ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Applicant:	Catapult Sports Pty Ltd 75-83 High St, Prahran, Melbourne Victoria 3181 AUS
Product Name:	Receiver/Anchor
Brand Name:	Catapult
Model No.:	VR7401
Model Difference:	N/A
Report Number:	T190606W03-RP1
FCC ID:	2ADAL-VR7401
FCC Rule Part:	§15.247, Cat: DTS
Issue Date:	Jul. 16, 2019
Date of Test:	May 30, 2019 ~ Jun. 19, 2019
Date of EUT Received:	May 30, 2019
Issued by:	Compliance Certification Services Inc.Wugu Lab. No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.) service@ccsrf.com

The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.10: 2013 and compliance standards.
The test results of this report relate only to the tested sample (EUT) identified in this report.
The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc. (Wugu Laboratory).

Tested By: Gary Lee

Gary Lee / Engineer

Approved By: Kevin Tsai

Kevin Tsai / Deputy Manager

Testing Laboratory 1309

Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
T190606W03-RP1	Rev.00	Initial creation of document	All	Jul. 02, 2019	Elle Chang
T190606W03-RP1	Rev.01	Updated frequency range, channel, data of band edge and spurious emission	Page 4, 30~33	Jul. 16, 2019	Elle Chang

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1 GENERAL INFORMATION

1.1 Product description

Product Name:	Receiver/Anchor	
Brand Name:	Catapult	
Model No.:	VR7401	
Model Difference:	N/A	
Hardware Version:	N/A	
Software Version:	N/A	
Power Supply:	3.7Vdc from Rechargeable Li-polymer Battery	
	Battery:	Model No.: 105085 Supplier: XPOWER SUOLUTION TECHNOLOGY

Wi-Fi 802.11	Frequency Range	Channels	Rated Power (dBm)	Modulation Technology
b	2412-2462	11	16.86	DSSS,
g			19.81	OFDM
n_HT20			18.68	
n_HT40	2422-2452	9	18.16	
Antenna Designation:	PCB Antenna, Antenna Gain: 4.79dBi			
Modulation type:	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM			
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 – 72.2Mbps 802.11 n_40MHz: 13.5 - 150.0Mbps			

1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 15.247 Meas. Guidance v05r02

ANSI C63.10:2013

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

1.3 Test Facility

Compliance Certification Services Inc. Wugu Lab. No.11, Wugong 6th Rd.,

Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.) (TAF code 1309)

FCC Designation number: TW1309

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.

1.6 Radiated Emission Test Sites For Measurements From 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.
There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

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 a 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 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 Radiated Emissions

The EUT is a placed on a 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 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 Configuration of Tested System

Fig. 2-1 Conducted Emission Configuration

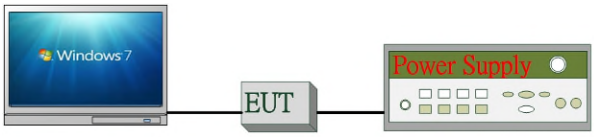


Fig. 2-2 Radiated Emission Configuration

Fig. 2-3 AC Power Line Conducted Emission

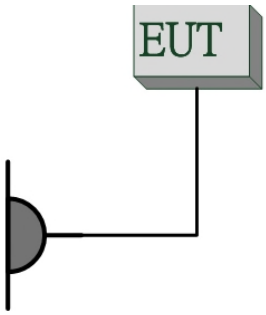


Table 2-1 Equipment Used in Tested System

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
2	DC Power Supply	Agilent	E3640A	MY52410006	N/A	Un-shielded
3	Notebook	Lenovo	T440P	PC-089AH5	Shielded	Un-shielded

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 & 99% 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	7	2442 MHz
2	2417 MHz	8	2447 MHz
3	2422 MHz	9	2452 MHz
4	2427 MHz	10	2457 MHz
5	2432 MHz	11	2462 MHz
6	2437 MHz		

7 channels are provided for 802.11n_HT40

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
3	2422 MHz	7	2442 MHz
4	2427 MHz	8	2447 MHz
5	2432 MHz	9	2452 MHz
6	2437 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)
802.11g	1 to 11	1,6,11	OFDM	6

RADIATED EMISSION TEST (ABOVE 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
802.11b	1 to 11	1, 6, 11	DSSS	1
802.11g	1 to 11	1, 6, 11	OFDM	6
802.11n (HT20)	1 to 11	1, 6, 11	OFDM	MCS 0
802.11n (HT40)	3 to 9	3, 6, 9	OFDM	MCS 0

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 E2 position was reported.

ANTENNA PORT CONDUCTED MEASUREMENT:

CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
802.11b	1 to 11	1, 6, 11	DSSS	1
802.11g	1 to 11	1, 6, 11	OFDM	6
802.11n (HT20)	1 to 11	1, 6, 11	OFDM	MCS 0
802.11n (HT40)	3 to 9	3, 6, 9	OFDM	MCS 0

5 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	+/- 1.2575 dB
Peak Output Power	+/- 1.92 dB
6dB Bandwidth	+/- 61.248 Hz
100 kHz Bandwidth of Frequency Band Edges	+/- 1.92 dB
Peak Power Density	+/- 1.996 dB
3M Semi Anechoic Chamber / 30M~200M	+/- 4.12 dB
3M Semi Anechoic Chamber / 200M~1000M	+/- 4.68 dB
3M Semi Anechoic Chamber / 1G~8G	+/- 5.18 dB
3M Semi Anechoic Chamber / 8G~18G	+/- 5.47 dB
3M Semi Anechoic Chamber / 18G~26G	+/- 3.81 dB
3M Semi Anechoic Chamber / 26G~40G	+/- 3.87 dB

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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.		

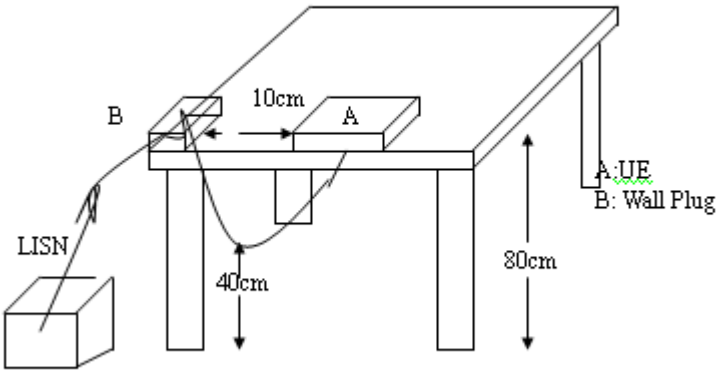
6.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
CABLE	EMCI	CFD300-NL	CERF	06/29/2018	06/28/2019
EMI Test Receiver	R&S	ESCI	100064	07/24/2018	07/23/2019
LISN	SCHWARZ-BECK	NSLK 8127	8127-541	01/31/2019	01/30/2020
LISN	SCHAFFNER	NNB 41	03/10013	02/13/2019	02/12/2020
Adapter	SAMSUNG	ETA-U90JWS	RT4D402KS/B		
Software	EZ-EMC(CCS-3A1-CE)				

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

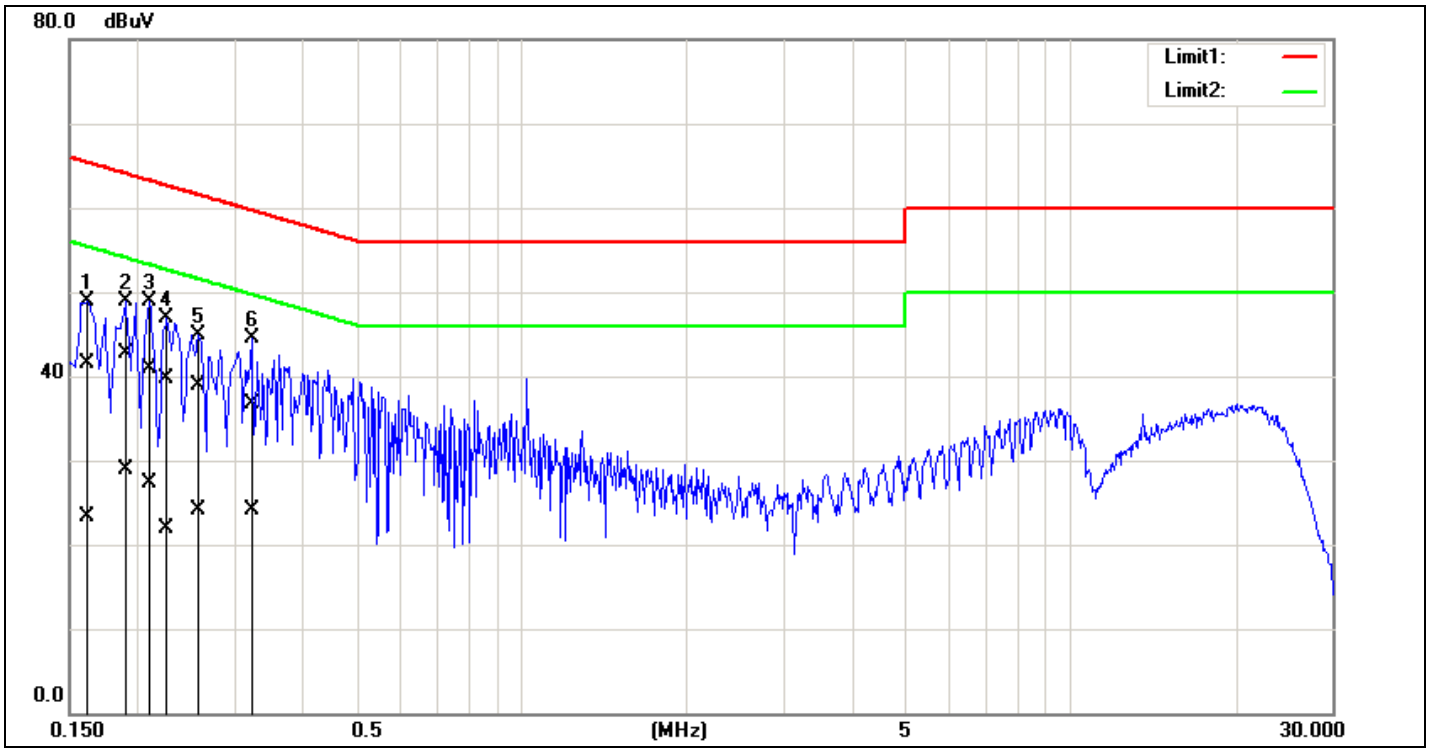
1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

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.

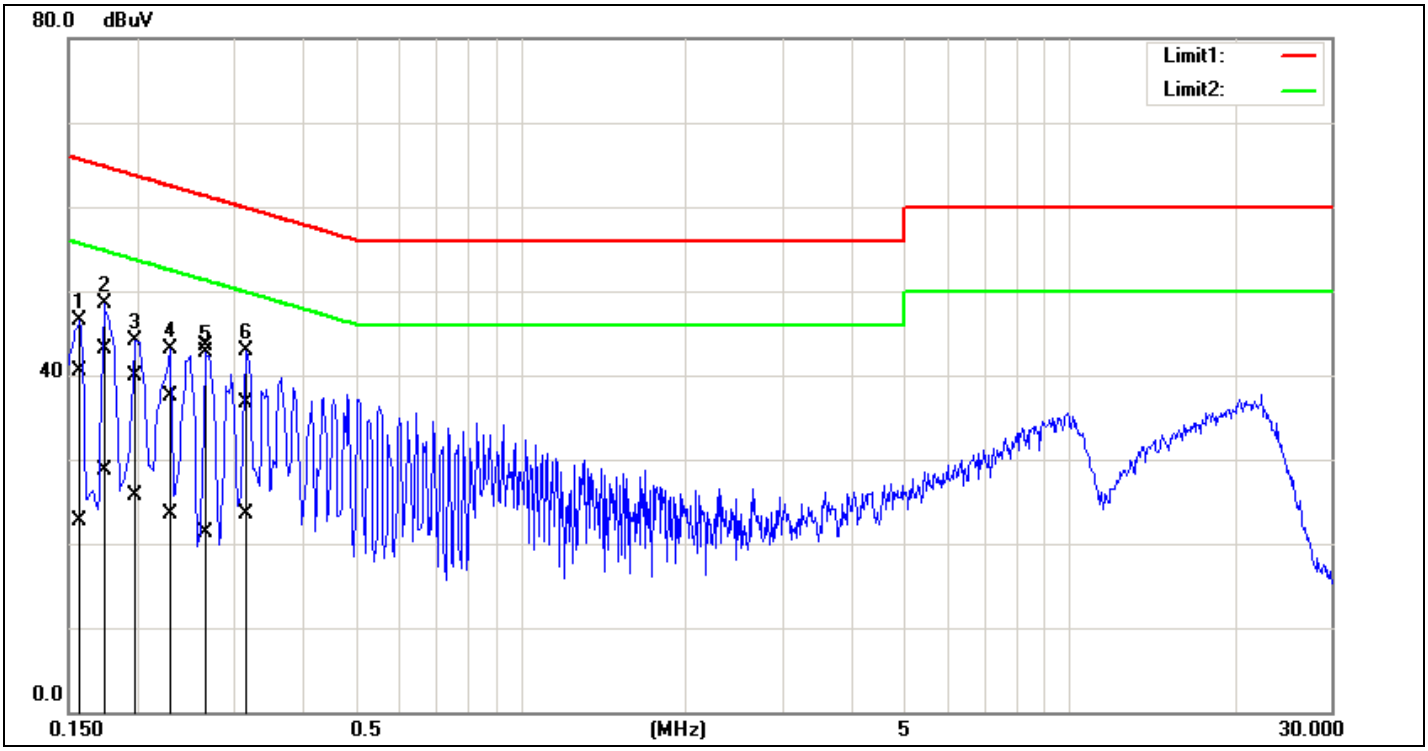
AC POWER LINE CONDUCTED EMISSION TEST DATA

Description:	**Operation**	**Date:**	**2019/6/17**
Line:	**L1**	**Temp.(℃)/Hum.(%):**	**24.8(℃)/58%**
Test Voltage:	**AC 120V/60Hz**	**Test By:**	**Gary**



No.	Frequency	QuasiPeak reading	Average reading	Correction factor	QuasiPeak result	Average result	QuasiPeak limit	Average limit	QuasiPeak margin	Average margin	Remark
	(MHz)	(dBuV)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dBuV)	(dBuV)	(dB)	(dB)	
1	0.1620	31.42	13.10	10.14	41.56	23.24	65.36	55.36	-23.80	-32.12	Pass
2*	0.1900	32.49	18.78	10.13	42.62	28.91	64.04	54.04	-21.42	-25.13	Pass
3	0.2100	30.80	17.25	10.13	40.93	27.38	63.21	53.21	-22.28	-25.83	Pass
4	0.2260	29.52	11.83	10.13	39.65	21.96	62.60	52.60	-22.95	-30.64	Pass
5	0.2580	28.71	13.97	10.13	38.84	24.10	61.50	51.50	-22.66	-27.40	Pass
6	0.3220	26.53	14.06	10.14	36.67	24.20	59.66	49.66	-22.99	-25.46	Pass

Description:	**Operation**	**Date:**	**2019/6/17**
Line:	**N**	**Temp.(℃)/Hum.(%):**	**24.8(℃)/58%**
Test Voltage:	**AC 120V/60Hz**	**Test By:**	**Gary**



No.	Frequency	QuasiPeak reading	Average reading	Correction factor	QuasiPeak result	Average result	QuasiPeak limit	Average limit	QuasiPeak margin	Average margin	Remark
	(MHz)	(dBuV)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dBuV)	(dBuV)	(dB)	(dB)	
1	0.1580	30.48	12.74	10.02	40.50	22.76	65.56	55.57	-25.06	-32.81	Pass
2	0.1740	33.14	18.61	10.02	43.16	28.63	64.76	54.77	-21.60	-26.14	Pass
3	0.1986	29.83	15.59	10.02	39.85	25.61	63.66	53.67	-23.81	-28.06	Pass
4	0.2300	27.42	13.46	10.02	37.44	23.48	62.45	52.45	-25.01	-28.97	Pass
5*	0.2660	33.44	11.26	10.02	43.46	21.28	61.24	51.24	-17.78	-29.96	Pass
6	0.3180	26.63	13.40	10.03	36.66	23.43	59.76	49.76	-23.10	-26.33	Pass

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:

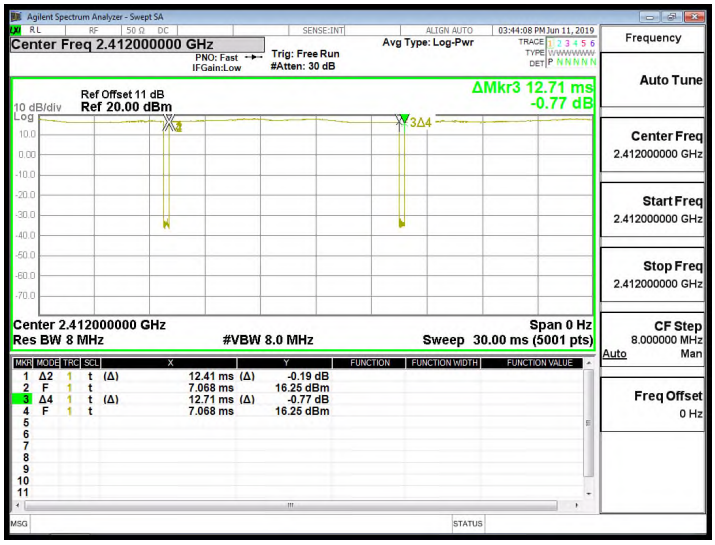
	Duty Cycle (%)	Duty Factor (dB)	1/T (kHz)	VBW setting (kHz)
802.11b	97.69	0.10	0.08	1.00
802.11g	87.20	0.59	0.48	1.00
802.11n_20	86.41	0.63	0.52	1.00
802.11n_40	90.25	0.45	1.06	2.00

b = 97.69%, g = 87.2%,n_ht_20 = 86.41%n_ht_40 = 90.25%

Duty Cycle Factor: 10 * log(1/0.9769) = 0.1
Duty Cycle Factor: 10 * log(1/0.872) = 0.59
Duty Cycle Factor: 10 * log(1/0.8641) = 0.63
Duty Cycle Factor: 10 * log(1/0.9025) = 0.45

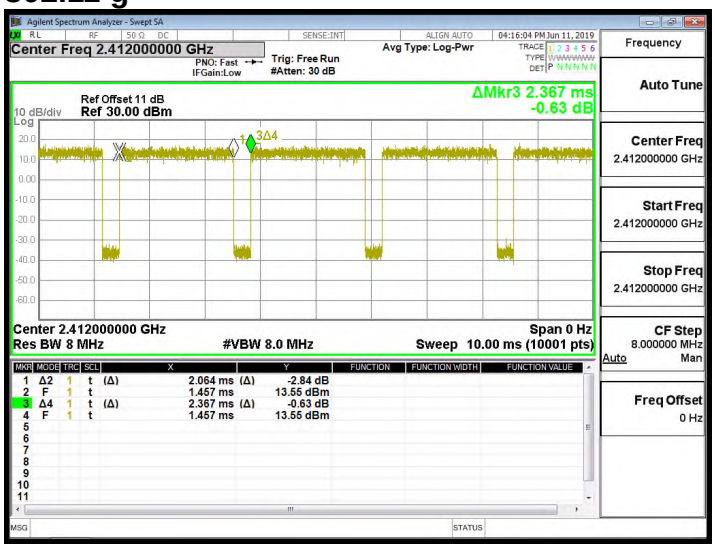
7.1 DUTY CYCLE TEST SIGNAL Measurement Result

802.11 b



802.11 n20

802.11 g



802.11 n40

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.

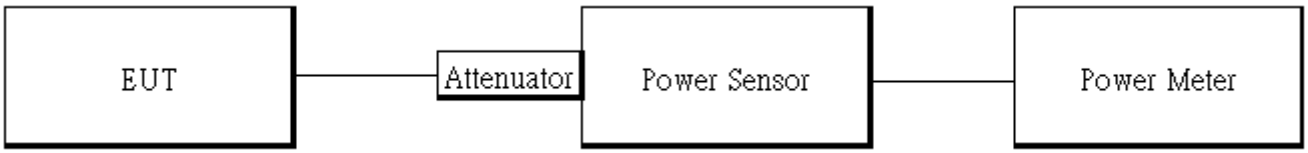
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

8.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
DC Power Supply	Agilent	E3640A	KR93300208	08/15/2018	08/14/2019
Power Meter	Anritsu	ML2496A	1242004	10/23/2018	10/22/2019
Power Sensor	Anritsu	MA2411B	1207365	10/23/2018	10/22/2019
Power Sensor	Anritsu	MA2411B	1207368	10/24/2018	10/23/2019

8.3 Test Set-up

Power Meter:



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 Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	16.75	30.00	PASS
6	2437	1	16.58	30.00	PASS
11	2462	1	**16.86**	30.00	PASS
802.11b Ch0					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	1	13.69	30.00	PASS
6	2437	1	13.57	30.00	PASS
11	2462	1	**13.89**	30.00	PASS

802.11g Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	**19.81**	30.00	PASS
6	2437	6	19.53	30.00	PASS
11	2462	6	19.76	30.00	PASS
802.11g Ch0					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	6	**12.85**	30.00	PASS
6	2437	6	12.72	30.00	PASS
11	2462	6	12.76	30.00	PASS

802.11n_HT20M Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	**18.68**	30.00	PASS
6	2437	MCS0	18.53	30.00	PASS
11	2462	MCS0	0.00	30.00	PASS
802.11n_HT20M Ch0					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	10.82	30.00	PASS
6	2437	MCS0	10.79	30.00	PASS
11	2462	MCS0	**10.85**	30.00	PASS

802.11n_HT40M Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit (dBm)	RESULT
3	2422	MCS0	**18.16**	30.00	PASS
6	2437	MCS0	18.08	30.00	PASS
9	2452	MCS0	17.68	30.00	PASS
802.11n_HT40M Ch0					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit (dBm)	RESULT
3	2422	MCS0	**10.94**	30.00	PASS
6	2437	MCS0	10.73	30.00	PASS
9	2452	MCS0	10.77	30.00	PASS

Note

Cable Loss *11.00* *dB*

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

9 6DB BANDWIDTH MEASUREMENT

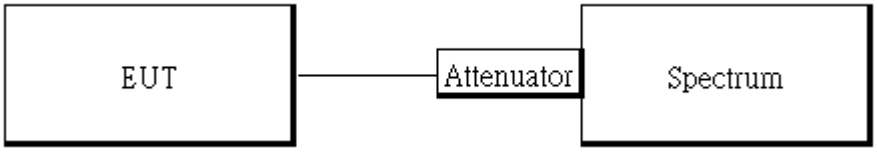
9.1 Standard Applicable

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

9.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
DC Power Supply	Agilent	E3640A	KR93300208	08/15/2018	08/14/2019
Spectrum Analyzer	Agilent	N9010A	MY53400256	11/21/2018	11/20/2019
DC Block	Mini-Circuits	BLK-18-S+	31129(1)	02/26/2019	02/25/2020

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. For 99% Bandwidth:

   Set the spectrum analyzer as RBW=1%, VBW = 3*RBW, Span = 30M/50MHz, Detector=Sample, Sweep=auto.
7. Turn on the 99% bandwidth function, max reading.
8. Repeat above procedures until all frequency of interest measured was complete.

