	-2.33	46.99	54.00	-7.01
3618.00	Peak	56.83	-2.33	54.50	74.00	-19.50
4824.00	Average	30.27	0.38	30.65	54.00	-23.35
4824.00	Peak	45.33	0.38	45.71	74.00	-28.29
7236.00	Average	39.22	6.06	45.28	54.00	-8.72
7236.00	Peak	51.60	6.06	57.66	74.00	-16.34

Operation Mode	:802.11g	Test Date	:2018-06-29
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2437 MHz	Engineer	:Jerry



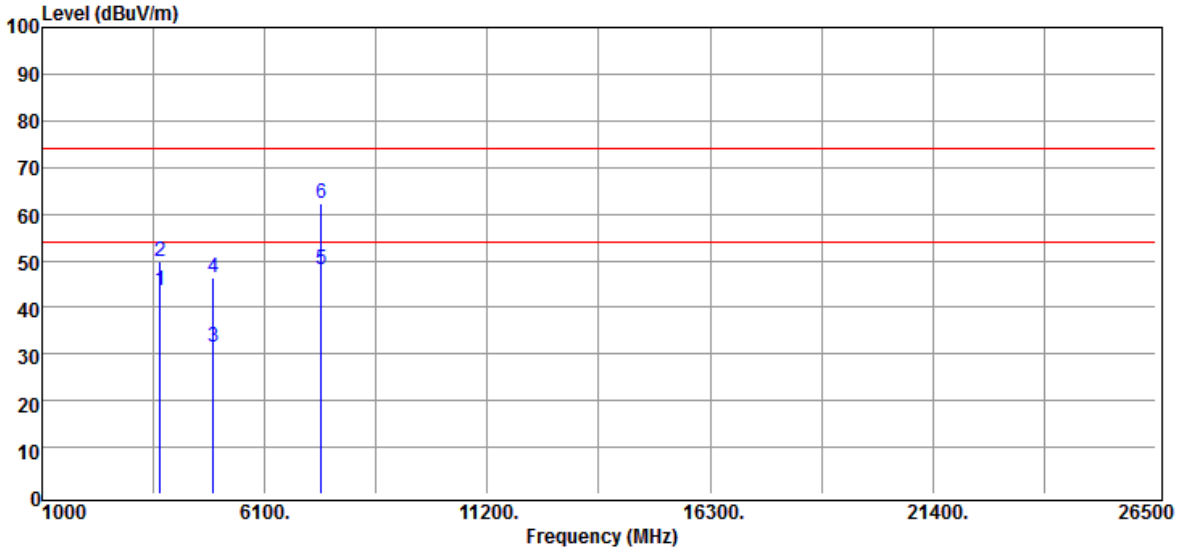
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3653.00	Average	47.20	-2.36	44.84	54.00	-9.16
3653.00	Peak	53.07	-2.36	50.71	74.00	-23.29
4874.00	Average	32.07	0.66	32.73	54.00	-21.27
4874.00	Peak	47.25	0.66	47.91	74.00	-26.09
7311.00	Average	42.53	6.54	49.07	54.00	-4.93
7311.00	Peak	57.83	6.54	64.37	74.00	-9.63

Operation Mode	:802.11g	Test Date	:2018-06-29
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2437 MHz	Engineer	:Jerry



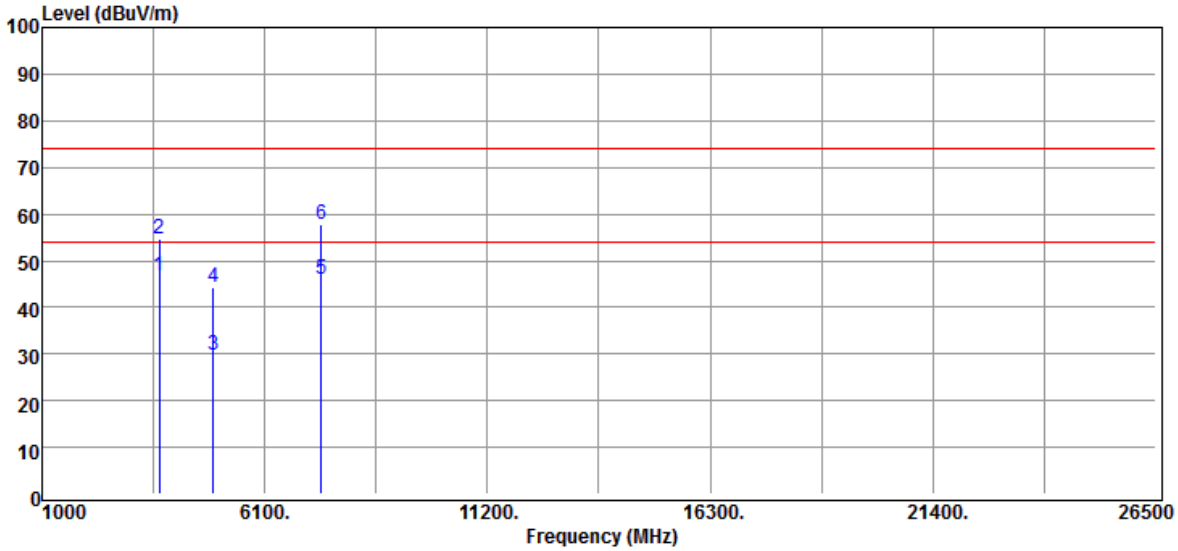
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3653.00	Average	48.72	-2.36	46.36	54.00	-7.64
3653.00	Peak	55.52	-2.36	53.16	74.00	-20.84
4874.00	Average	30.32	0.66	30.98	54.00	-23.02
4874.00	Peak	45.68	0.66	46.34	74.00	-27.66
7311.00	Average	39.97	6.54	46.51	54.00	-7.49
7311.00	Peak	51.83	6.54	58.37	74.00	-15.63

Operation Mode	:802.11g	Test Date	:2018-06-29
Test Mode	:Tx CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2462 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3695.00	Average	46.00	-2.41	43.59	54.00	-10.41
3695.00	Peak	52.10	-2.41	49.69	74.00	-24.31
4924.00	Average	30.58	0.97	31.55	54.00	-22.45
4924.00	Peak	45.32	0.97	46.29	74.00	-27.71
7386.00	Average	40.99	7.19	48.18	54.00	-5.82
7386.00	Peak	55.24	7.19	62.43	74.00	-11.57

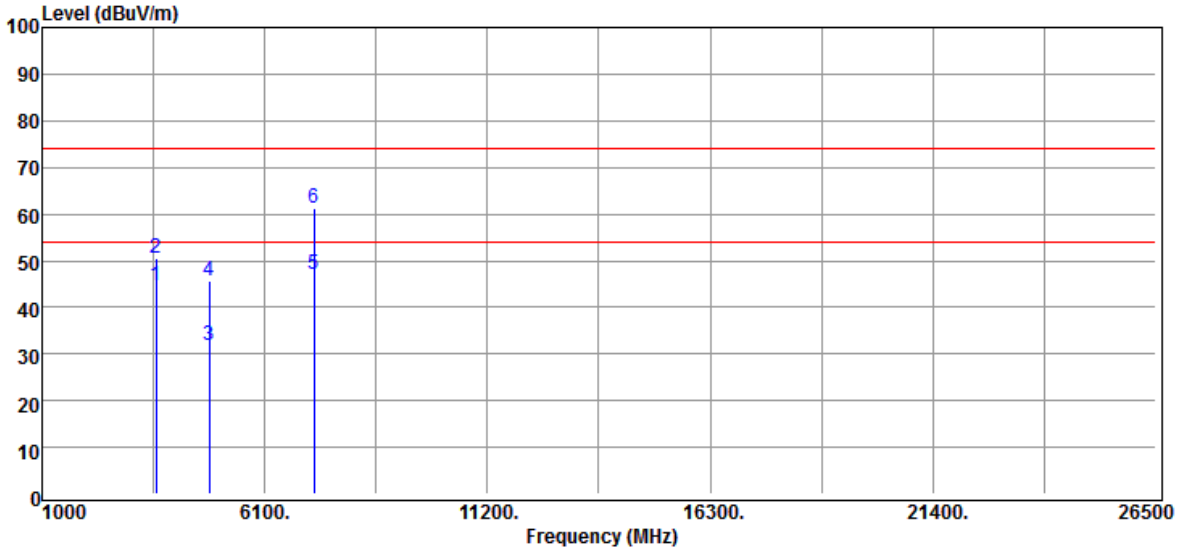
Operation Mode	:802.11g	Test Date	:2018-06-29
Test Mode	:Tx CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2462 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3688.00	Average	49.15	-2.40	46.75	54.00	-7.25
3688.00	Peak	57.21	-2.40	54.81	74.00	-19.19
4924.00	Average	28.92	0.97	29.89	54.00	-24.11
4924.00	Peak	43.22	0.97	44.19	74.00	-29.81
7386.00	Average	38.88	7.19	46.07	54.00	-7.93
7386.00	Peak	50.52	7.19	57.71	74.00	-16.29