9.5 Measurement Result

6dB Bandwidth

802.11b Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	7581.00	> 500	PASS
2437	**8068.00**	> 500	PASS
2462	8057.00	> 500	PASS

802.11g Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	**16360.00**	> 500	PASS
2437	**16360.00**	> 500	PASS
2462	**16360.00**	> 500	PASS

802.11_n_HT20 Ch0

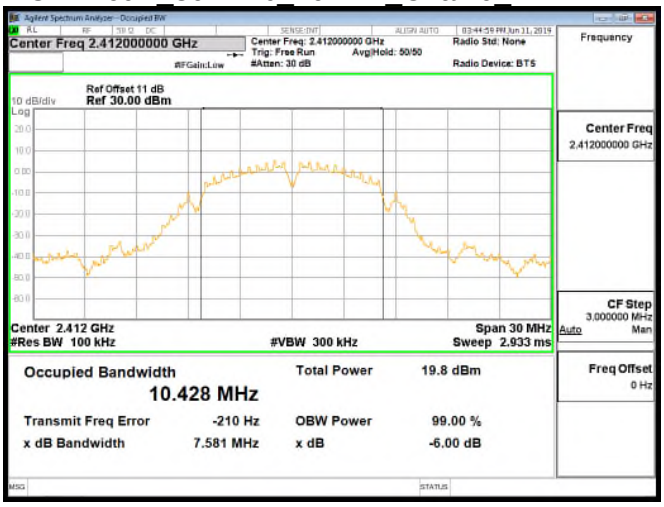
Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	17600.00	> 500	PASS
2437	**17610.00**	> 500	PASS
2462	17600.00	> 500	PASS

802.11_n_HT40 Ch0

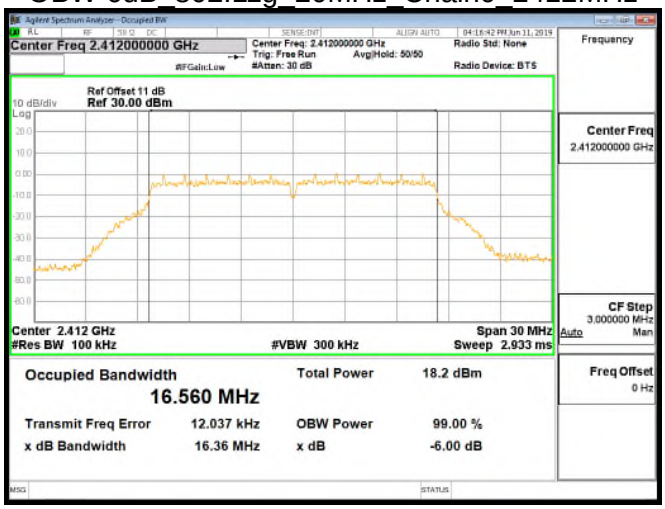
Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2422	36340.00	> 500	PASS
2437	36290.00	> 500	PASS
2452	**36350.00**	> 500	PASS

Refer to next page for plots

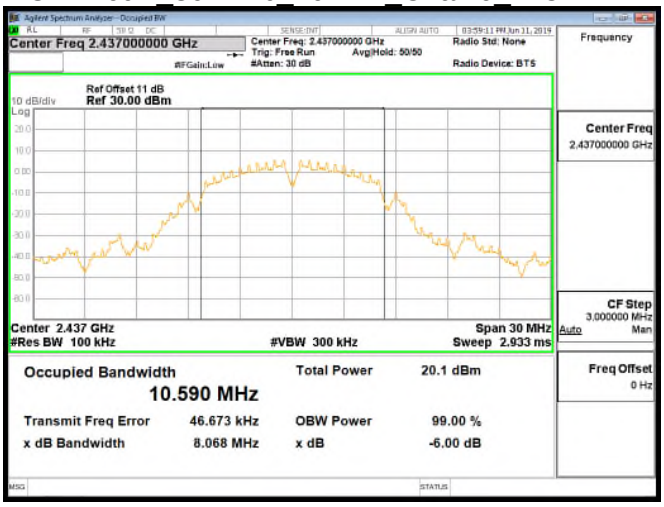
OBW 6dB_802.11b_20MHz_Chain0_2412MHz



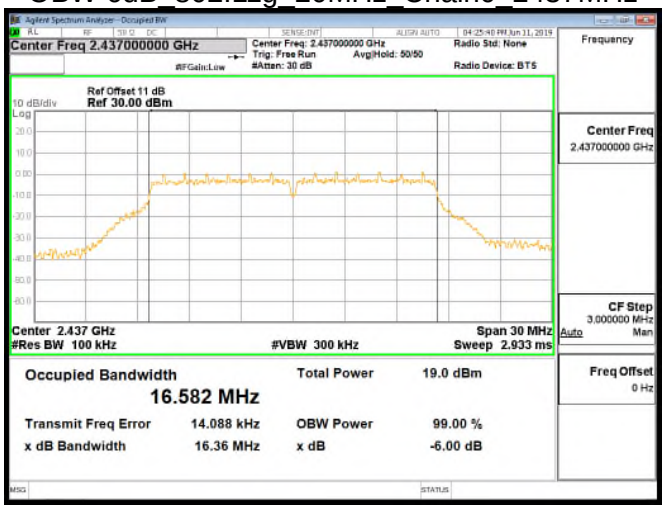
OBW 6dB_802.11g_20MHz_Chain0_2412MHz



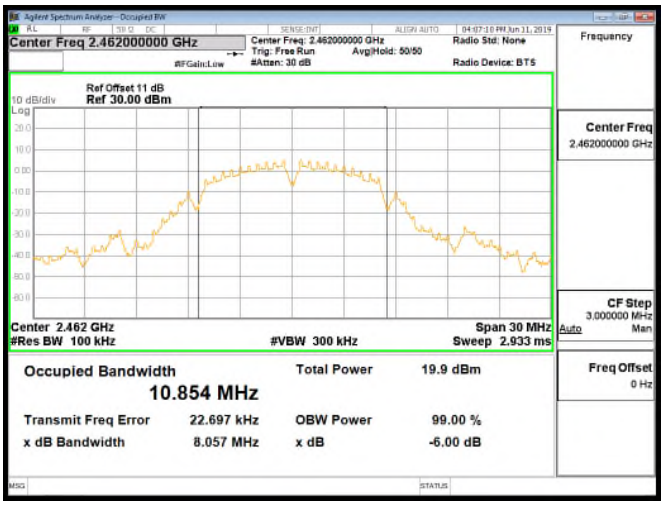
OBW 6dB_802.11b_20MHz_Chain0_2437MHz



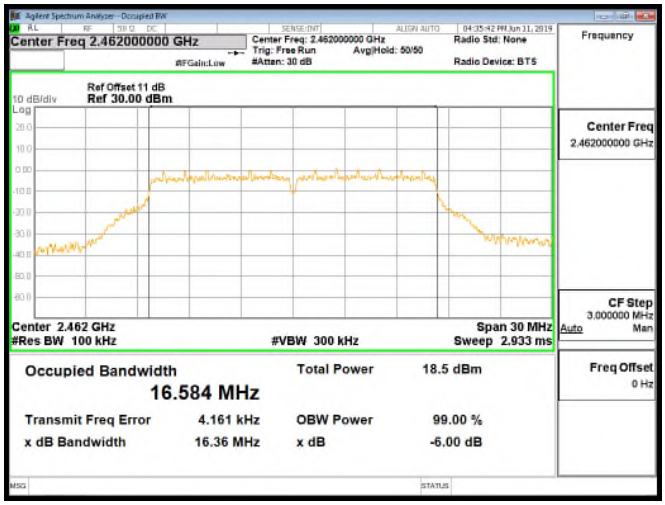
OBW 6dB_802.11g_20MHz_Chain0_2437MHz



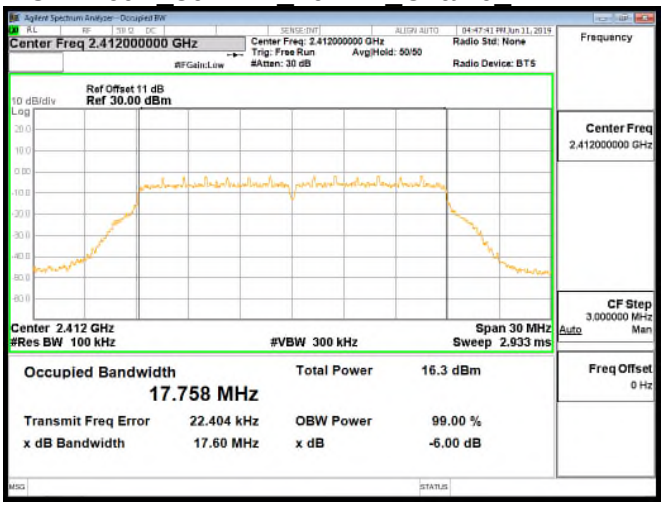
OBW 6dB_802.11b_20MHz_Chain0_2462MHz



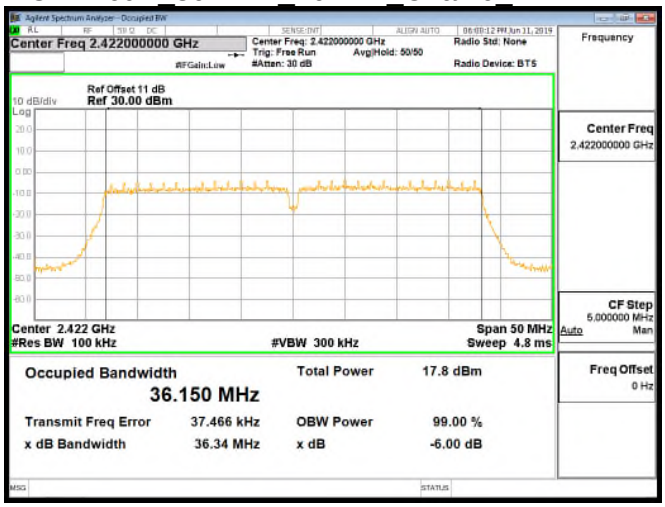
OBW 6dB_802.11g_20MHz_Chain0_2462MHz



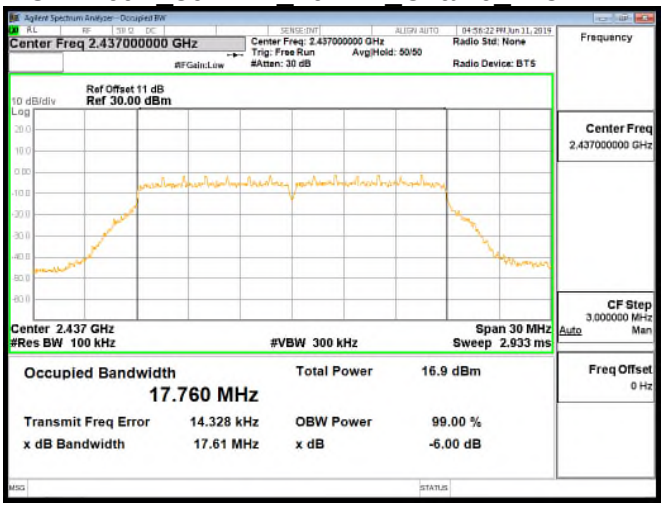
OBW 6dB_802.11n_20MHz_Chain0_2412MHz



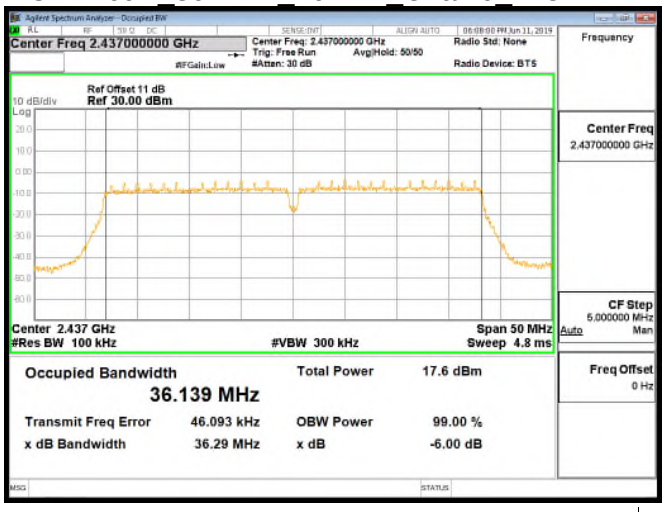
OBW 6dB_802.11n_40MHz_Chain0_2422MHz



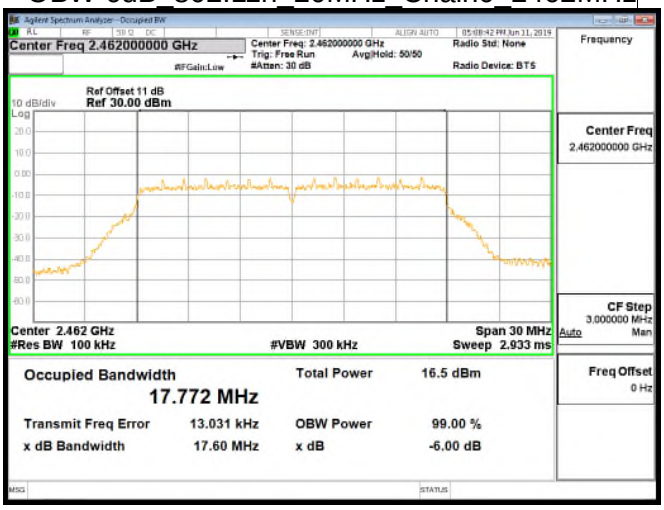
OBW 6dB_802.11n_20MHz_Chain0_2437MHz



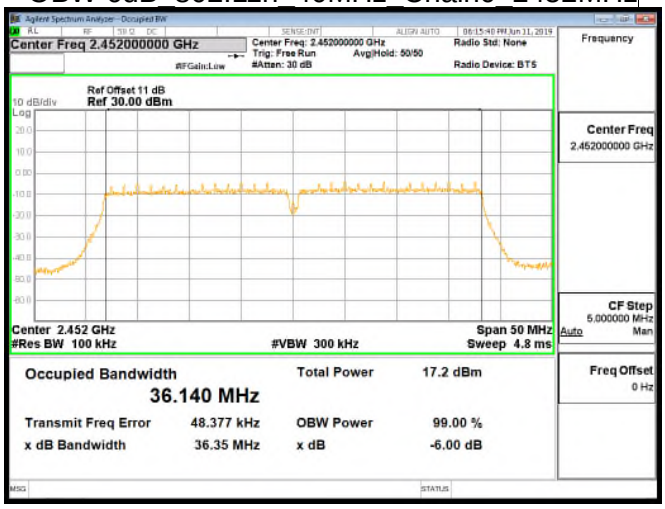
OBW 6dB_802.11n_40MHz_Chain0_2437MHz



OBW 6dB_802.11n_20MHz_Chain0_2462MHz



OBW 6dB_802.11n_40MHz_Chain0_2452MHz



10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

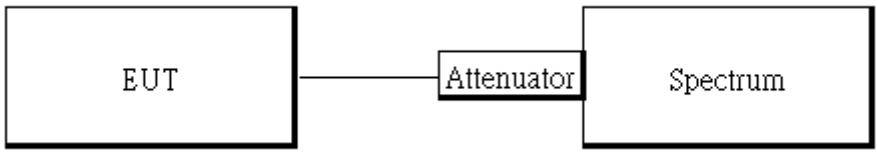
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the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

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.

10.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
DC Power Supply	Agilent	E3640A	KR93300208	08/15/2018	08/14/2019
Spectrum Analyzer	Agilent	N9010A	MY53400256	11/21/2018	11/20/2019
DC Block	Mini-Circuits	BLK-18-S+	31129(1)	02/26/2019	02/25/2020

10.3 Test SET-UP



10.4 Measurement Procedure

Reference Level of Emission Limit:

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.
9. 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.

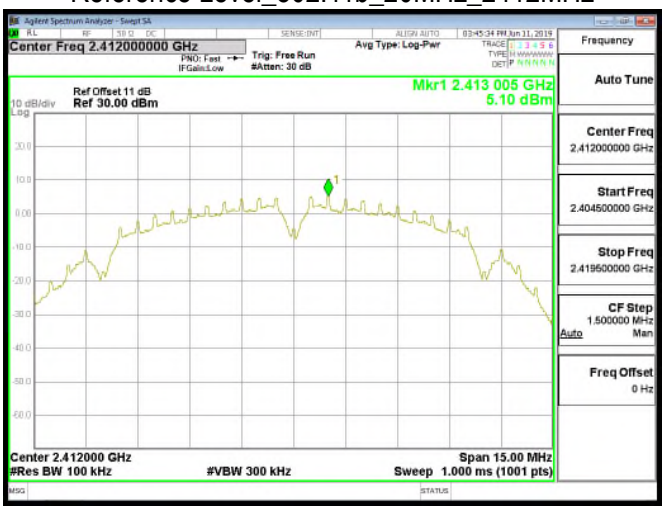
10.5 Measurement Result

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	5.10	-14.90	2412	0.20	-19.80
2437	5.21	-14.79	2437	1.06	-18.94
2462	4.99	-15.01	2462	0.49	-19.51
Reference Level of Limit 802.11n20 mode			**Reference Level of Limit 802.11n40 MODE**		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)	Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	-1.91	-21.91	2422	-3.48	-23.48
2437	-1.31	-21.31	2437	-3.54	-23.54
2462	-1.74	-21.74	2452	-4	-24.00