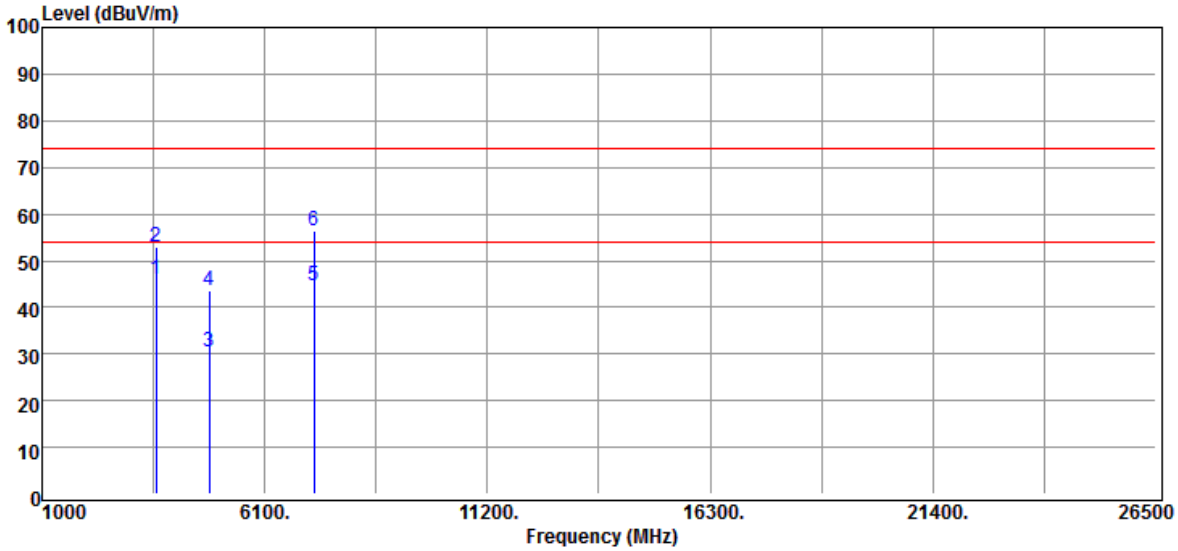
Radiated Spurious Emission Measurement Result (802.11_HT20)

Operation Mode	:802.11n20	Test Date	:2018-06-29
Test Mode	:Tx CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2412 MHz	Engineer	:Jerry



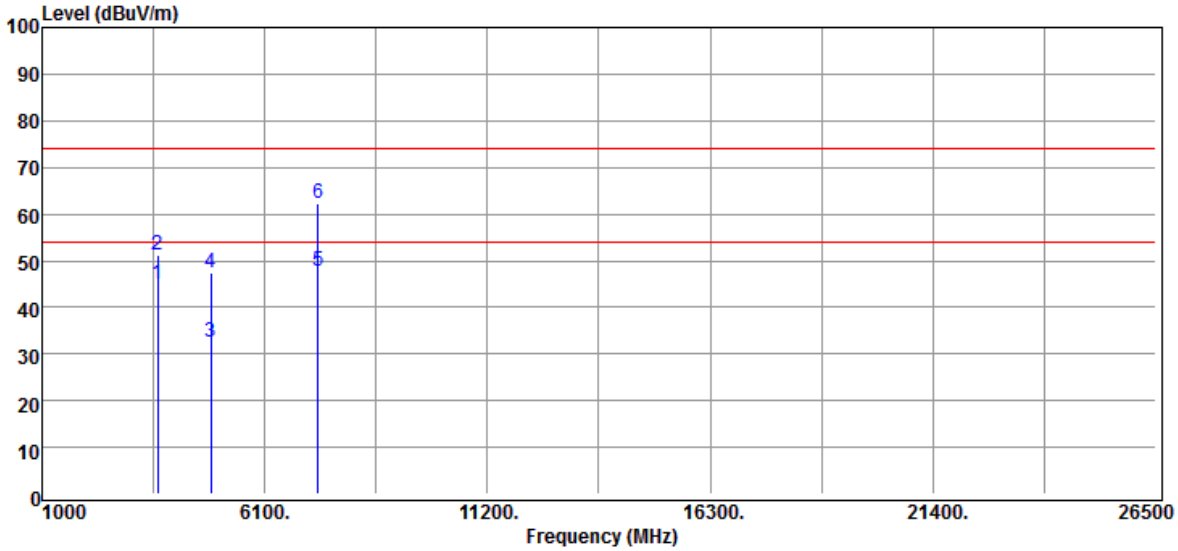
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3618.00	Average	47.01	-2.33	44.68	54.00	-9.32
3618.00	Peak	52.69	-2.33	50.36	74.00	-23.64
4824.00	Average	31.35	0.38	31.73	54.00	-22.27
4824.00	Peak	45.22	0.38	45.60	74.00	-28.40
7236.00	Average	40.87	6.06	46.93	54.00	-7.07
7236.00	Peak	55.26	6.06	61.32	74.00	-12.68

Operation Mode	:802.11n20	Test Date	:2018-06-29
Test Mode	:Tx CH Low	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2412 MHz	Engineer	:Jerry



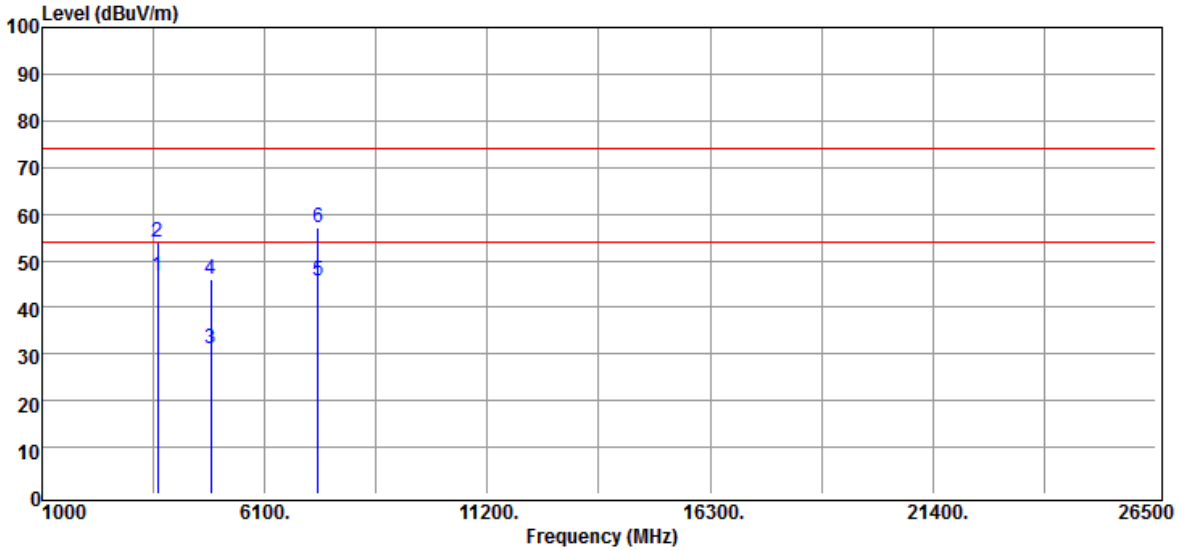
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3618.00	Average	48.35	-2.33	46.02	54.00	-7.98
3618.00	Peak	55.10	-2.33	52.77	74.00	-21.23
4824.00	Average	30.19	0.38	30.57	54.00	-23.43
4824.00	Peak	43.25	0.38	43.63	74.00	-30.37
7236.00	Average	38.71	6.06	44.77	54.00	-9.23
7236.00	Peak	50.24	6.06	56.30	74.00	-17.70