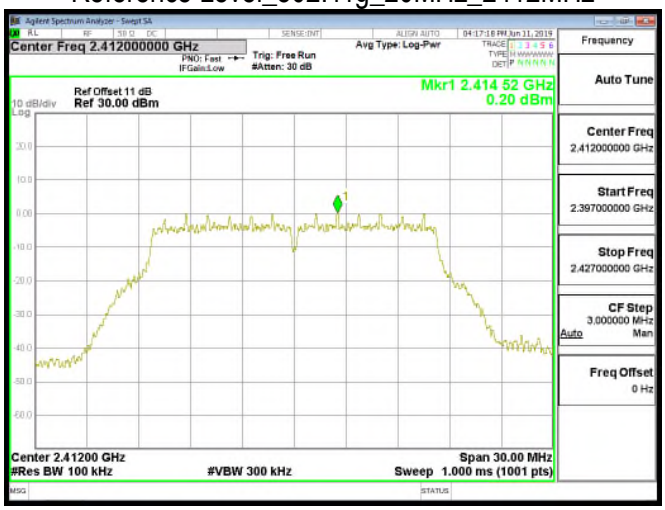
Note

Cable Loss *11.00* *dB*

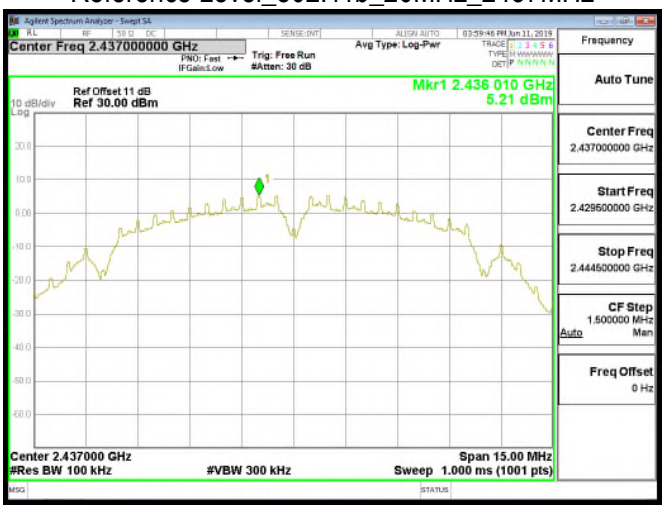
Reference Level_802.11b_20MHz_2412MHz



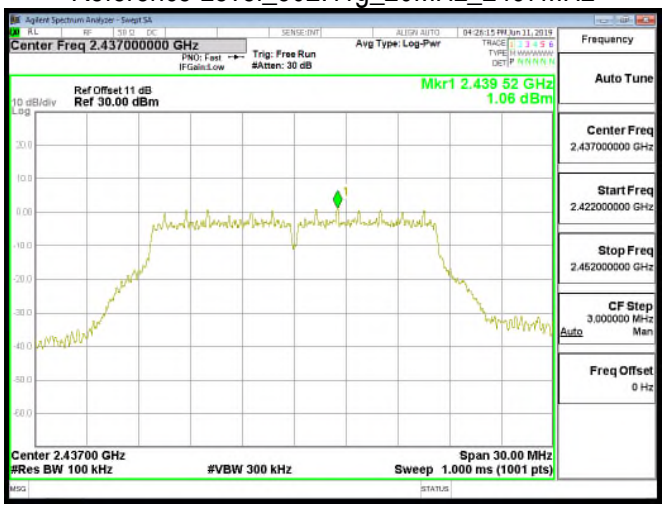
Reference Level_802.11g_20MHz_2412MHz



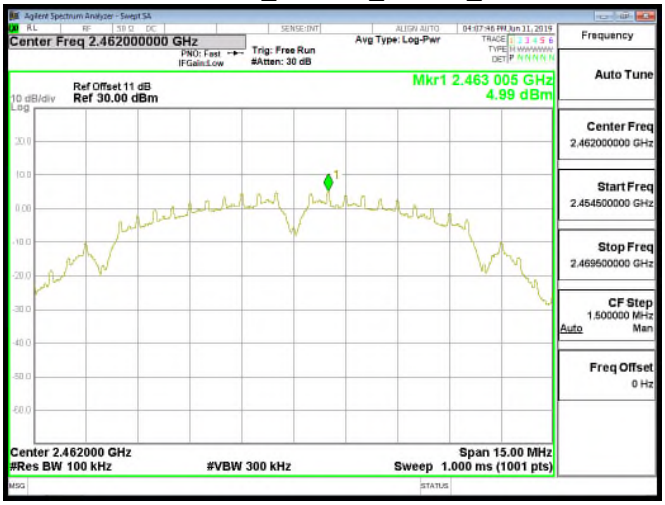
Reference Level_802.11b_20MHz_2437MHz



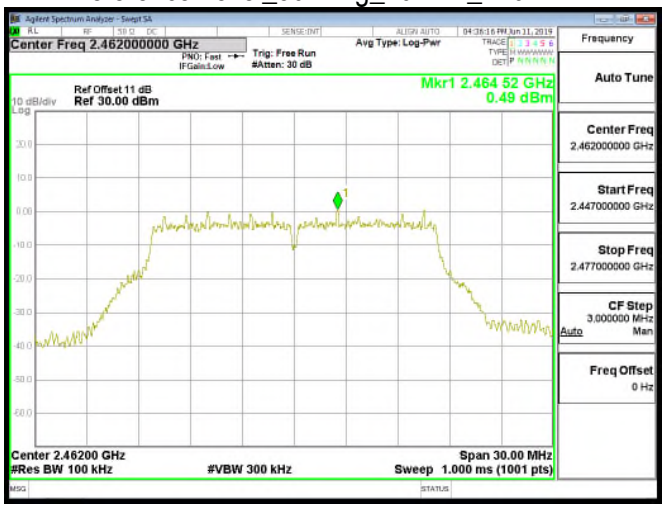
Reference Level_802.11g_20MHz_2437MHz



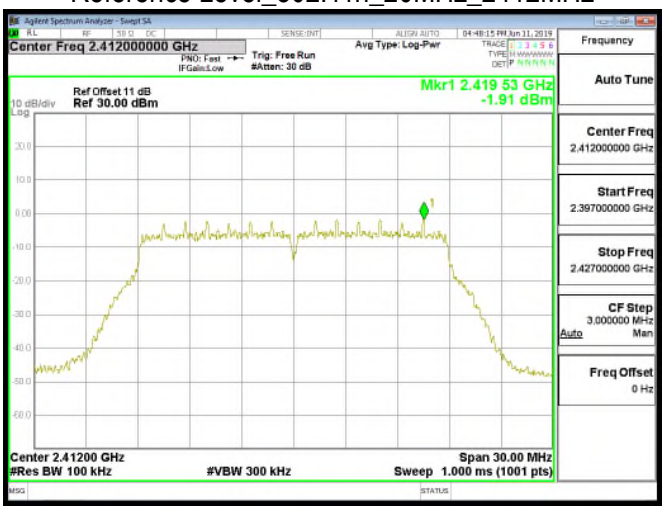
Reference Level_802.11b_20MHz_2462MHz



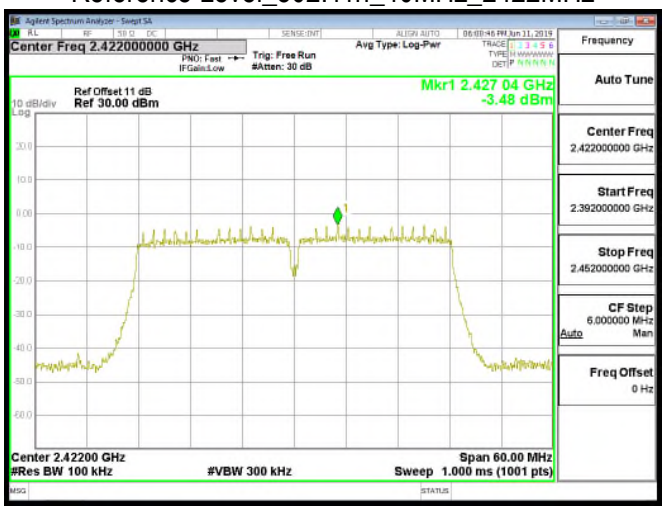
Reference Level_802.11g_20MHz_2462MHz



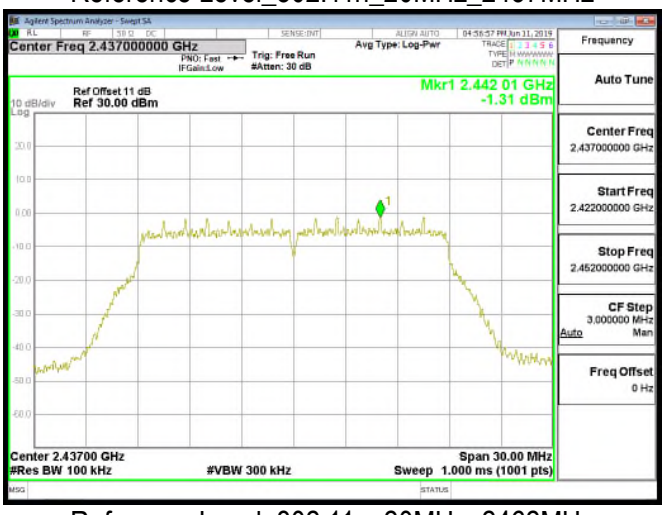
Reference Level_802.11n_20MHz_2412MHz



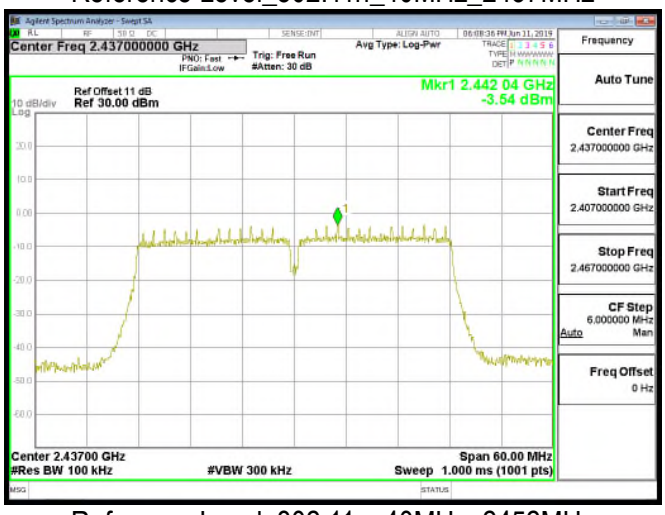
Reference Level_802.11n_40MHz_2422MHz



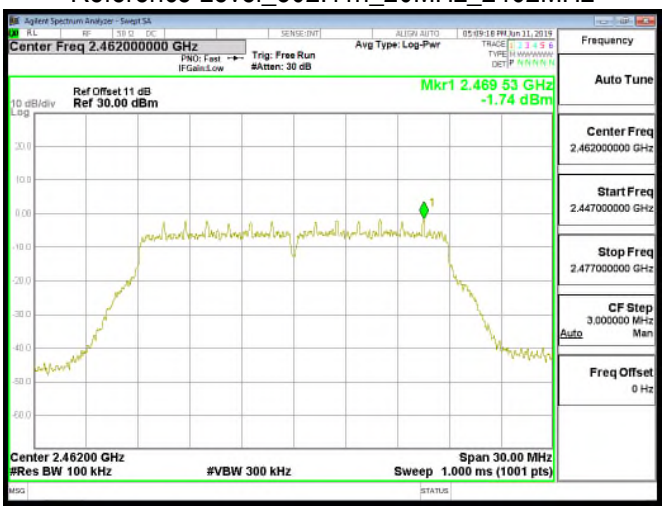
Reference Level_802.11n_20MHz_2437MHz



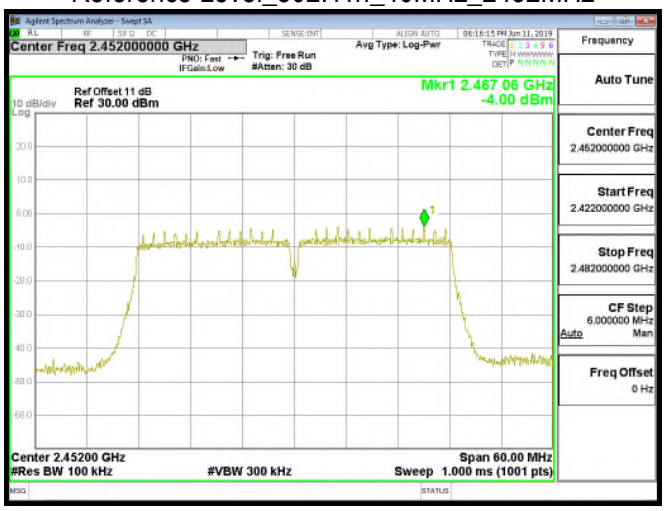
Reference Level_802.11n_40MHz_2437MHz



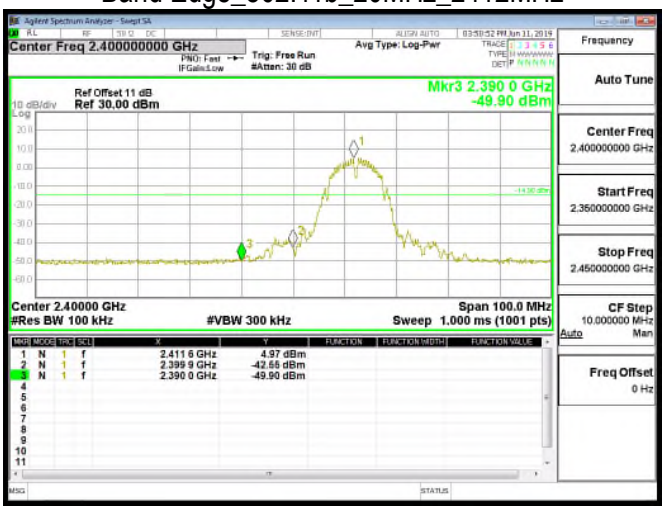
Reference Level_802.11n_20MHz_2462MHz



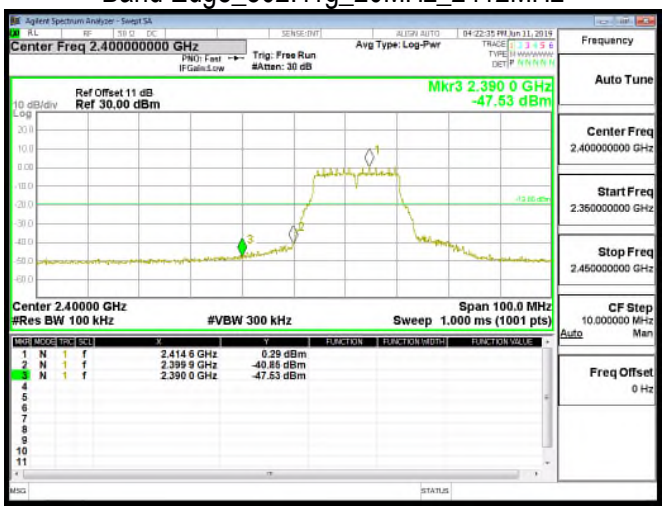
Reference Level_802.11n_40MHz_2452MHz



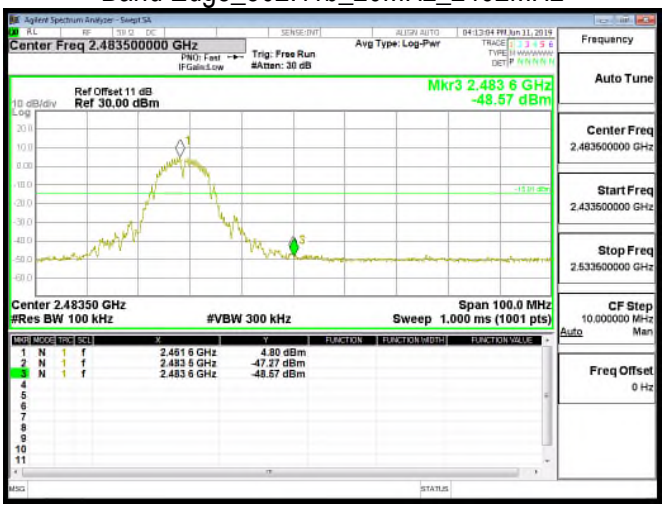
Band Edge_802.11b_20MHz_2412MHz



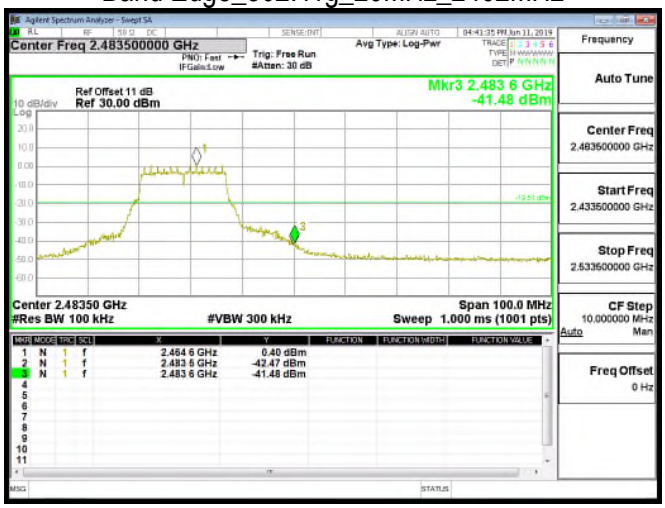
Band Edge_802.11g_20MHz_2412MHz



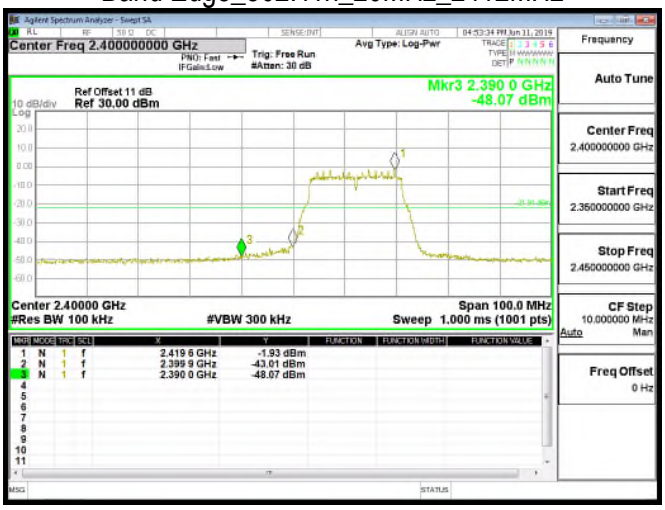
Band Edge_802.11b_20MHz_2462MHz



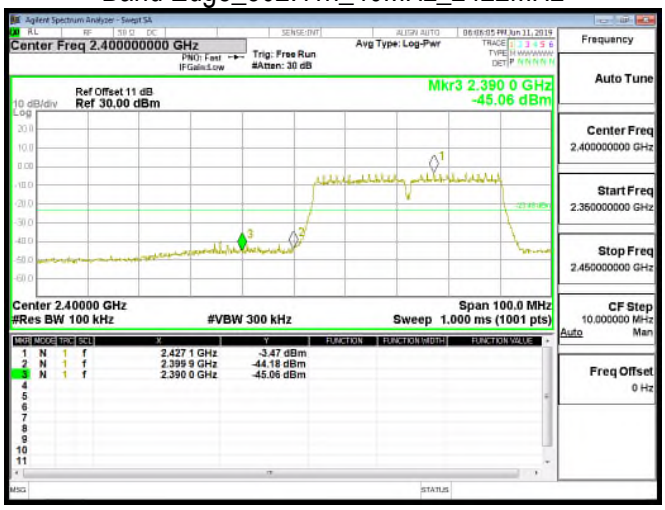
Band Edge_802.11g_20MHz_2462MHz



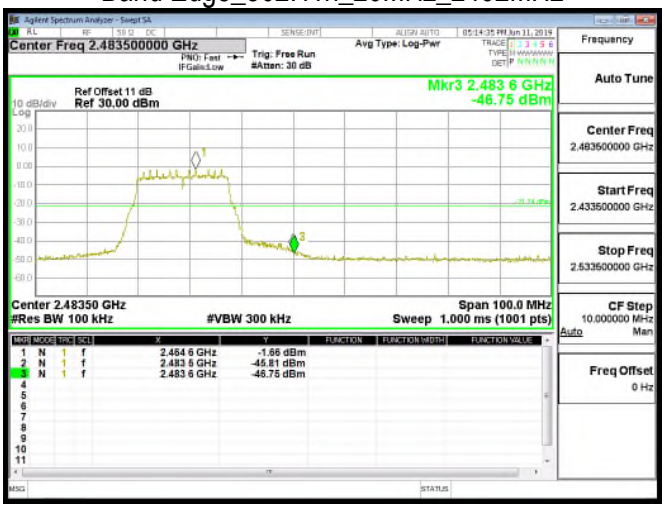
Band Edge_802.11n_20MHz_2412MHz



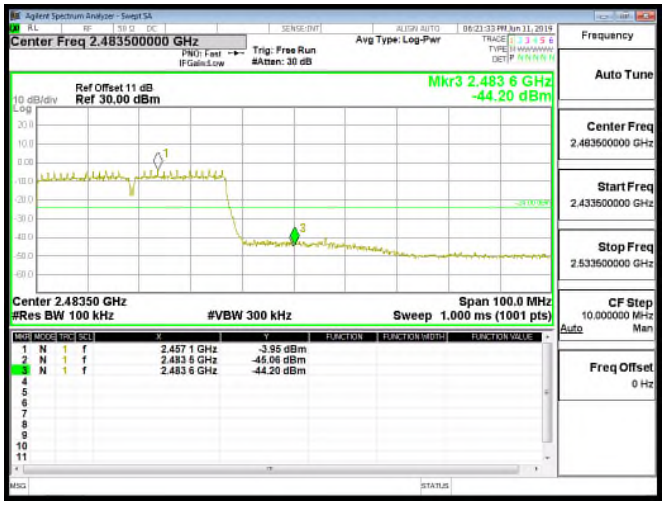
Band Edge_802.11n_40MHz_2422MHz



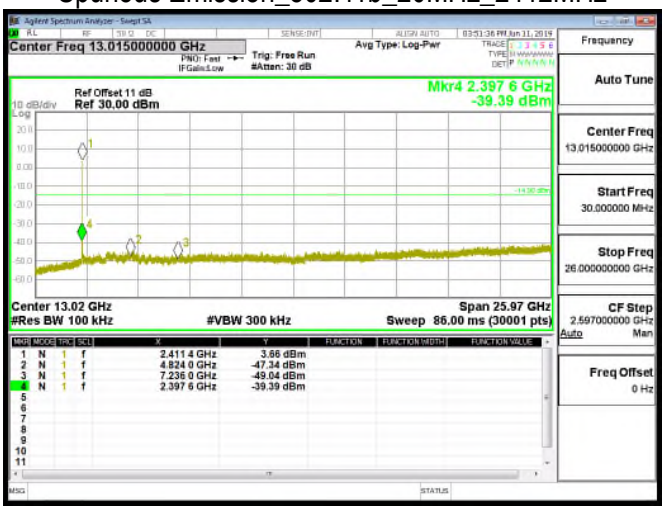
Band Edge_802.11n_20MHz_2462MHz



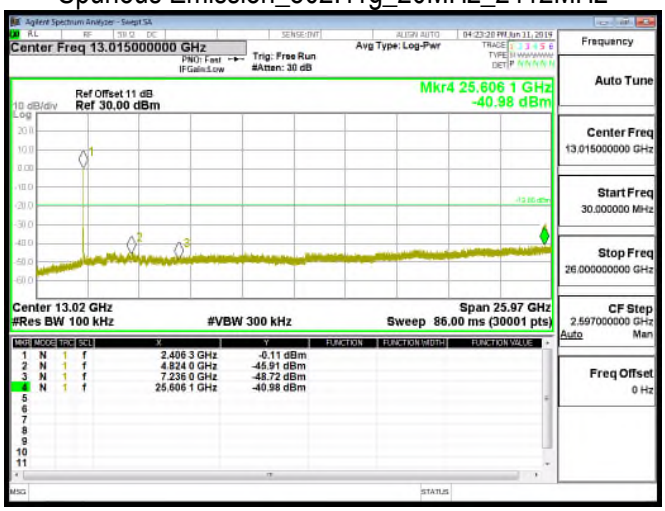
Band Edge_802.11n_40MHz_2452MHz



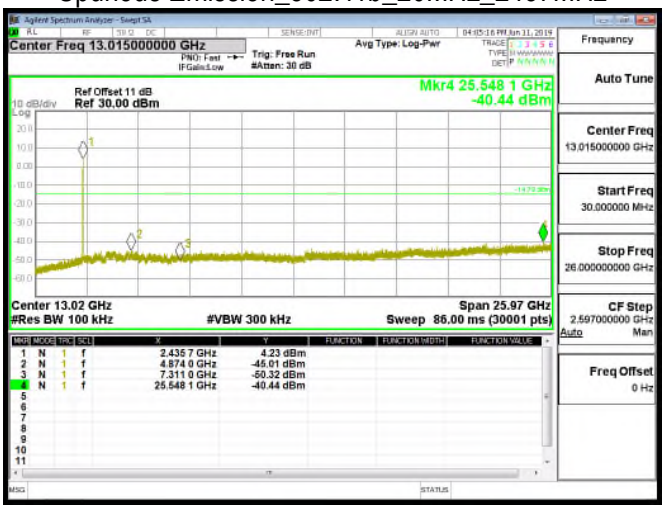
Spurious Emission_802.11b_20MHz_2412MHz



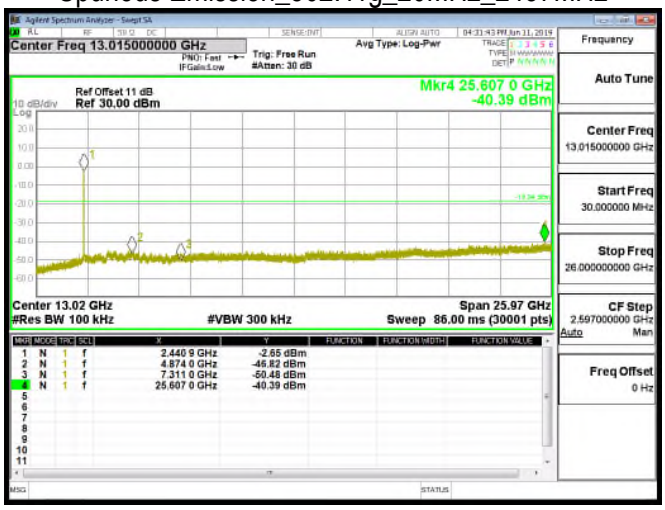
Spurious Emission_802.11g_20MHz_2412MHz



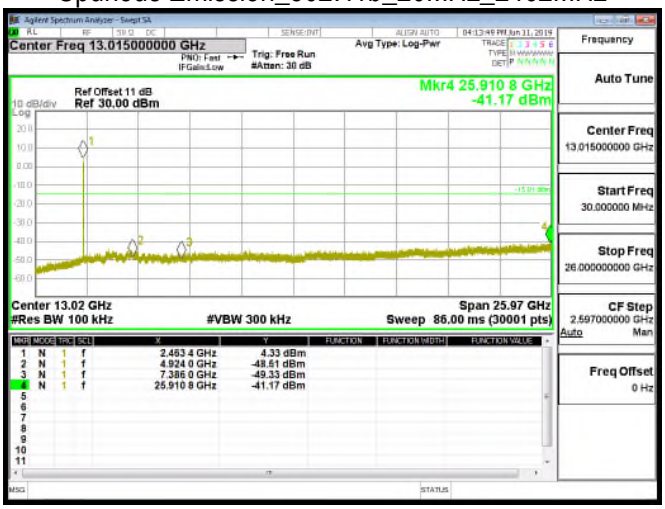
Spurious Emission_802.11b_20MHz_2437MHz



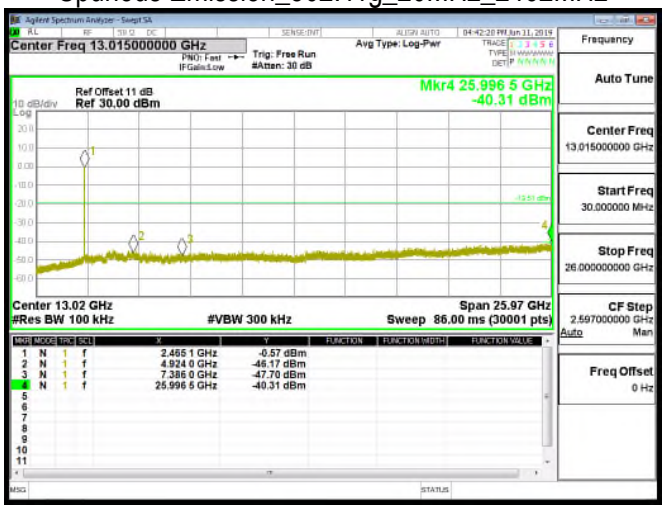
Spurious Emission_802.11g_20MHz_2437MHz



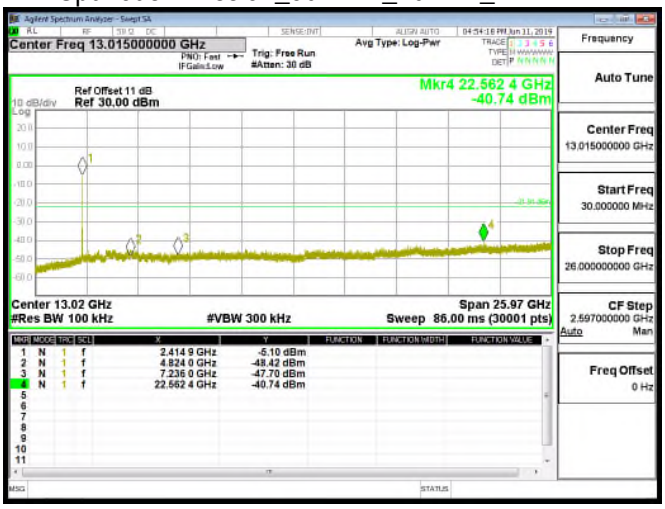
Spurious Emission_802.11b_20MHz_2462MHz



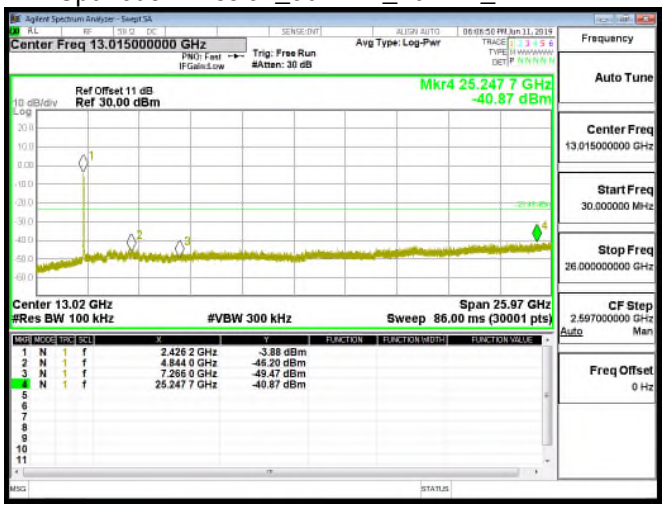
Spurious Emission_802.11g_20MHz_2462MHz



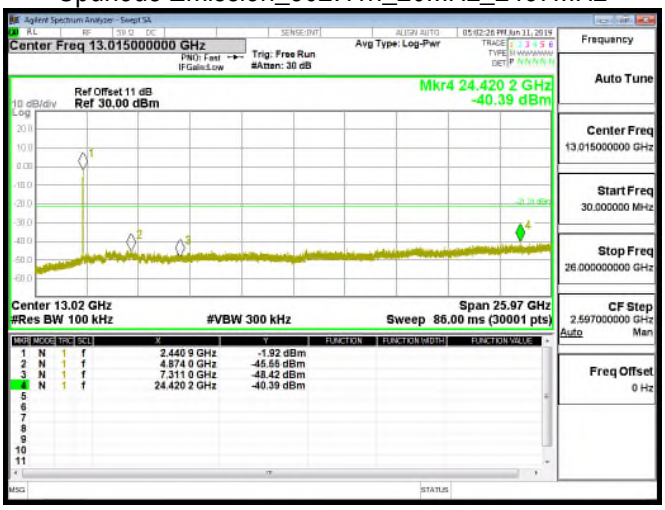
Spurious Emission_802.11n_20MHz_2412MHz



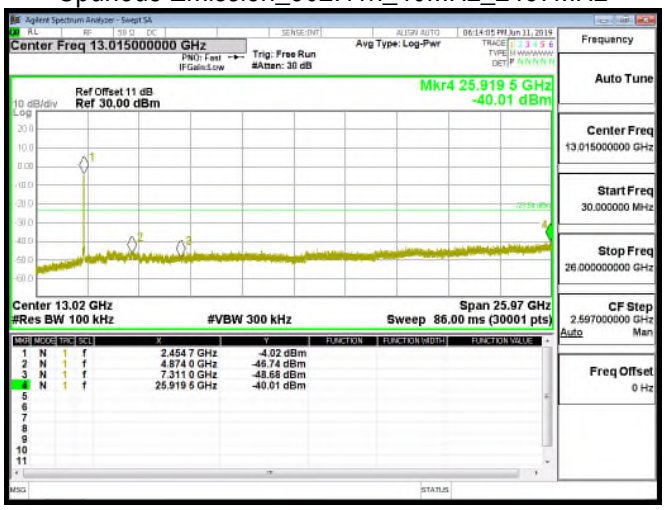
Spurious Emission_802.11n_40MHz_2422MHz



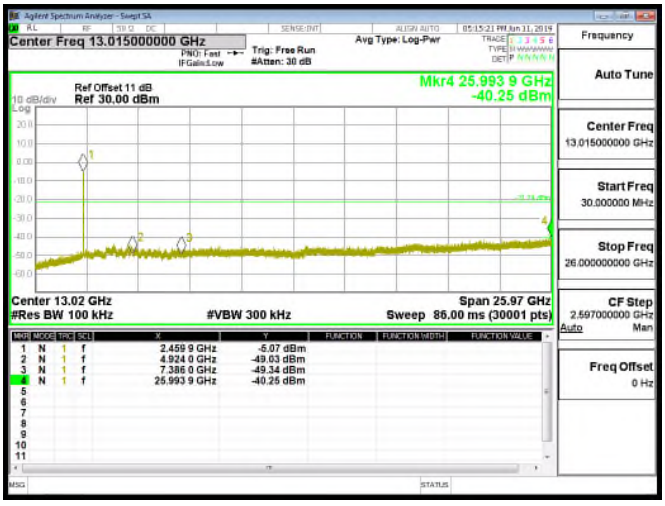
Spurious Emission_802.11n_20MHz_2437MHz



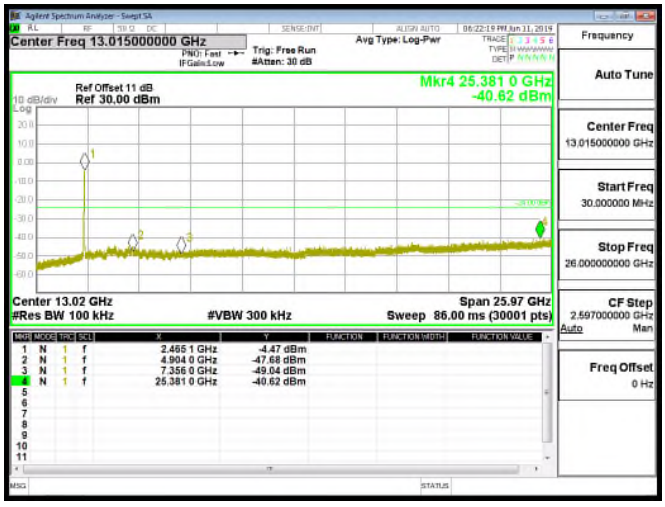
Spurious Emission_802.11n_40MHz_2437MHz



Spurious Emission_802.11n_20MHz_2462MHz



Spurious Emission_802.11n_40MHz_2452MHz



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)