Operation Mode	:802.11n20	Test Date	:2018-06-29
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2437 MHz	Engineer	:Jerry



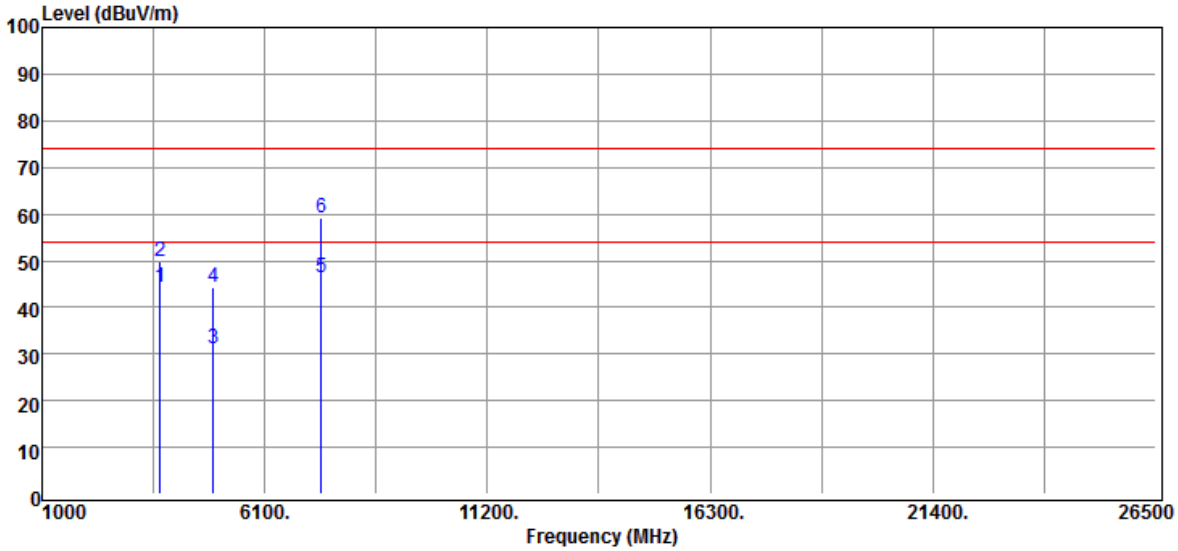
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3653.00	Average	47.51	-2.36	45.15	54.00	-8.85
3653.00	Peak	53.68	-2.36	51.32	74.00	-22.68
4874.00	Average	31.88	0.66	32.54	54.00	-21.46
4874.00	Peak	46.83	0.66	47.49	74.00	-26.51
7311.00	Average	41.23	6.54	47.77	54.00	-6.23
7311.00	Peak	55.89	6.54	62.43	74.00	-11.57

Operation Mode	:802.11n20	Test Date	:2018-06-29
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2437 MHz	Engineer	:Jerry