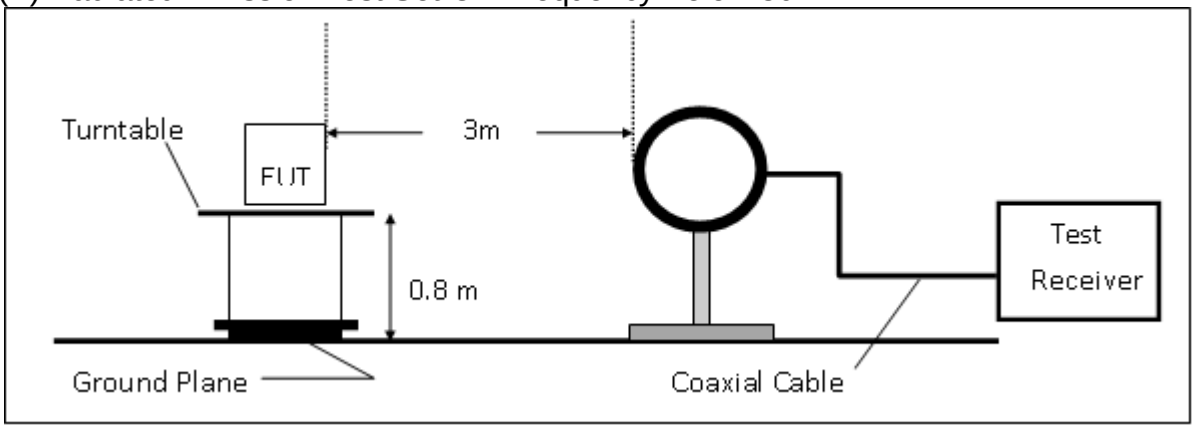
11.2 Measurement Equipment Used:

966A Chamber					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
Low Pass Filter	EWT	EWT-56-0019	RF46	02/26/2019	02/25/2020
High Pass Filter	R&S	F13 HPF 3GHz	RF64	02/26/2019	02/25/2020
Band Reject Filters	MICRO TRONICS	BRM 50702	120	02/26/2019	02/25/2020
Bilog Antenna	Sunol Sciences	JB3	A030105	07/13/2018	07/12/2019
Cable	HUBER SUHNER	SUCOFLEX 104PEA	25157	02/26/2019	02/25/2020
Cable	HUBER SUHNER	SUCOFLEX 104PEA	20995	02/26/2019	02/25/2020
Digital Ther-mo-Hygro Meter	WISEWIND	1206	D07	01/30/2019	01/29/2020
double Ridged Guide Horn Anten-na	ETC	MCTD 1209	DRH13M02003	08/20/2018	08/19/2019
Loop Antenna	COM-POWER	AL-130	121051	03/22/2019	03/21/2020
Horn Antenna	ETS LINDGREN	3116	00026370	12/26/2018	12/25/2019
Pre-Amplifier	EMEC	EM330	060609	02/26/2019	02/25/2020
Pre-Amplifier	HP	8449B	3008A00965	02/26/2019	02/25/2020
PSA Series Spec-trum Analyzer	Agilent	E4446A	MY46180323	05/29/2019	05/28/2020
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R
Software	e3 V6.11-20180413				

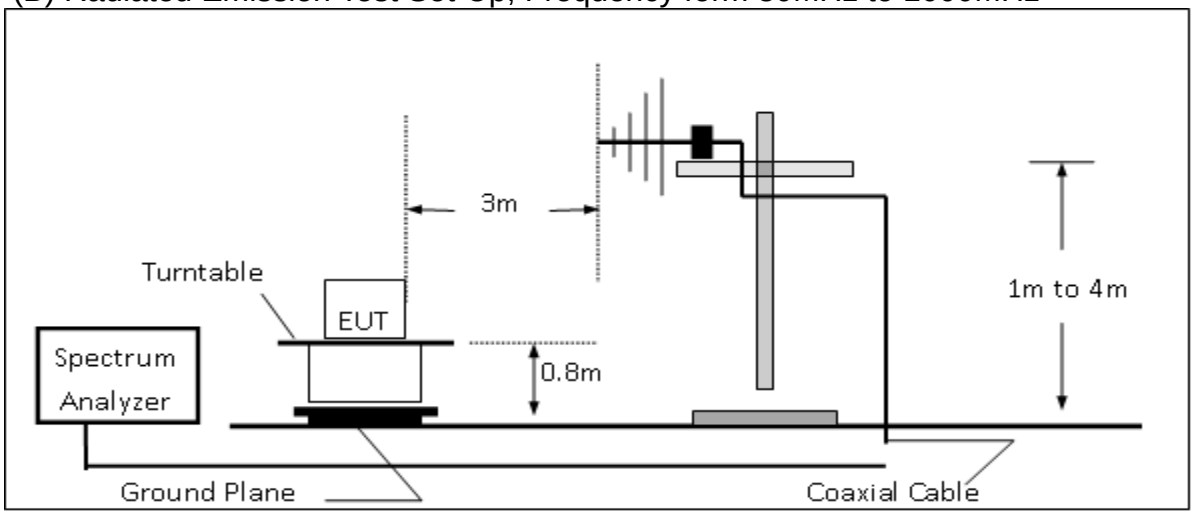
NOTE: N.C.R refers to Not Calibrated Required.

11.3 Test SET-UP

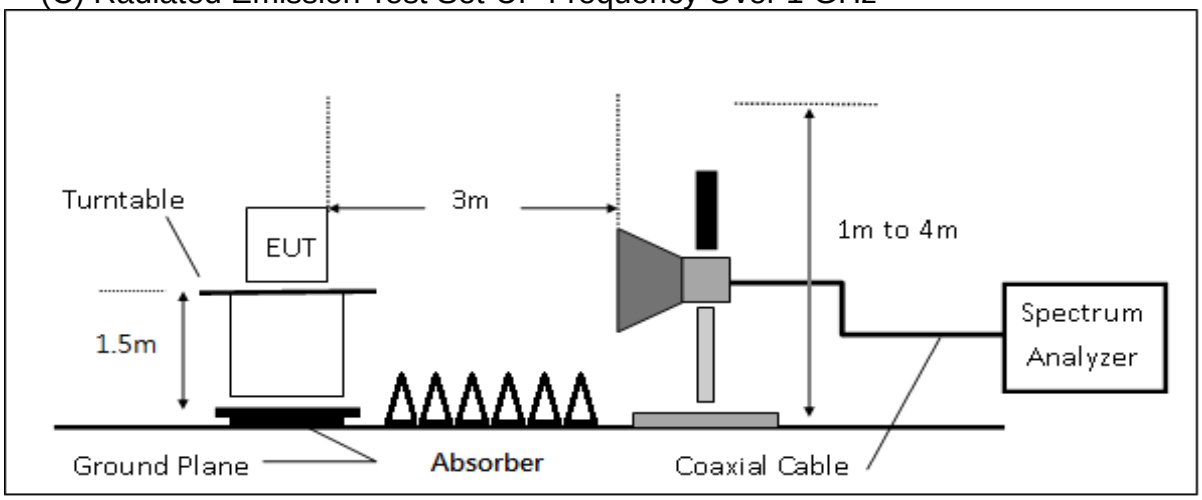
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(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)

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

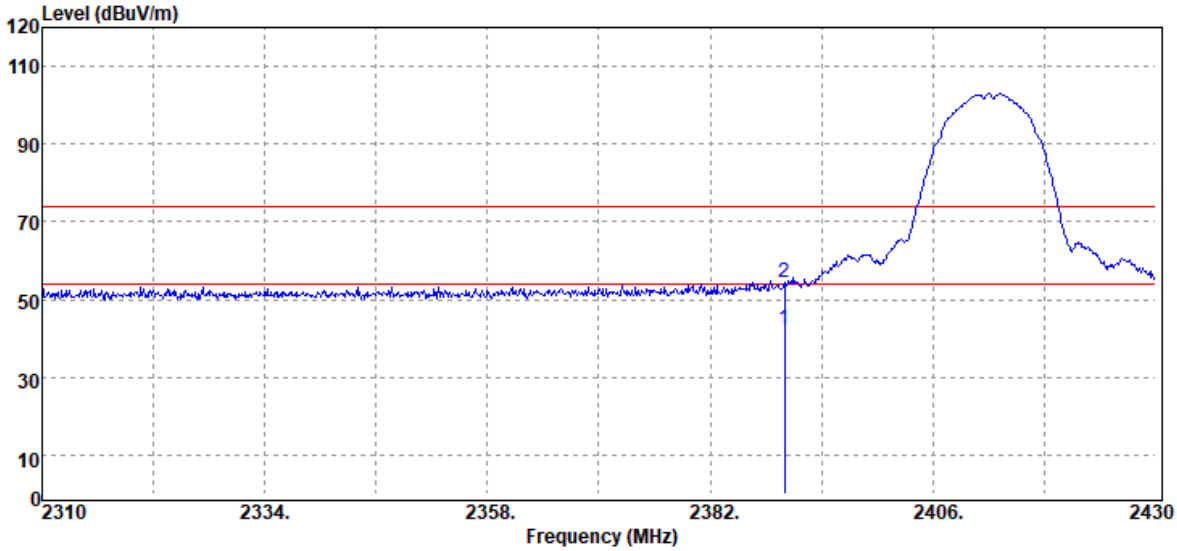
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

11.7 Measurement Result

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

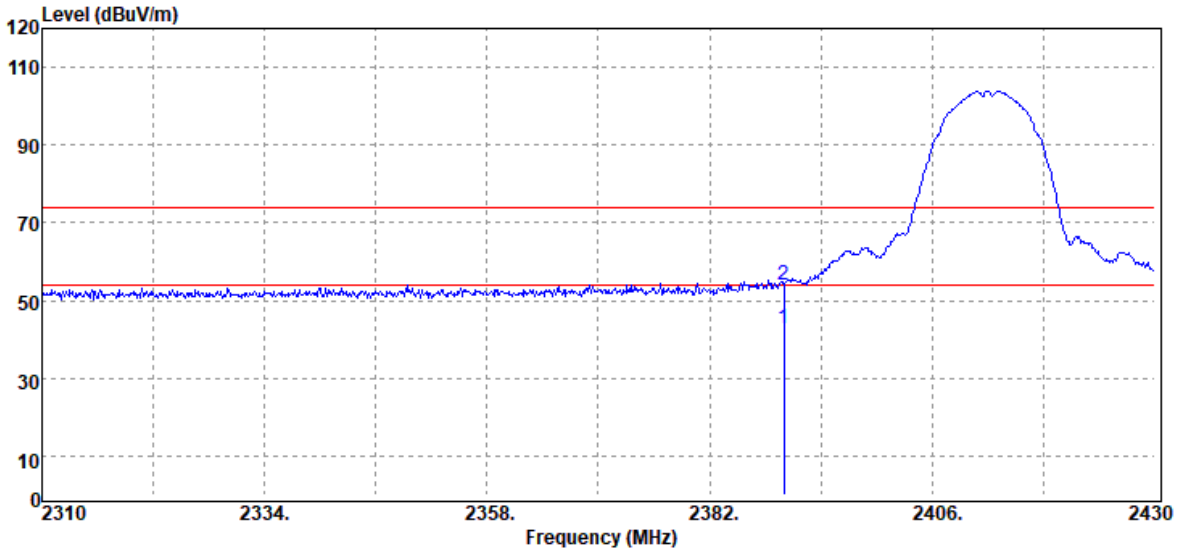
Radiated Band Edge Measurement Result

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11b	Temp./Humi.	:21/53
Frequency	:2412 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:BE CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



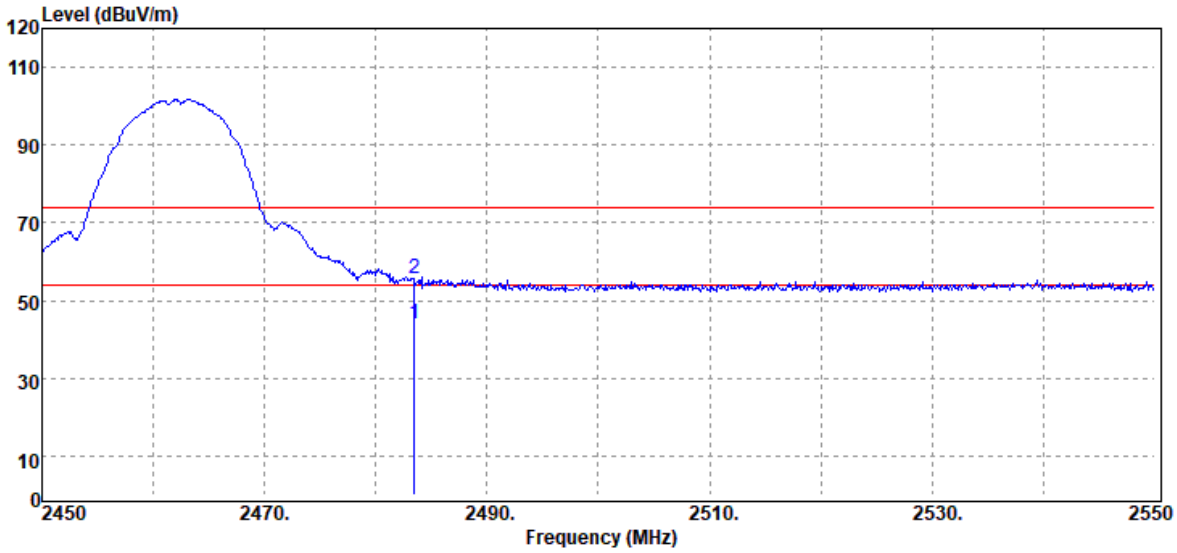
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	45.62	-3.38	42.24	54.00	-11.76
2390.00	Peak	57.97	-3.38	54.59	74.00	-19.41

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11b	Temp./Humi.	:21/53
Frequency	:2412 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:BE CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



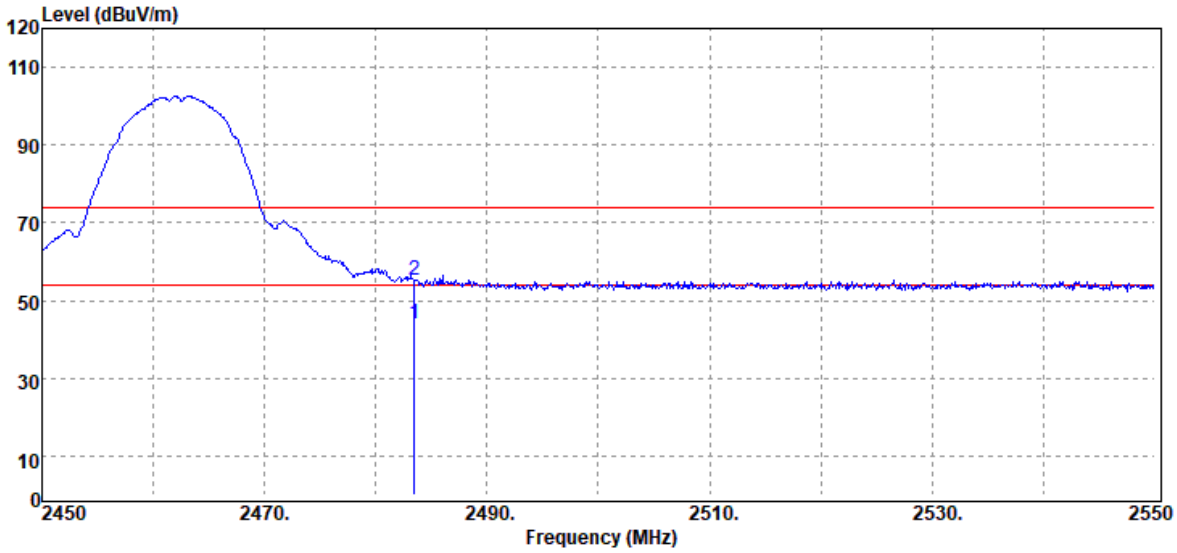
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	46.07	-3.38	42.69	54.00	-11.31
2390.00	Peak	57.35	-3.38	53.97	74.00	-20.03

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11b	Temp./Humi.	:21/53
Frequency	:2462 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:BE CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



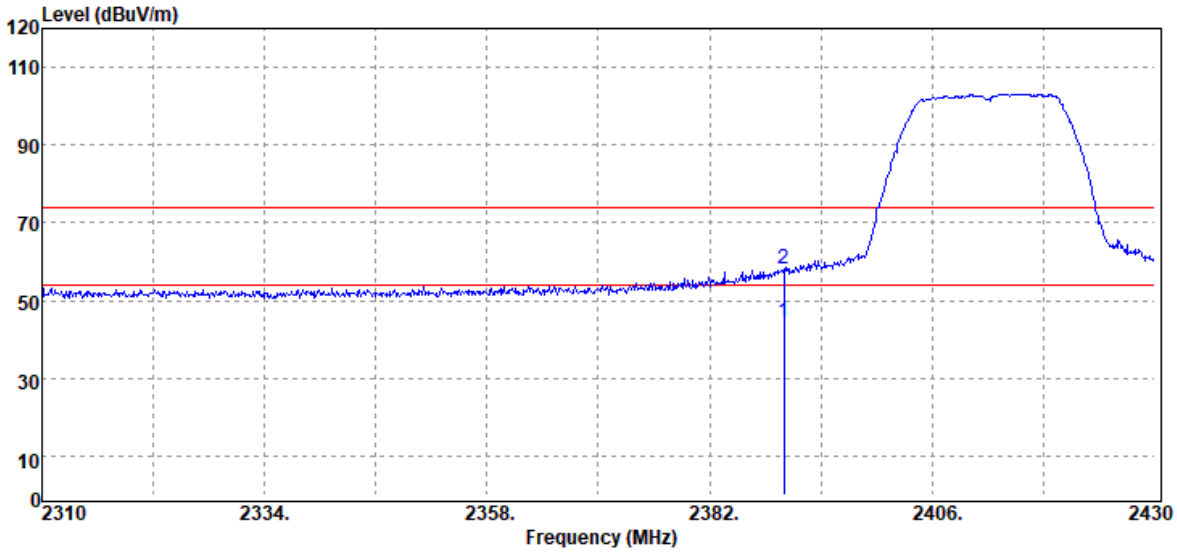
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	47.04	-2.83	44.21	54.00	-9.79
2483.50	Peak	58.63	-2.83	55.80	74.00	-18.20

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11b	Temp./Humi.	:21/53
Frequency	:2462 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:BE CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



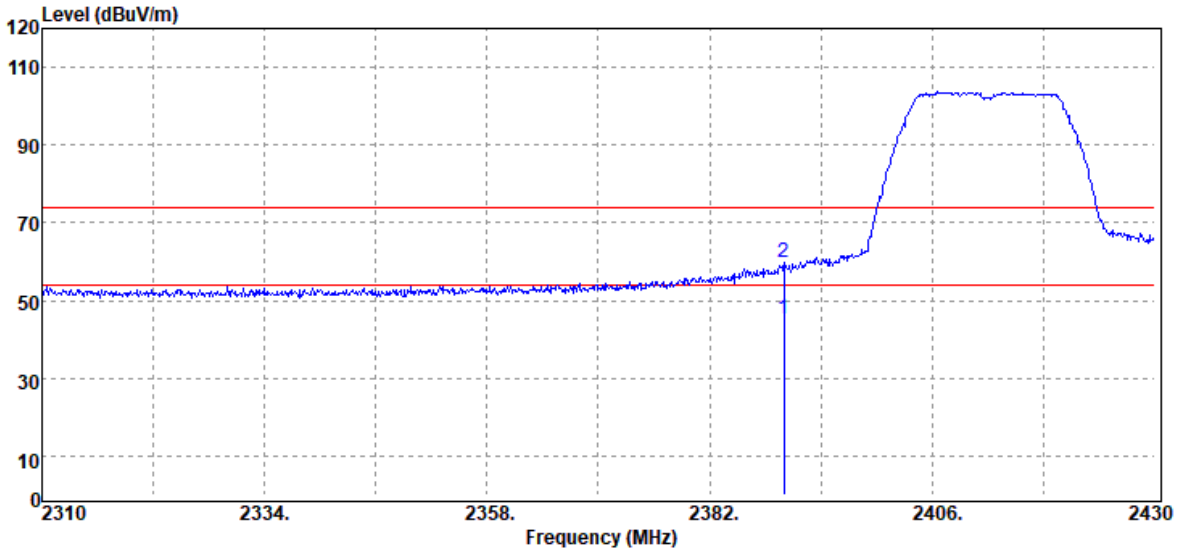
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	46.96	-2.83	44.13	54.00	-9.87
2483.50	Peak	58.13	-2.83	55.30	74.00	-18.70

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11g	Temp./Humi.	:21/53
Frequency	:2412 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:BE CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



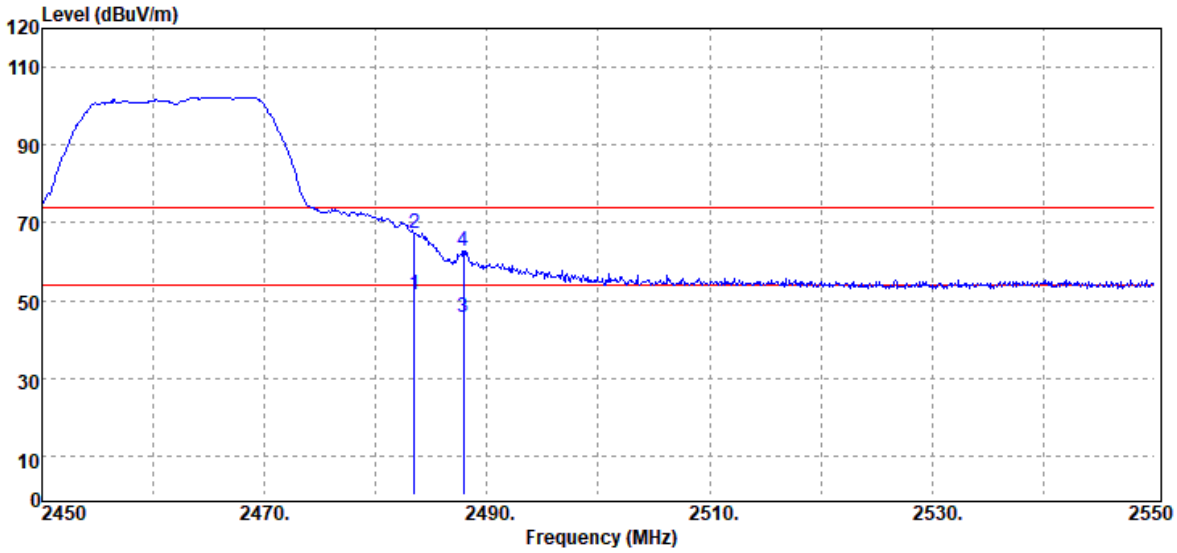
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	47.86	-3.38	44.48	54.00	-9.52
2390.00	Peak	61.53	-3.38	58.15	74.00	-15.85

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11g	Temp./Humi.	:21/53
Frequency	:2412 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:BE CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



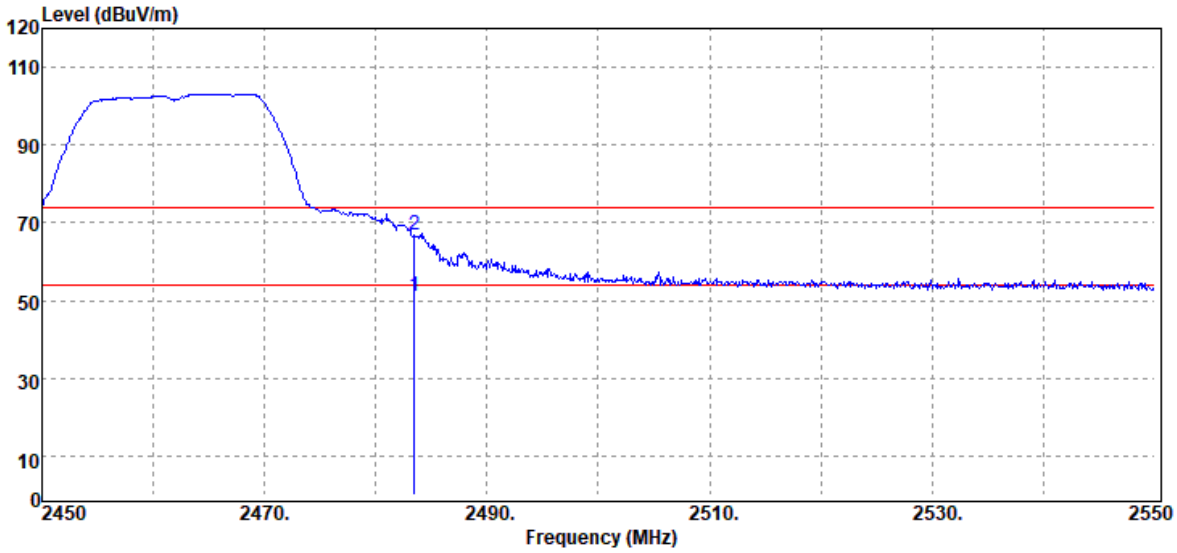
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	48.57	-3.38	45.19	54.00	-8.81
2390.00	Peak	63.18	-3.38	59.80	74.00	-14.20

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11g	Temp./Humi.	:21/53
Frequency	:2462 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:BE CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



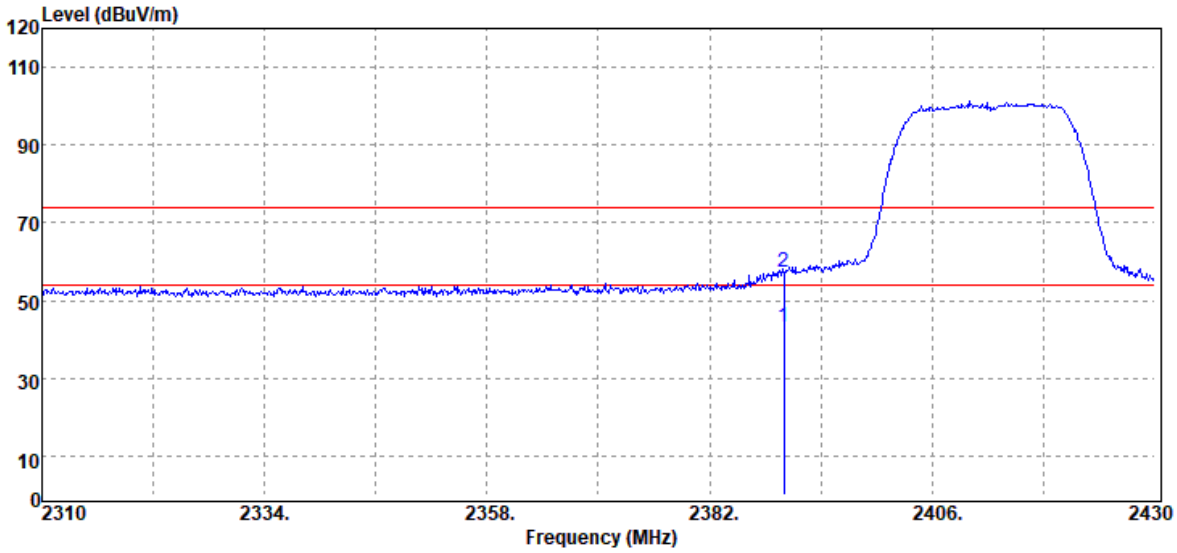
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	54.26	-2.83	51.43	54.00	-2.57
2483.50	Peak	70.27	-2.83	67.44	74.00	-6.56
2487.90	Average	48.45	-2.80	45.65	54.00	-8.35
2487.90	Peak	65.67	-2.80	62.87	74.00	-11.13

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11g	Temp./Humi.	:21/53
Frequency	:2462 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:BE CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



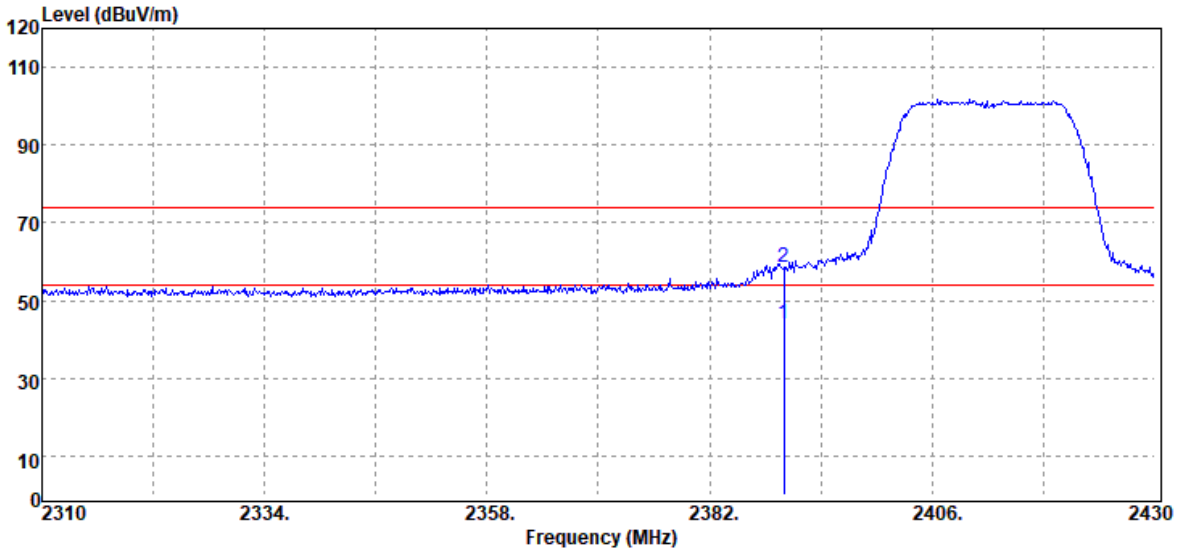
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	53.75	-2.83	50.92	54.00	-3.08
2483.50	Peak	69.51	-2.83	66.68	74.00	-7.32

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n20	Temp./Humi.	:21/53
Frequency	:2412 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:BE CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



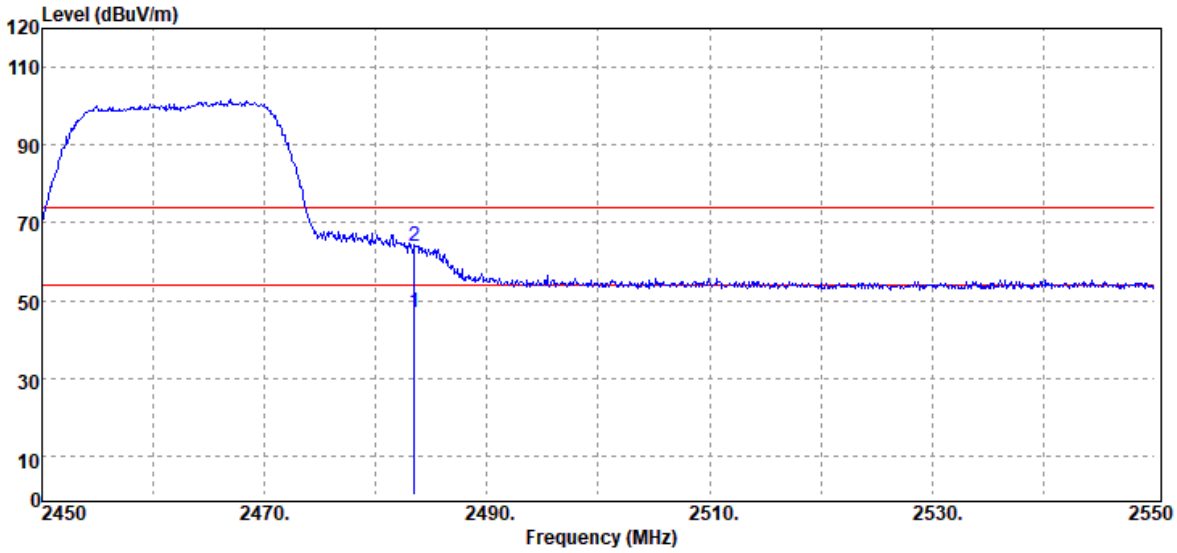
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	46.56	-3.38	43.18	54.00	-10.82
2390.00	Peak	60.80	-3.38	57.42	74.00	-16.58

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n20	Temp./Humi.	:21/53
Frequency	:2412 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:BE CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



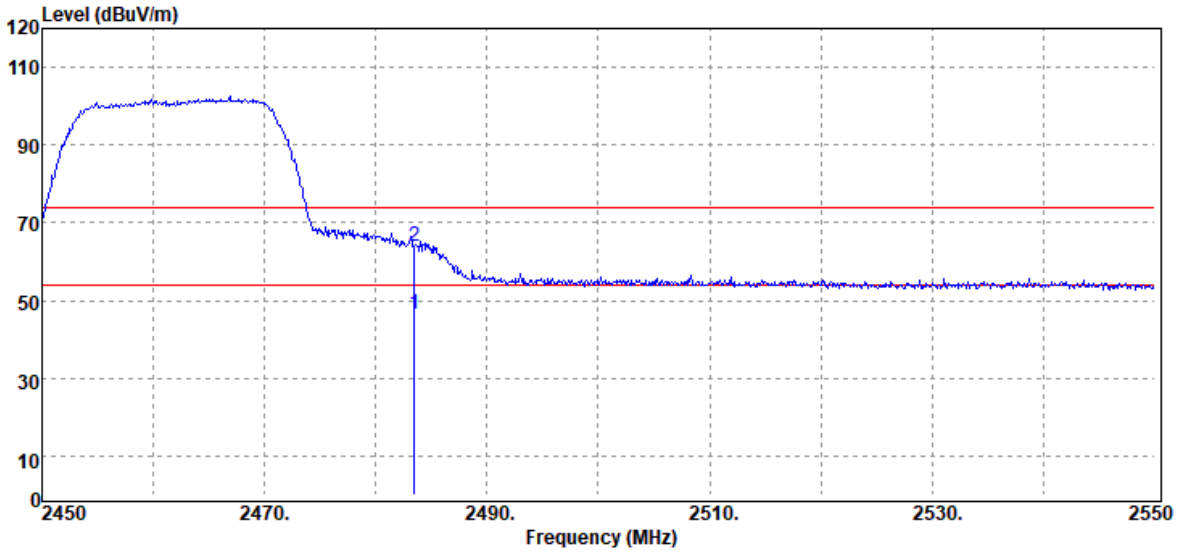
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	47.31	-3.38	43.93	54.00	-10.07
2390.00	Peak	62.04	-3.38	58.66	74.00	-15.34

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n20	Temp./Humi.	:21/53
Frequency	:2462 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:BE CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



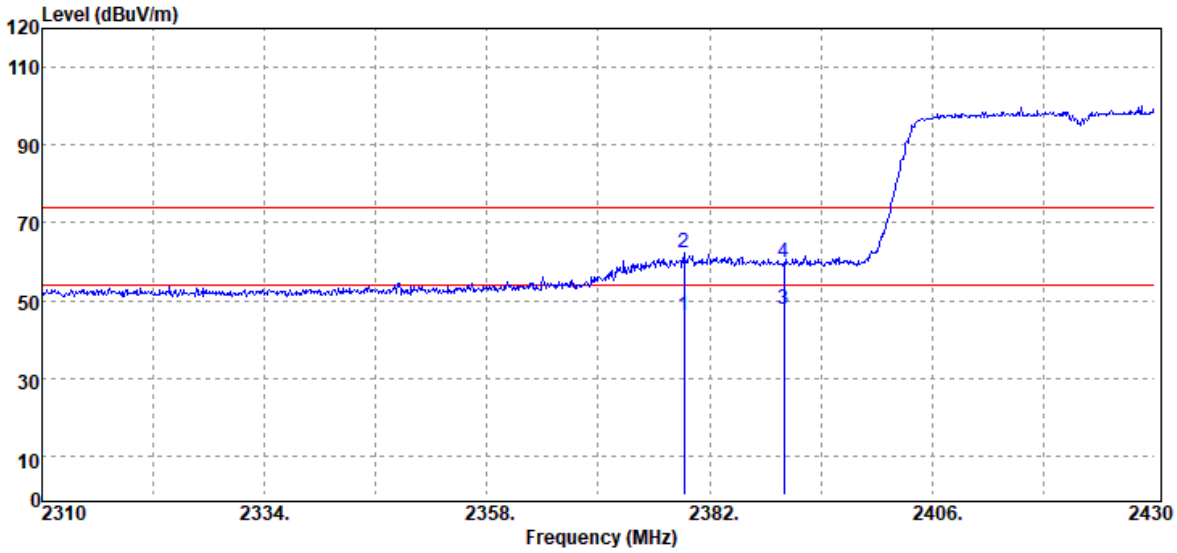
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	49.55	-2.83	46.72	54.00	-7.28
2483.50	Peak	66.62	-2.83	63.79	74.00	-10.21

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n20	Temp./Humi.	:21/53
Frequency	:2462 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:BE CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



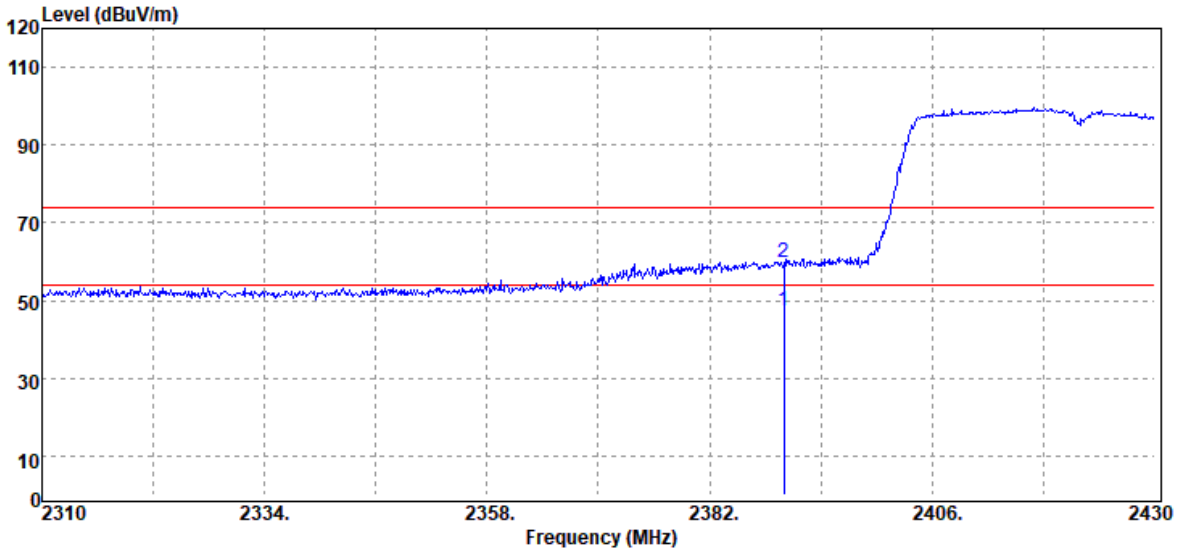
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	49.17	-2.83	46.34	54.00	-7.66
2483.50	Peak	66.62	-2.83	63.79	74.00	-10.21

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n40	Temp./Humi.	:21/53
Frequency	:2422 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:BE CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