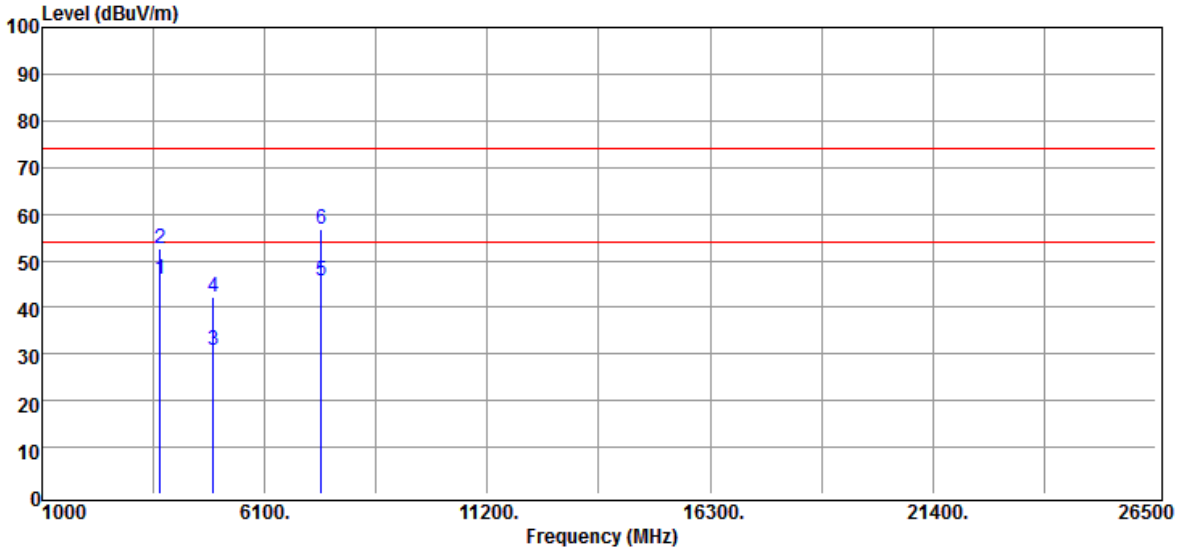
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3653.00	Average	48.96	-2.36	46.60	54.00	-7.40
3653.00	Peak	56.38	-2.36	54.02	74.00	-19.98
4874.00	Average	30.38	0.66	31.04	54.00	-22.96
4874.00	Peak	45.27	0.66	45.93	74.00	-28.07
7311.00	Average	39.07	6.54	45.61	54.00	-8.39
7311.00	Peak	50.63	6.54	57.17	74.00	-16.83

Operation Mode	:802.11n20	Test Date	:2018-06-29
Test Mode	:Tx CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:2462 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3695.00	Average	46.55	-2.41	44.14	54.00	-9.86
3695.00	Peak	52.09	-2.41	49.68	74.00	-24.32
4924.00	Average	30.12	0.97	31.09	54.00	-22.91
4924.00	Peak	43.23	0.97	44.20	74.00	-29.80
7386.00	Average	39.22	7.19	46.41	54.00	-7.59
7386.00	Peak	52.10	7.19	59.29	74.00	-14.71

Operation Mode	:802.11n20	Test Date	:2018-06-29
Test Mode	:Tx CH High	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:2462 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
3695.00	Average	48.35	-2.41	45.94	54.00	-8.06
3695.00	Peak	55.01	-2.41	52.60	74.00	-21.40
4924.00	Average	29.84	0.97	30.81	54.00	-23.19
4924.00	Peak	41.39	0.97	42.36	74.00	-31.64
7386.00	Average	38.36	7.19	45.55	54.00	-8.45
7386.00	Peak	49.61	7.19	56.80	74.00	-17.20

12 PEAK POWER SPECTRAL DENSITY

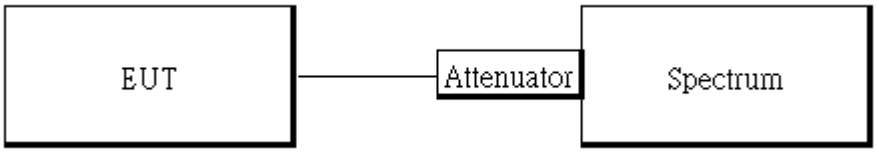
12.1 Standard Applicable

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

12.2 Measurement Equipment Used

Refer to section 8.2 for details.