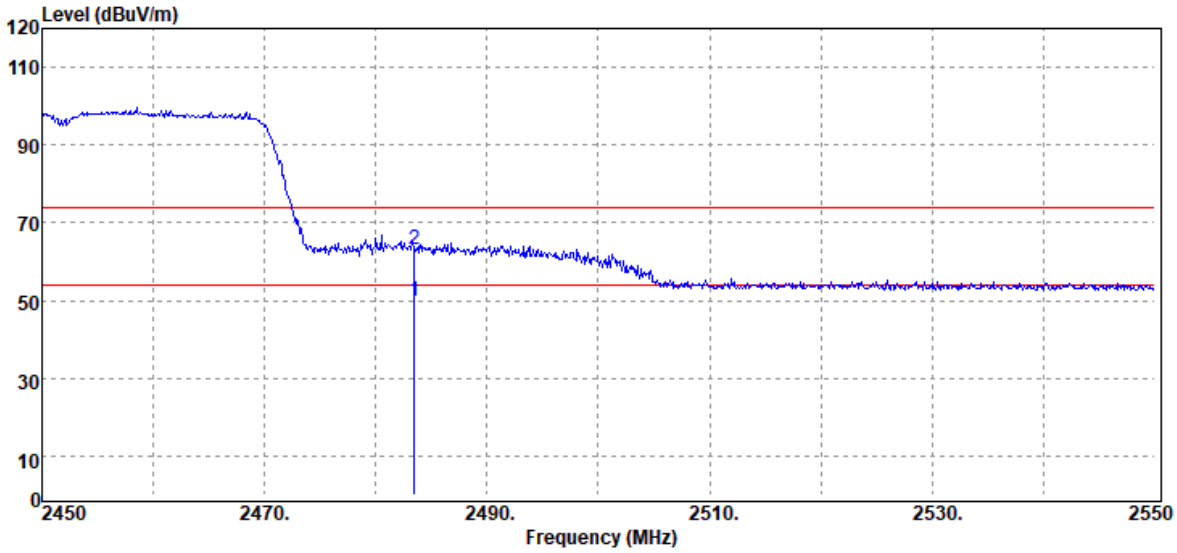
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2379.24	Average	49.61	-3.37	46.24	54.00	-7.76
2379.24	Peak	65.65	-3.37	62.28	74.00	-11.72
2390.00	Average	51.20	-3.38	47.82	54.00	-6.18
2390.00	Peak	63.15	-3.38	59.77	74.00	-14.23

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n40	Temp./Humi.	:21/53
Frequency	:2422 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:BE CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



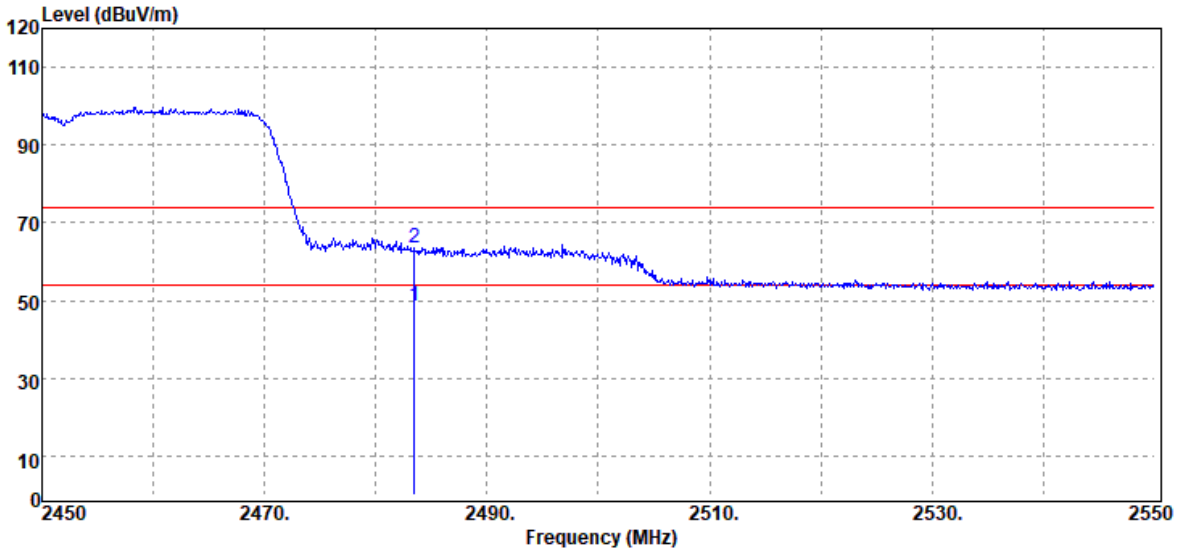
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	50.67	-3.38	47.29	54.00	-6.71
2390.00	Peak	63.25	-3.38	59.87	74.00	-14.13

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n40	Temp./Humi.	:21/53
Frequency	:2452 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:BE CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



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	52.57	-2.83	49.74	54.00	-4.26
2483.50	Peak	66.05	-2.83	63.22	74.00	-10.78

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n40	Temp./Humi.	:21/53
Frequency	:2452 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:BE CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		

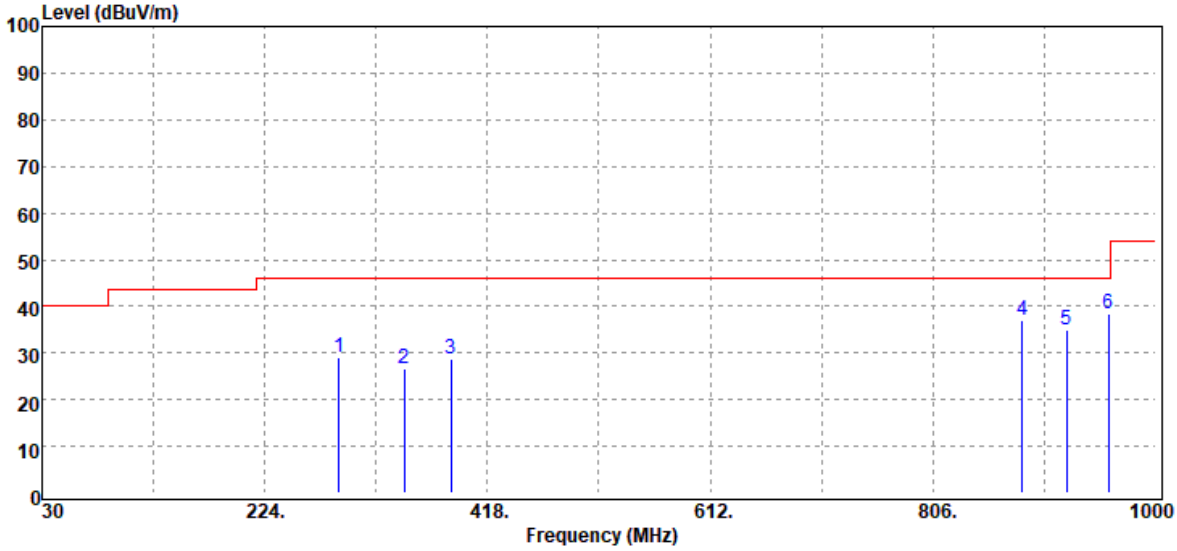


Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	51.28	-2.83	48.45	54.00	-5.55
2483.50	Peak	66.37	-2.83	63.54	74.00	-10.46

Below 1GHz Worst-Case Data:

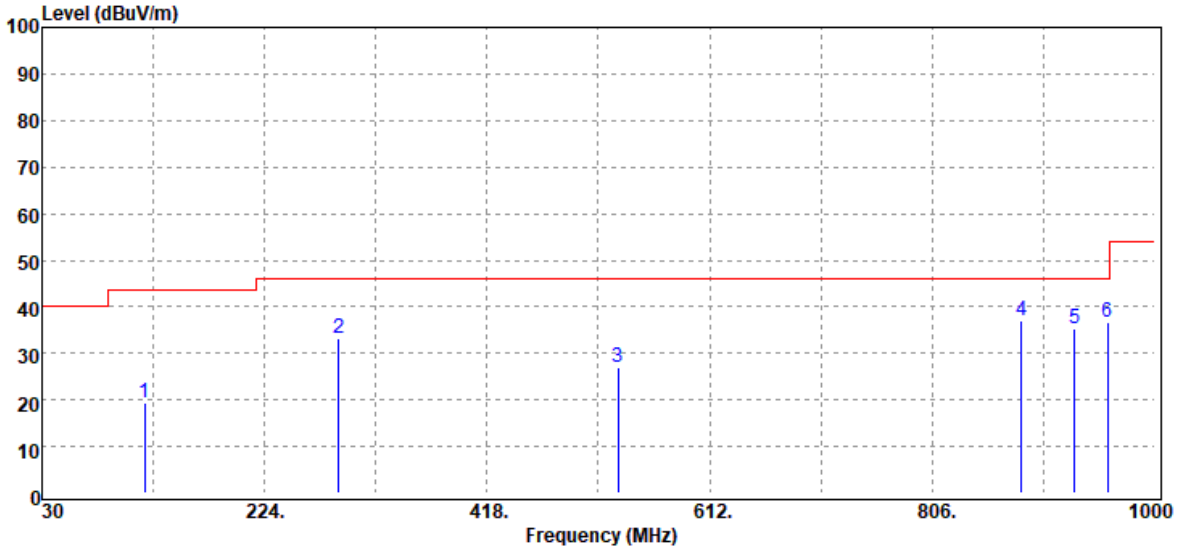
Radiated Spurious Emission Measurement Result

Project Number	:T190606W03	Test Date	:2019-06-19
Operation Band	:802.11g	Temp./Humi.	:21/53
Frequency	:2437 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol.	:E2 Plan		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
288.99	Peak	37.45	-8.36	29.09	46.00	-16.91
345.25	Peak	33.68	-7.12	26.56	46.00	-19.44
385.99	Peak	34.88	-6.20	28.68	46.00	-17.32
883.60	Peak	33.21	3.65	36.86	46.00	-9.14
922.40	Peak	30.88	3.93	34.81	46.00	-11.19
959.26	Peak	33.90	4.48	38.38	46.00	-7.62

Project Number	:T190606W03	Test Date	:2019-06-19
Operation Band	:802.11g	Temp./Humi.	:21/53
Frequency	:2437 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol.	:E2 Plan		

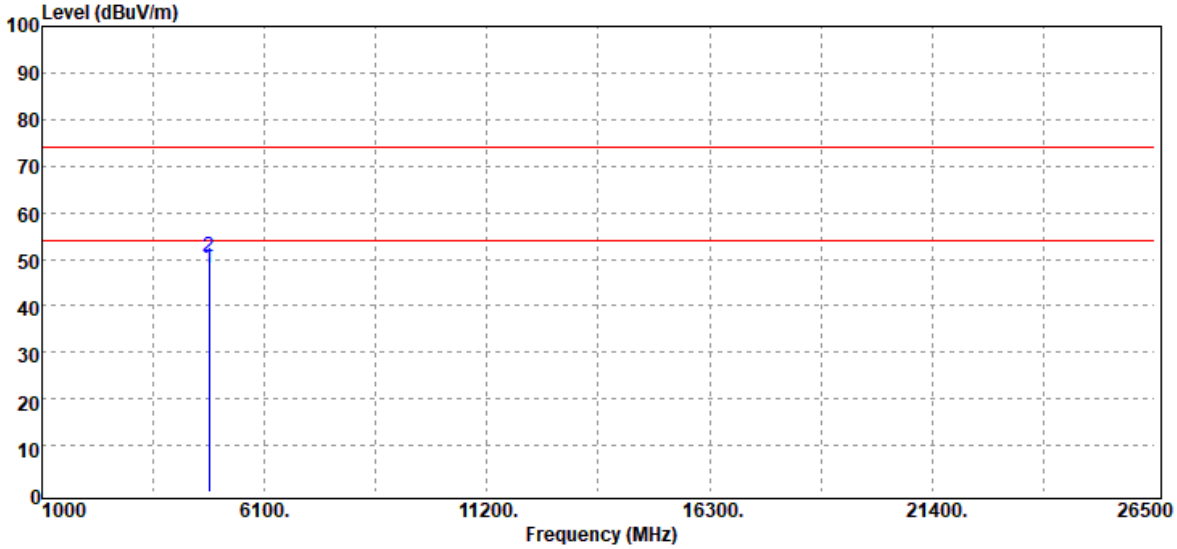


Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
119.24	Peak	28.20	-8.94	19.26	43.50	-24.24
288.99	Peak	41.43	-8.36	33.07	46.00	-12.93
532.46	Peak	29.22	-2.29	26.93	46.00	-19.07
883.60	Peak	33.22	3.65	36.87	46.00	-9.13
930.16	Peak	31.55	3.82	35.37	46.00	-10.63
959.26	Peak	32.08	4.48	36.56	46.00	-9.44

Above 1GHz Worst-Case Data:

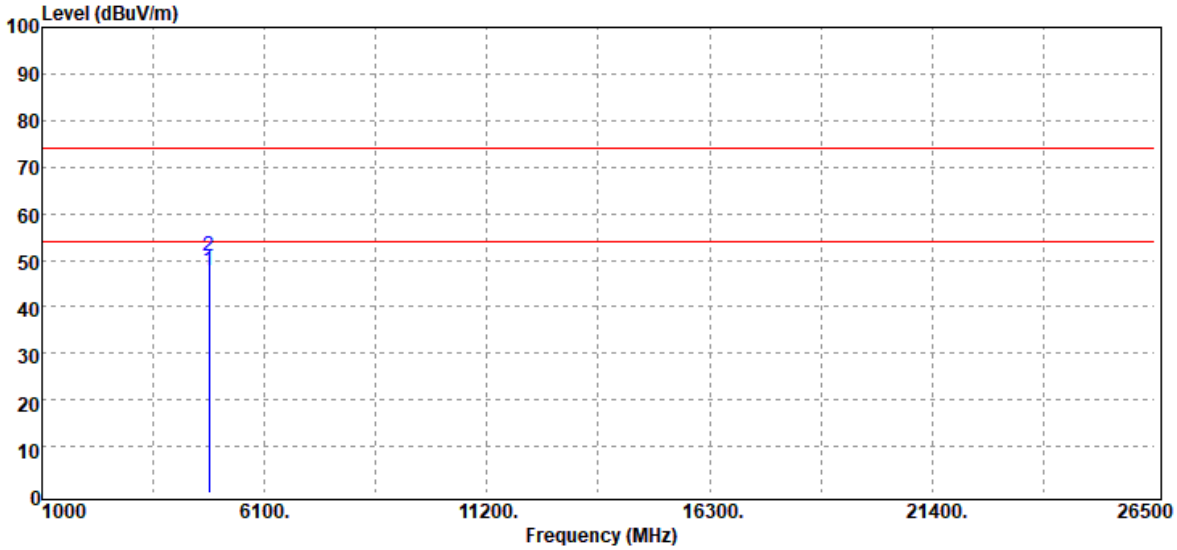
Radiated Spurious Emission Measurement Result

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11b	Temp./Humi.	:21/53
Frequency	:2412 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Tx CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



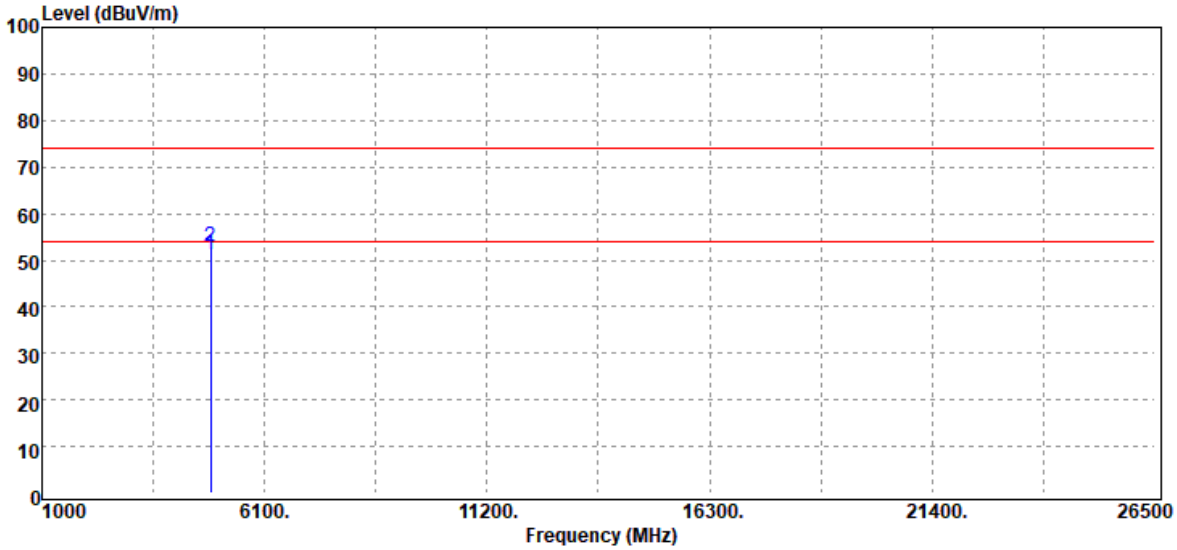
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4824.00	Average	45.05	3.05	48.10	54.00	-5.90
4824.00	Peak	47.37	3.05	50.42	74.00	-23.58

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11b	Temp./Humi.	:21/53
Frequency	:2412 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Tx CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



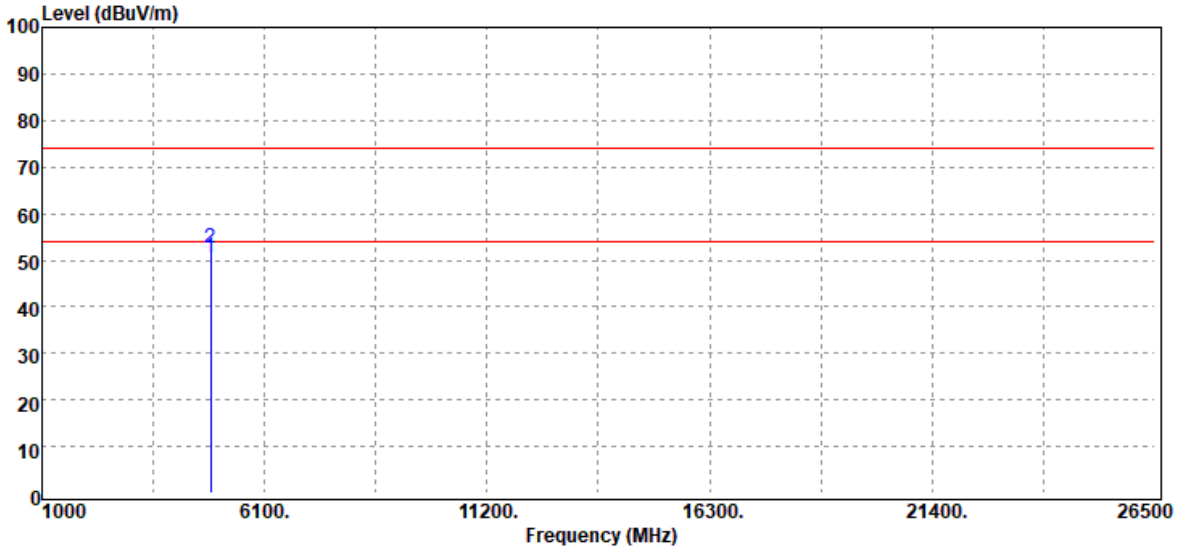
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4824.00	Average	44.81	3.05	47.86	54.00	-6.14
4824.00	Peak	47.90	3.05	50.95	74.00	-23.05

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11b	Temp./Humi.	:21/53
Frequency	:2437 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol.	:E2 Plan		



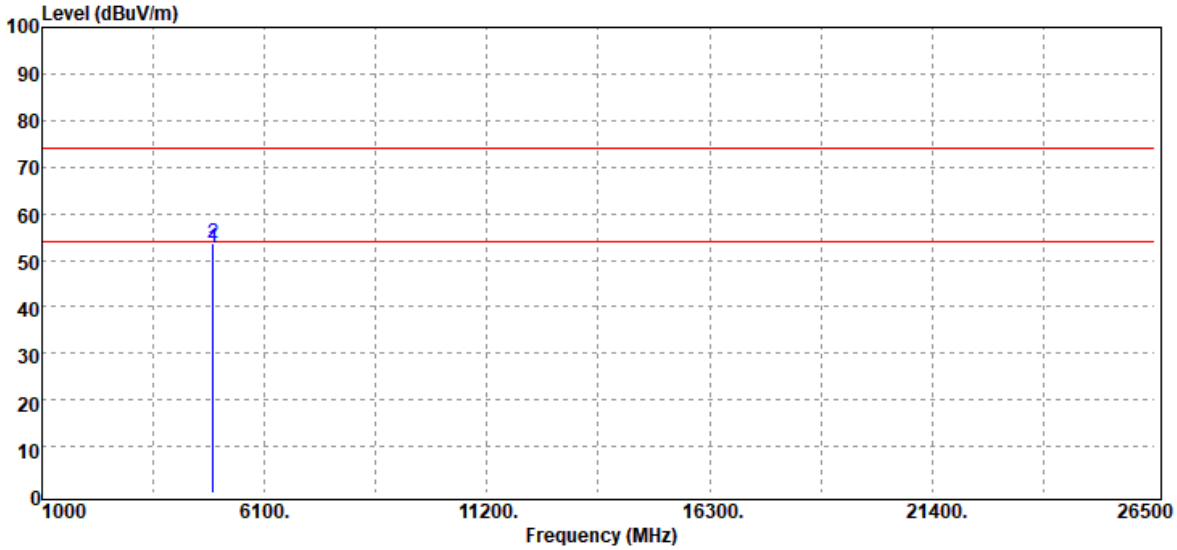
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4874.00	Average	48.04	3.31	51.35	54.00	-2.65
4874.00	Peak	49.65	3.31	52.96	74.00	-21.04

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11b	Temp./Humi.	:21/53
Frequency	:2437 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol.	:E2 Plan		



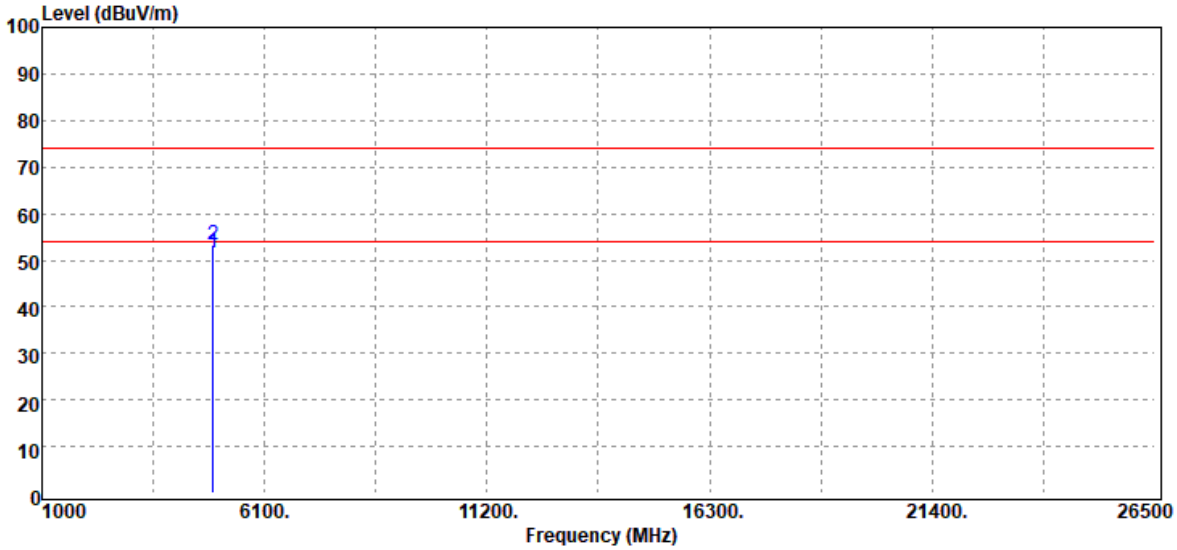
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4874.00	Average	47.25	3.31	50.56	54.00	-3.44
4874.00	Peak	49.32	3.31	52.63	74.00	-21.37

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11b	Temp./Humi.	:21/53
Frequency	:2462 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Tx CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



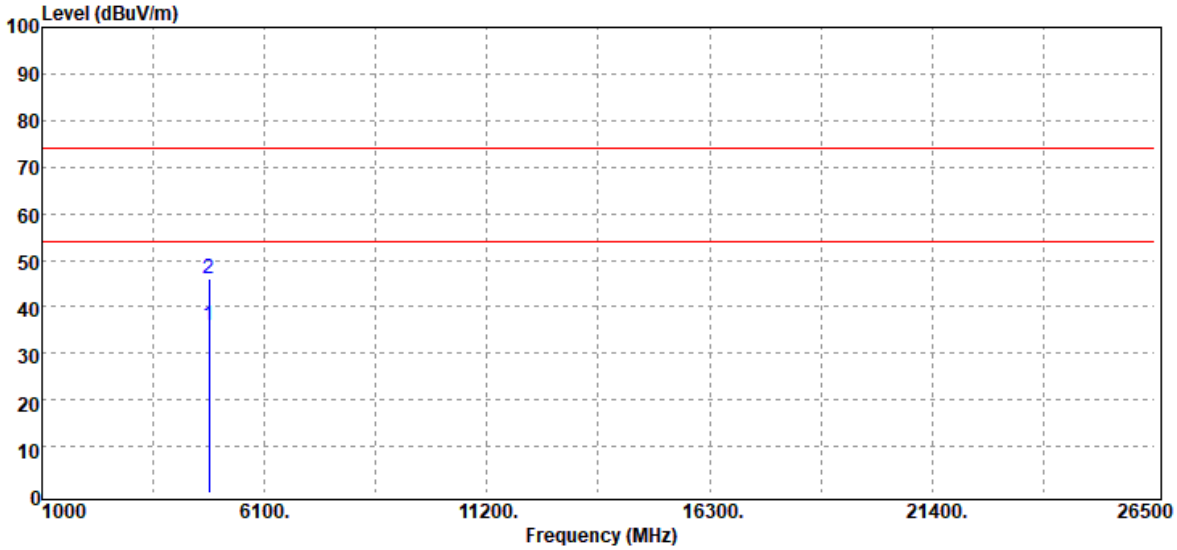
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4924.00	Average	48.88	3.75	52.63	54.00	-1.37
4924.00	Peak	50.02	3.75	53.77	74.00	-20.23

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11b	Temp./Humi.	:21/53
Frequency	:2462 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Tx CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



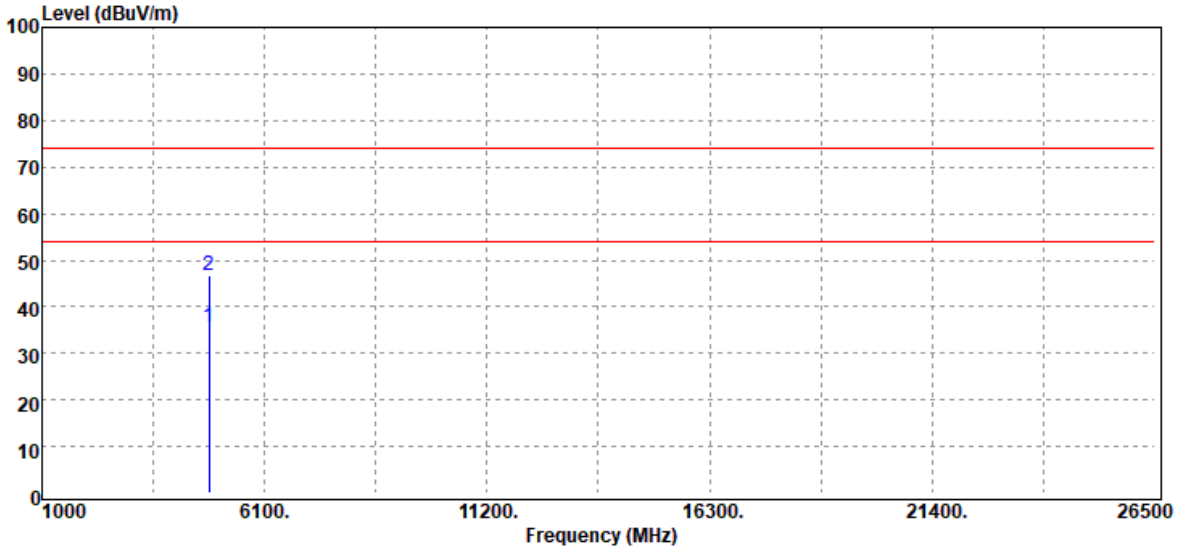
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4924.00	Average	47.81	3.75	51.56	54.00	-2.44
4924.00	Peak	49.50	3.75	53.25	74.00	-20.75

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11g	Temp./Humi.	:21/53
Frequency	:2412 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Tx CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



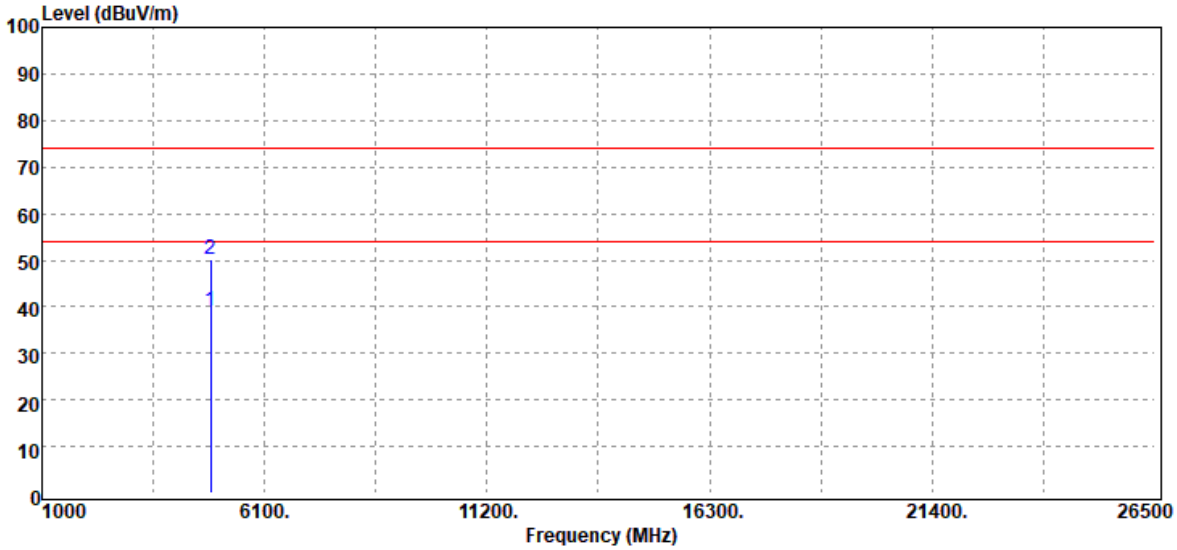
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4824.00	Average	32.86	3.05	35.91	54.00	-18.09
4824.00	Peak	43.09	3.05	46.14	74.00	-27.86

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11g	Temp./Humi.	:21/53
Frequency	:2412 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Tx CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



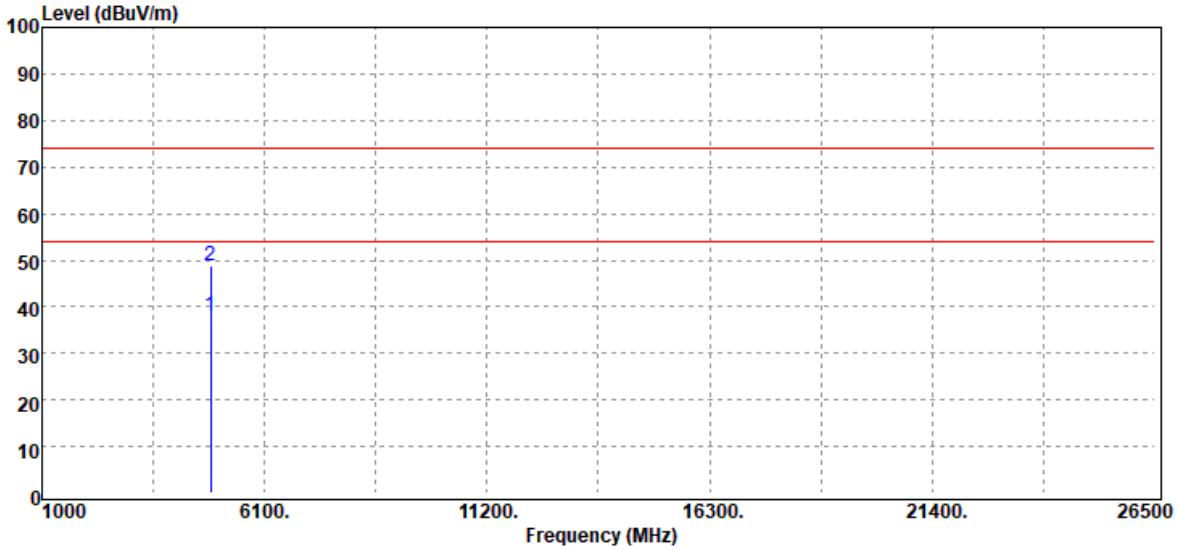
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4824.00	Average	32.71	3.05	35.76	54.00	-18.24
4824.00	Peak	43.63	3.05	46.68	74.00	-27.32

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11g	Temp./Humi.	:21/53
Frequency	:2437 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol.	:E2 Plan		



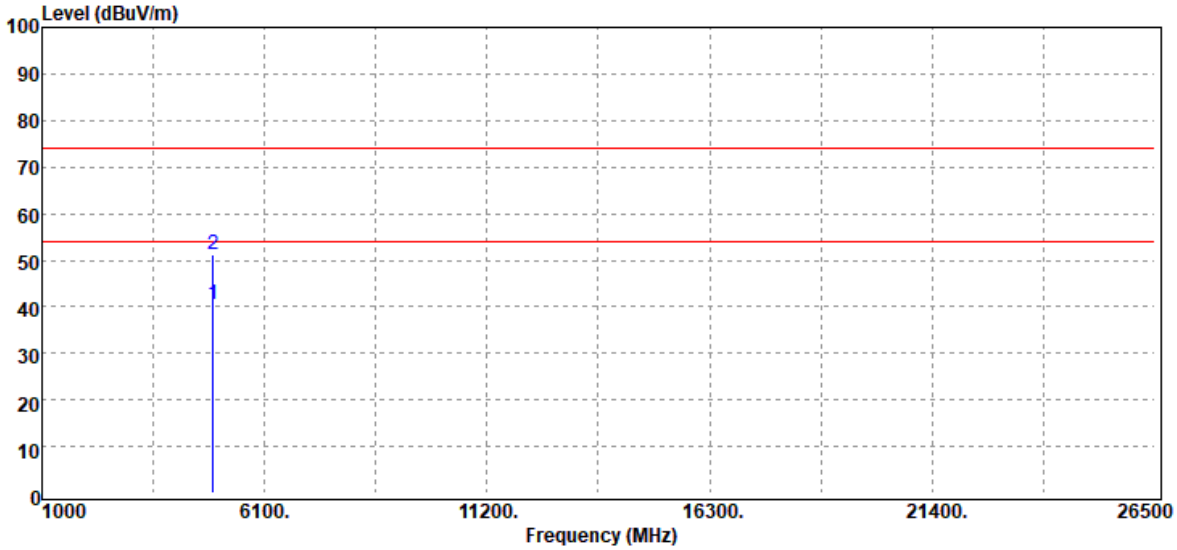
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4874.00	Average	35.72	3.31	39.03	54.00	-14.97
4874.00	Peak	46.96	3.31	50.27	74.00	-23.73

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11g	Temp./Humi.	:21/53
Frequency	:2437 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol.	:E2 Plan		



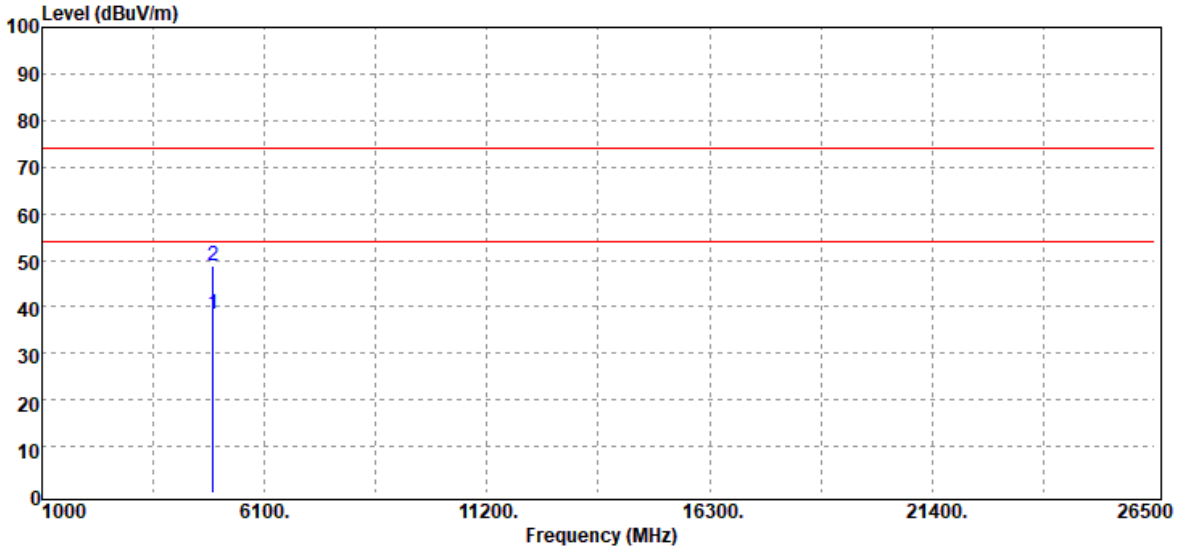
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4874.00	Average	34.63	3.31	37.94	54.00	-16.06
4874.00	Peak	45.34	3.31	48.65	74.00	-25.35

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11g	Temp./Humi.	:21/53
Frequency	:2462 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Tx CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



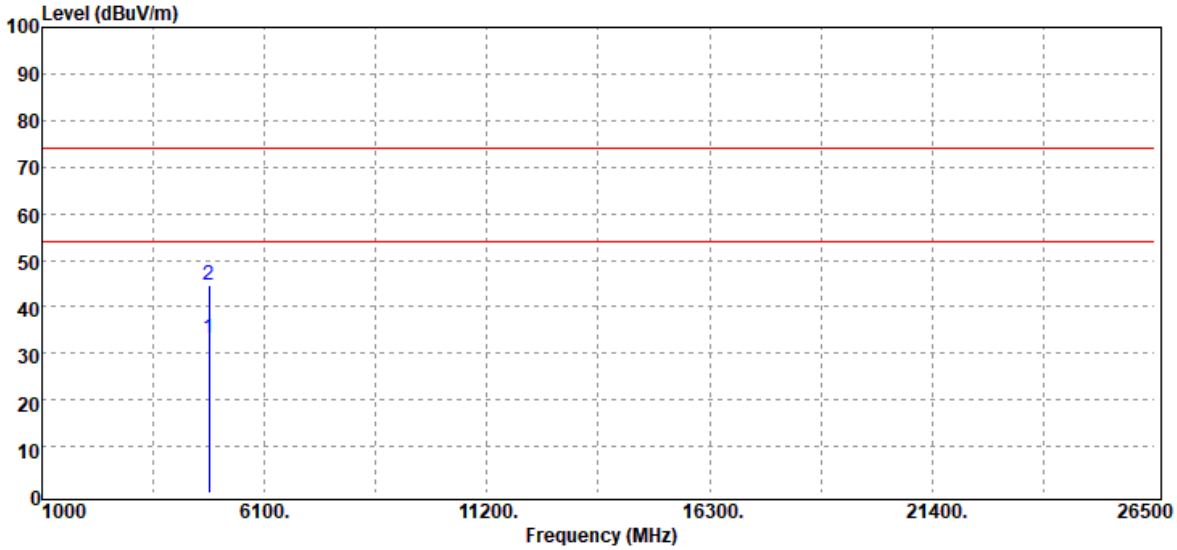
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4924.00	Average	36.89	3.75	40.64	54.00	-13.36
4924.00	Peak	47.47	3.75	51.22	74.00	-22.78

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11g	Temp./Humi.	:21/53
Frequency	:2462 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Tx CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



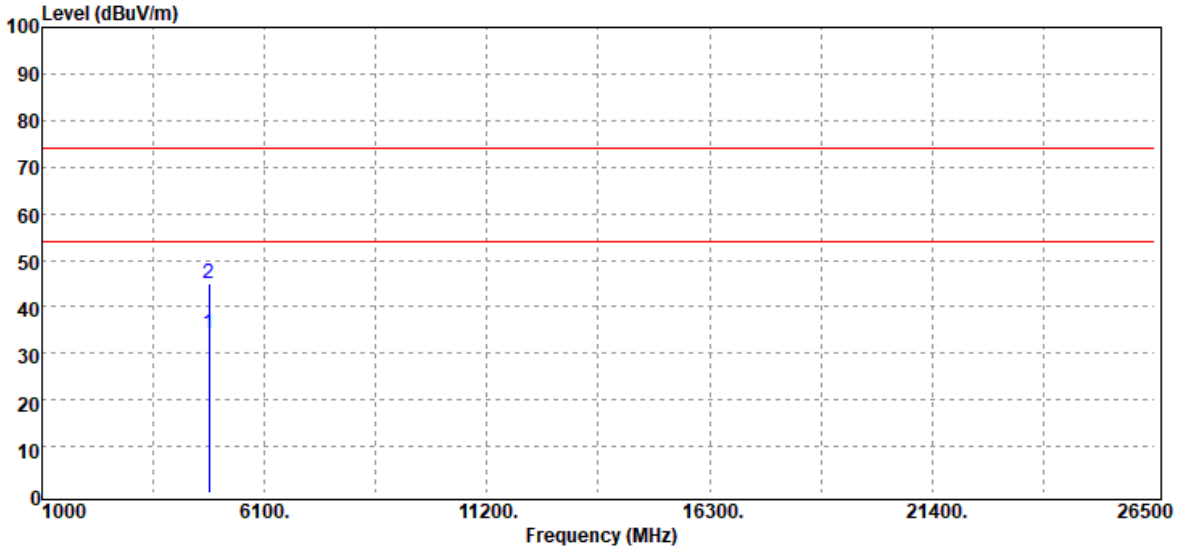
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4924.00	Average	34.62	3.75	38.37	54.00	-15.63
4924.00	Peak	45.16	3.75	48.91	74.00	-25.09

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n20	Temp./Humi.	:21/53
Frequency	:2412 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Tx CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



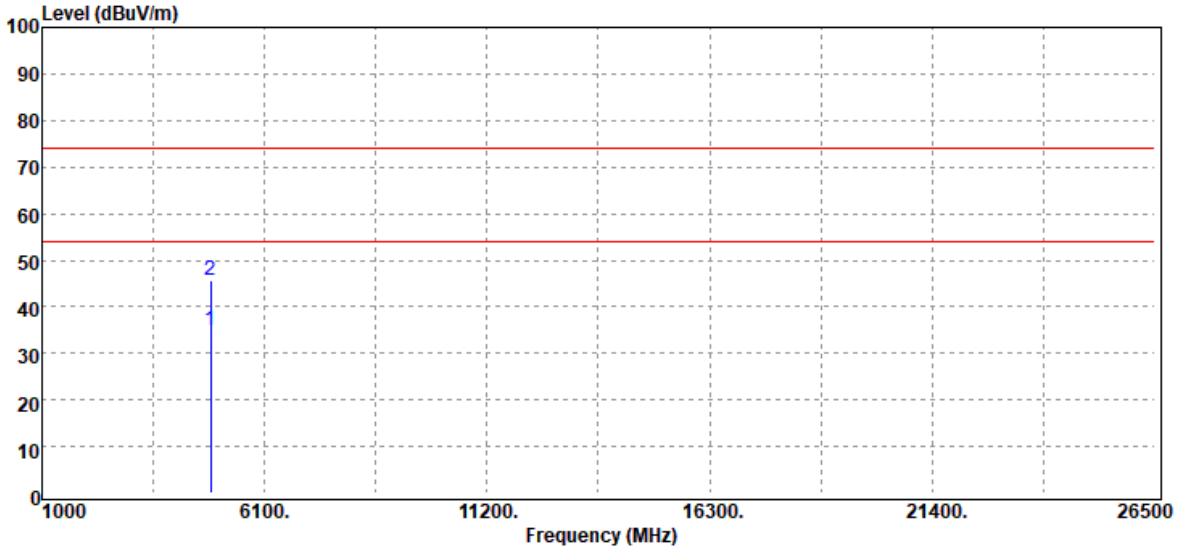
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4824.00	Average	30.11	3.05	33.16	54.00	-20.84
4824.00	Peak	41.50	3.05	44.55	74.00	-29.45

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n20	Temp./Humi.	:21/53
Frequency	:2412 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Tx CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



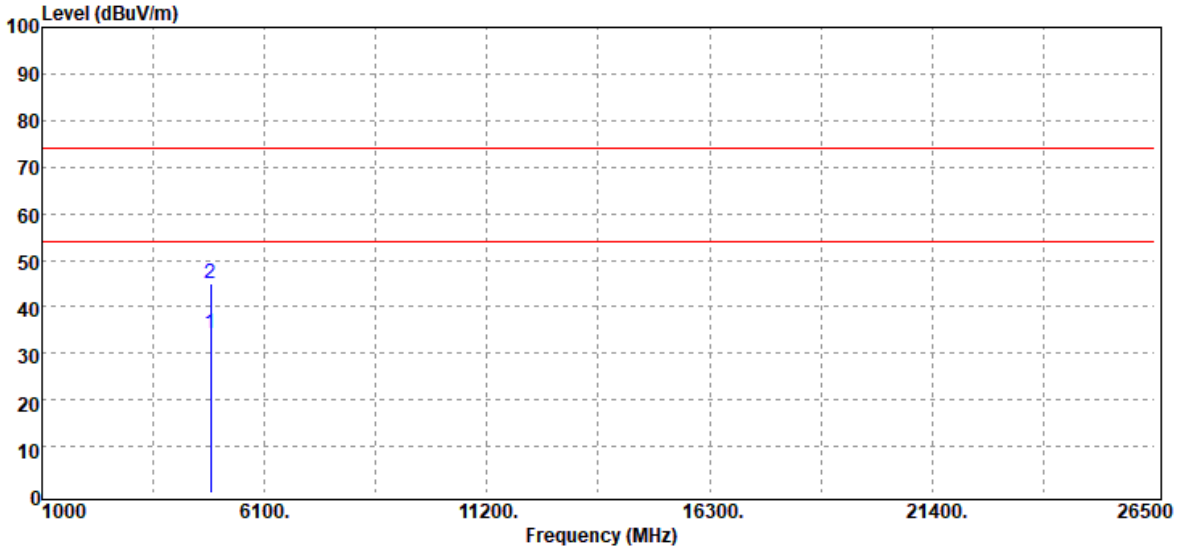
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4824.00	Average	31.05	3.05	34.10	54.00	-19.90
4824.00	Peak	42.03	3.05	45.08	74.00	-28.92