12.3 Test Set-up



12.4 Measurement Procedure

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 3 kHz & VBW = 10 kHz.
5. For defining Restricted Band Edge Limit:
   Set the RBW = 100kHz & VBW = 300 kHz.
6. Detector = peak.
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum amplitude level.

12.5 Measurement Result

POWER DENSITY 802.11b			
Freq. (MHz)	PPSD (dBm)	Limit (dBm)	Result
2412	-4.87	8.00	PASS
2437	-5.88	8.00	PASS
2462	-4.82	8.00	PASS

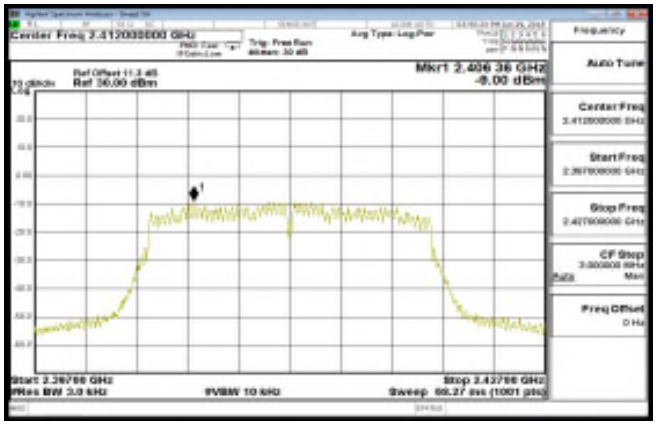
POWER DENSITY 802.11g			
Freq. (MHz)	PPSD (dBm)	Limit (dBm)	Result
2412	-9.00	8.00	PASS
2437	-8.49	8.00	PASS
2462	-7.80	8.00	PASS

POWER DENSITY 802.11n HT20			
Freq. (MHz)	PPSD (dBm)	Limit (dBm)	Result
2412	-10.16	8.00	PASS
2437	-9.76	8.00	PASS
2462	-10.31	8.00	PASS

Refer to next page for plots.

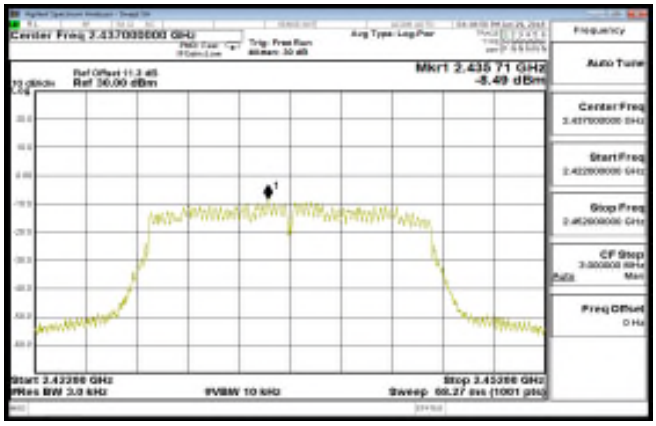
802.11b PSD(CH-Low)

802.11g PSD(CH-Low)



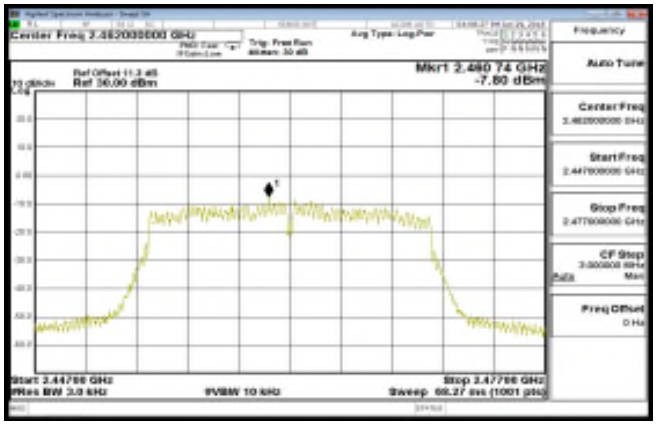
802.11b PSD (CH-Mid)

802.11g PSD (CH-Mid)

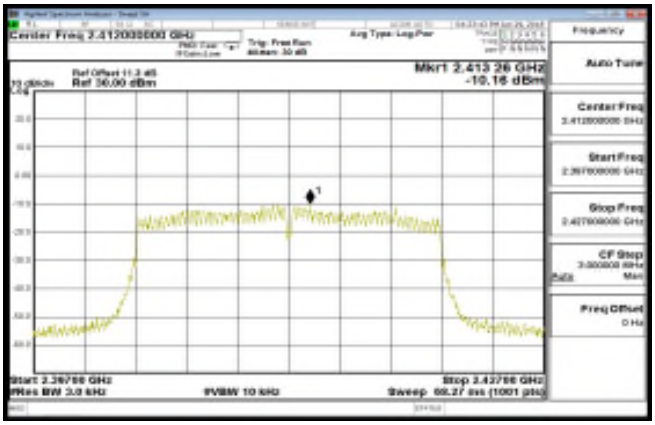


802.11b PSD (CH-High)

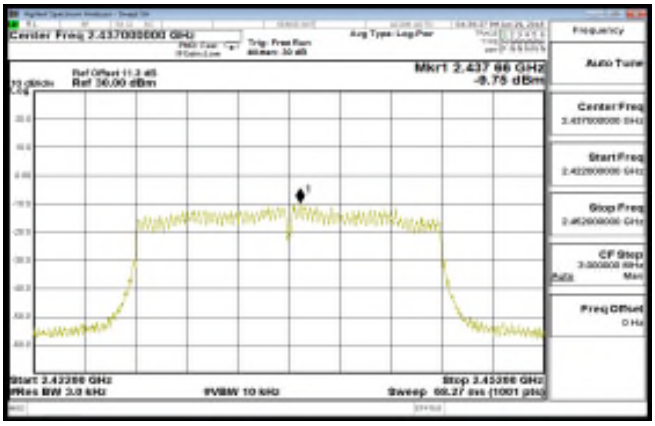
P802.11g PSD (CH-High)



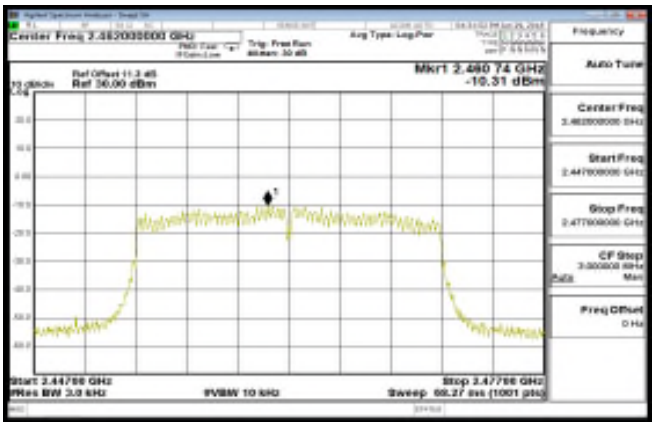
802.11n_HT20 PSD (CH-Low)



802.11n_HT20 PSD (CH-Mid)



802.11n_HT20 PSD (CH-High)



13 ANTENNA REQUIREMENT

13.1 Standard Applicable

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

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

In case of point-to-point operation, the power shall be reduced by the one dB for every 3 dB that the directional gain of antenna exceeds 6dBi.

13.2 Antenna Connected Construction

An embedded-in antenna design is used.

The antenna connector is designed with unique type RF connector and no consideration of replacement. Please see EUT photo and antenna spec. for details.

The antenna gain is less than 6dBi. Therefore, it is not necessary to reduce maximum output power limit.

~ End of Report ~