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n20	Temp./Humi.	:21/53
Frequency	:2437 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol.	:E2 Plan		



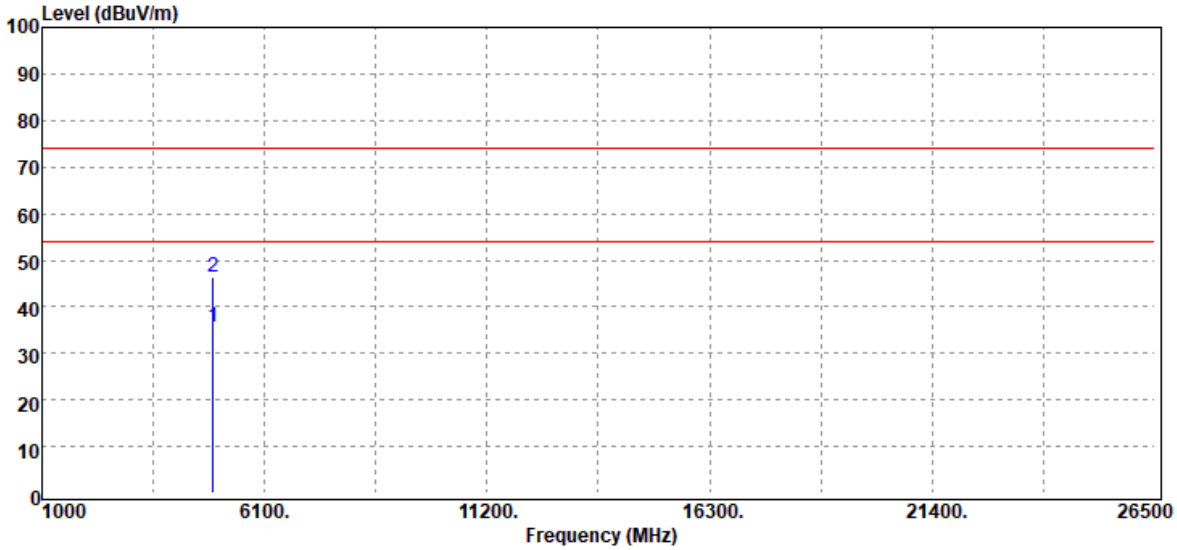
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4874.00	Average	31.59	3.31	34.90	54.00	-19.10
4874.00	Peak	42.47	3.31	45.78	74.00	-28.22

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n20	Temp./Humi.	:21/53
Frequency	:2437 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol.	:E2 Plan		



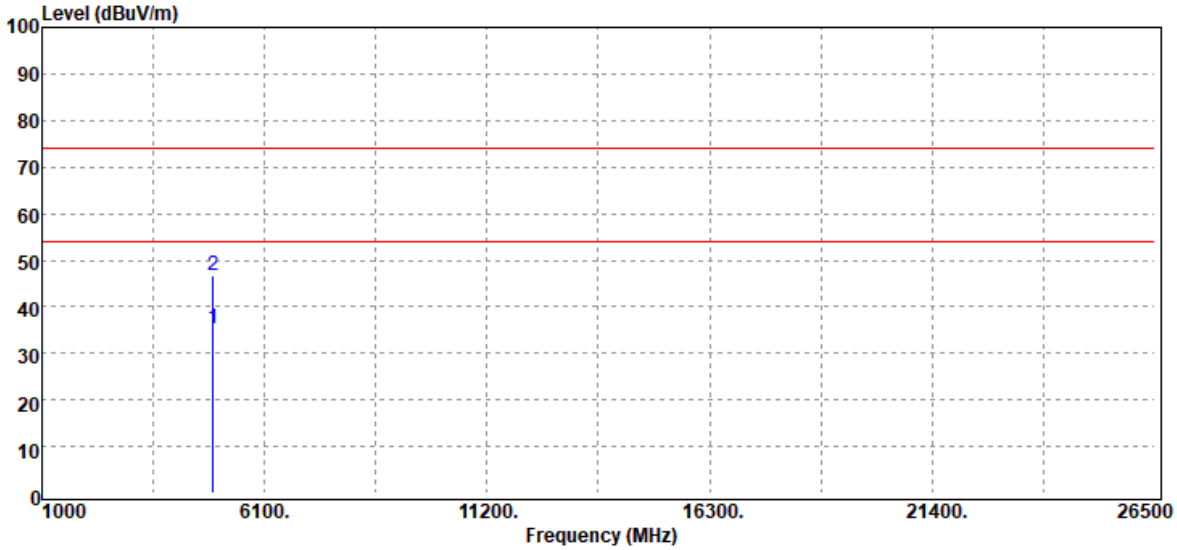
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4874.00	Average	30.89	3.31	34.20	54.00	-19.80
4874.00	Peak	41.55	3.31	44.86	74.00	-29.14

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n20	Temp./Humi.	:21/53
Frequency	:2462 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Tx CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



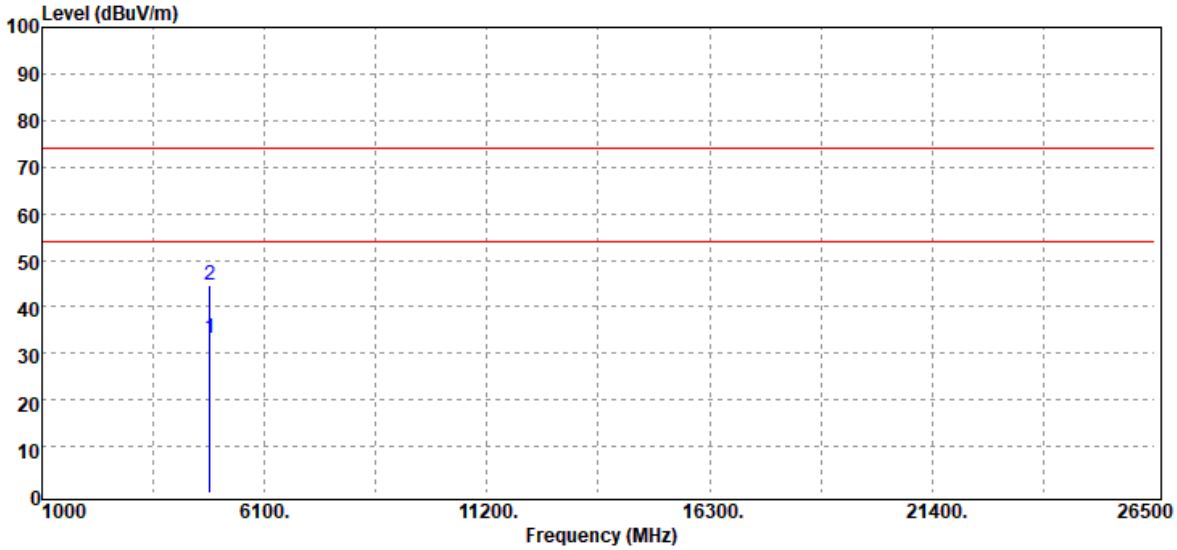
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4924.00	Average	31.89	3.75	35.64	54.00	-18.36
4924.00	Peak	42.65	3.75	46.40	74.00	-27.60

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n20	Temp./Humi.	:21/53
Frequency	:2462 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Tx CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



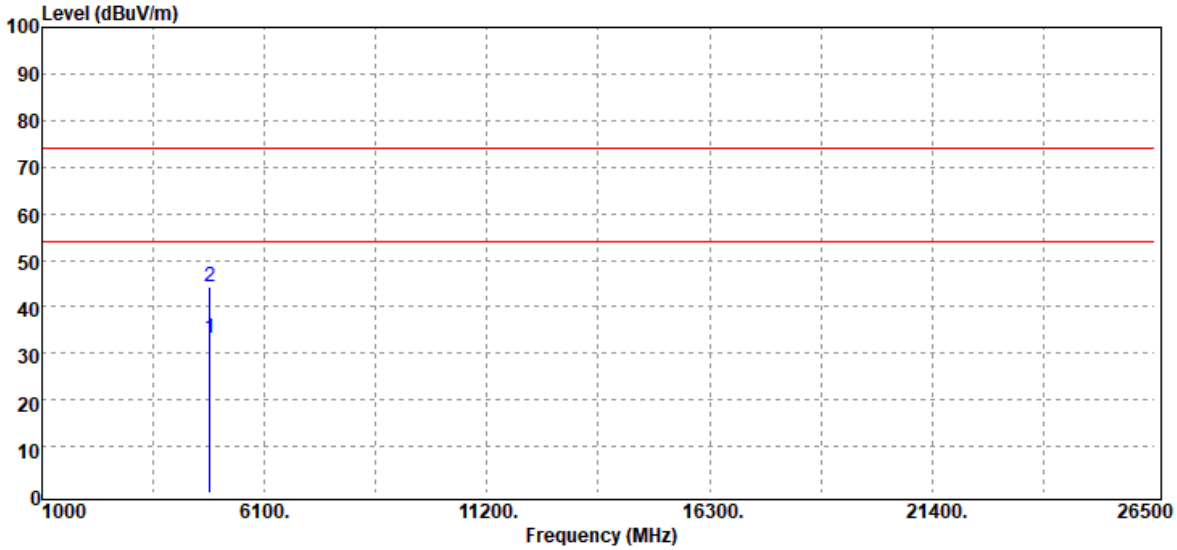
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4924.00	Average	31.44	3.75	35.19	54.00	-18.81
4924.00	Peak	42.79	3.75	46.54	74.00	-27.46

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n40	Temp./Humi.	:21/53
Frequency	:2422 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Tx CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



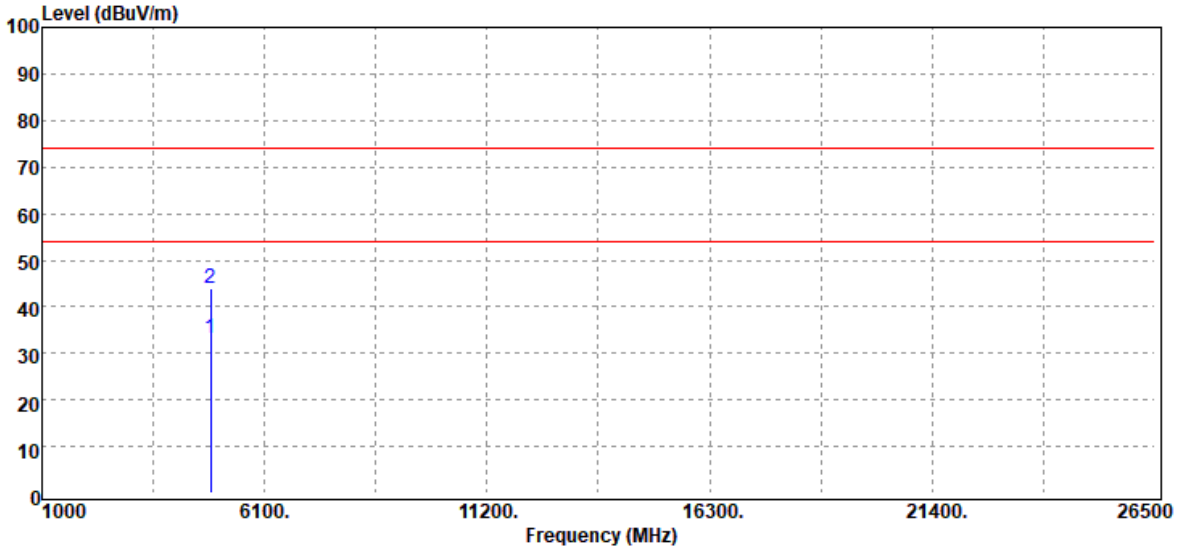
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4844.00	Average	30.28	3.09	33.37	54.00	-20.63
4844.00	Peak	41.64	3.09	44.73	74.00	-29.27

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n40	Temp./Humi.	:21/53
Frequency	:2422 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Tx CH Low	Engineer	:Kane
EUT Pol.	:E2 Plan		



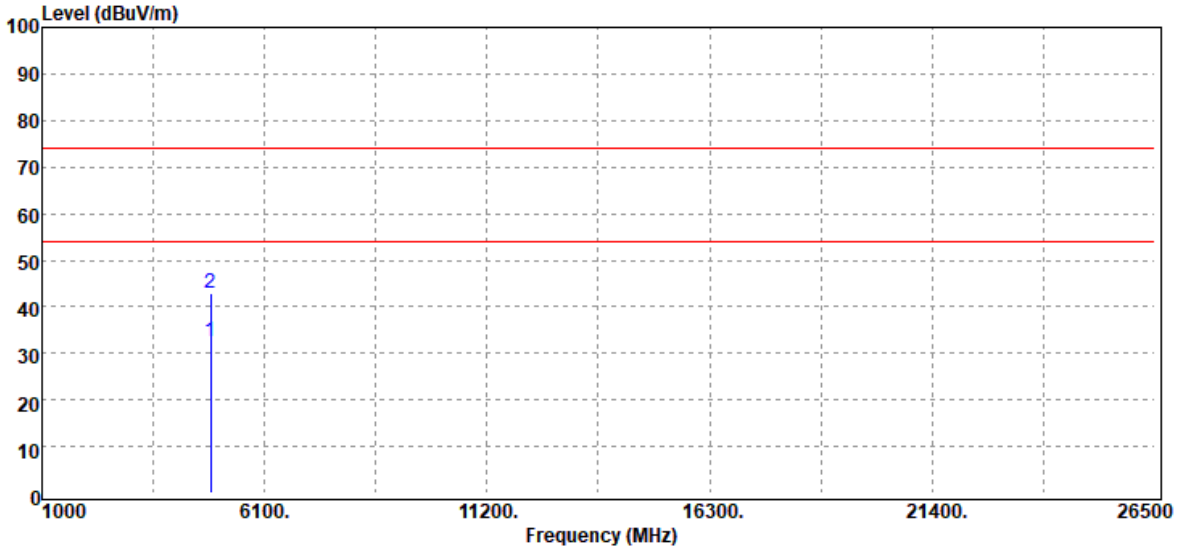
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4844.00	Average	30.22	3.09	33.31	54.00	-20.69
4844.00	Peak	41.19	3.09	44.28	74.00	-29.72

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n40	Temp./Humi.	:21/53
Frequency	:2437 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol.	:E2 Plan		



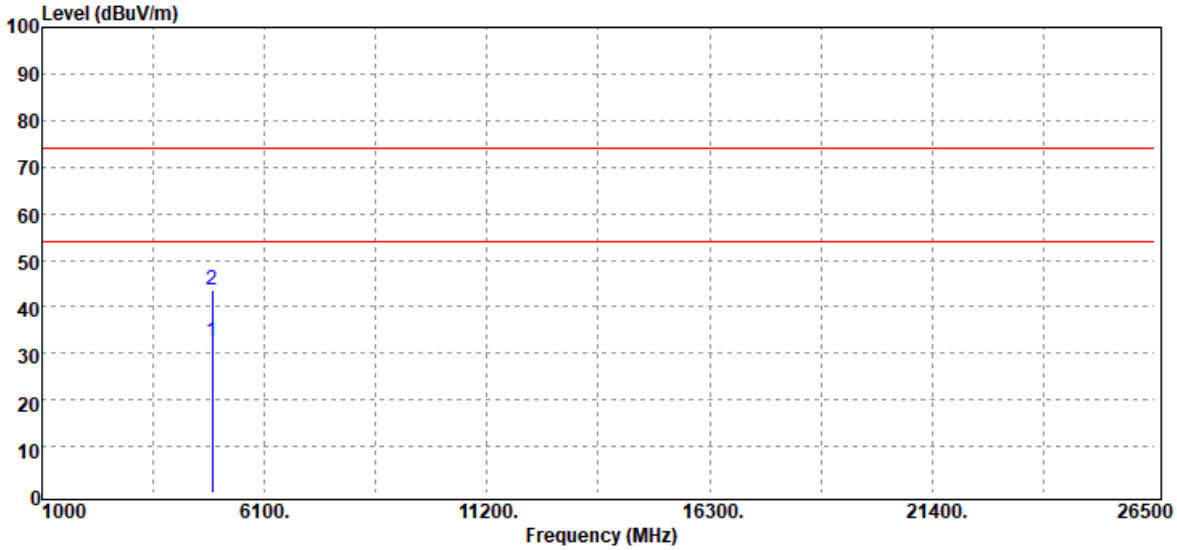
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4874.00	Average	30.07	3.31	33.38	54.00	-20.62
4874.00	Peak	40.55	3.31	43.86	74.00	-30.14

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n40	Temp./Humi.	:21/53
Frequency	:2437 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Tx CH Mid	Engineer	:Kane
EUT Pol.	:E2 Plan		



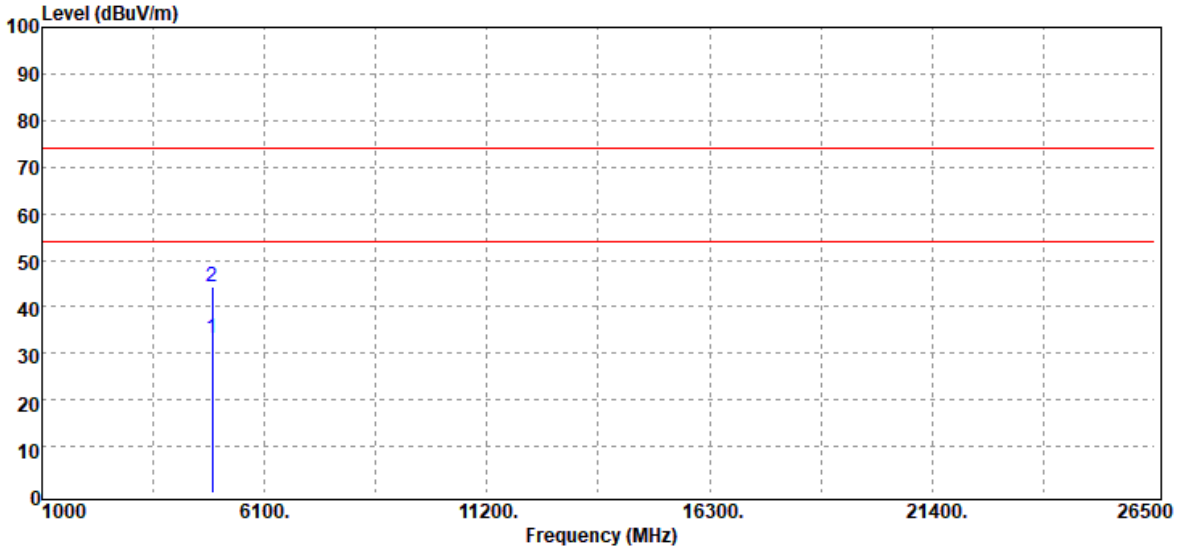
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4874.00	Average	29.22	3.31	32.53	54.00	-21.47
4874.00	Peak	39.69	3.31	43.00	74.00	-31.00

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n40	Temp./Humi.	:21/53
Frequency	:2452 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Tx CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4904.00	Average	28.89	3.56	32.45	54.00	-21.55
4904.00	Peak	39.95	3.56	43.51	74.00	-30.49

Project Number	:T190606W03	Test Date	:2019-06-14
Operation Band	:802.11n40	Temp./Humi.	:21/53
Frequency	:2452 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Tx CH High	Engineer	:Kane
EUT Pol.	:E2 Plan		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4904.00	Average	29.74	3.56	33.30	54.00	-20.70
4904.00	Peak	40.73	3.56	44.29	74.00	-29.71

12 POWER SPECTRAL DENSITY

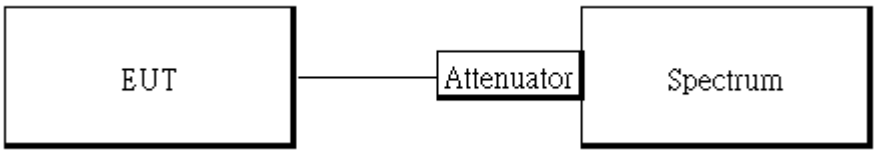
12.1 Standard Applicable

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

Conducted Emission Test Site					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
DC Power Supply	Agilent	E3640A	KR93300208	08/15/2018	08/14/2019
Spectrum Analyzer	Agilent	N9010A	MY53400256	11/21/2018	11/20/2019
DC Block	Mini-Circuits	BLK-18-S+	31129(1)	02/26/2019	02/25/2020

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

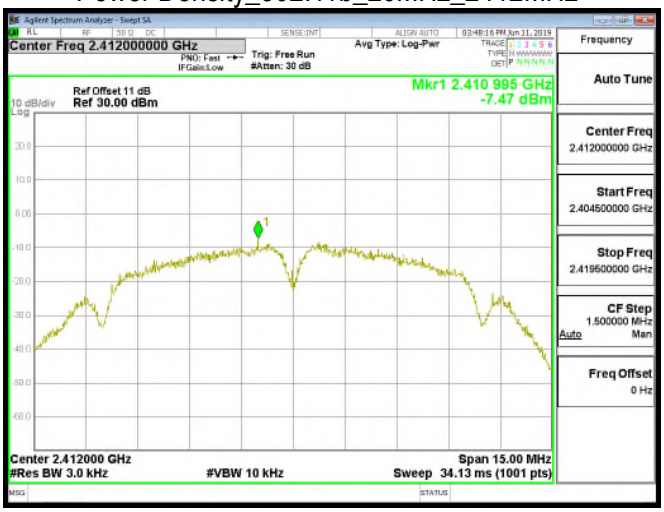
POWER DENSITY 802.11b_Ch0				POWER DENSITY 802.11g_Ch0			
Freq. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result	Freq. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-7.47	8.00	PASS	2412	-13.05	8.00	PASS
2437	-6.99	8.00	PASS	2437	-12.41	8.00	PASS
2462	-8.55	8.00	PASS	2462	-12.97	8.00	PASS
POWER DENSITY 802.11n HT20_Ch0				**POWER DENSITY 802.11n HT40_Ch0**			
Freq. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result	Freq. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-15.22	8.00	PASS	2422	-16.9	8.00	PASS
2437	-14.89	8.00	PASS	2437	-16.7	8.00	PASS
2462	-15.27	8.00	PASS	2452	-17.19	8.00	PASS

Note

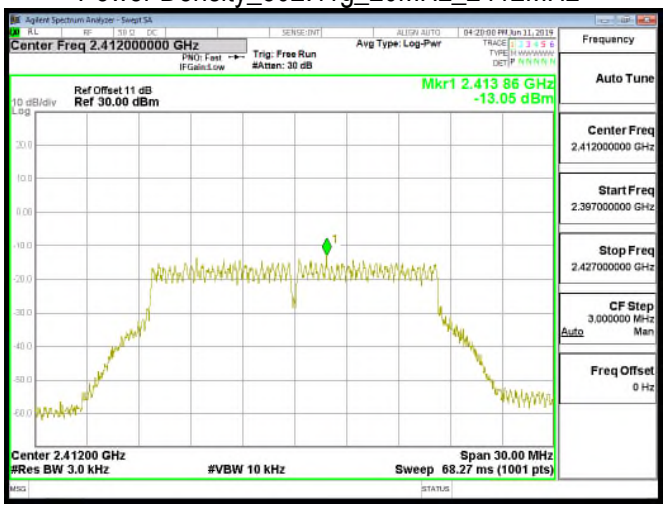
Cable Loss 11.00 dB

**Refer to next page for plots*

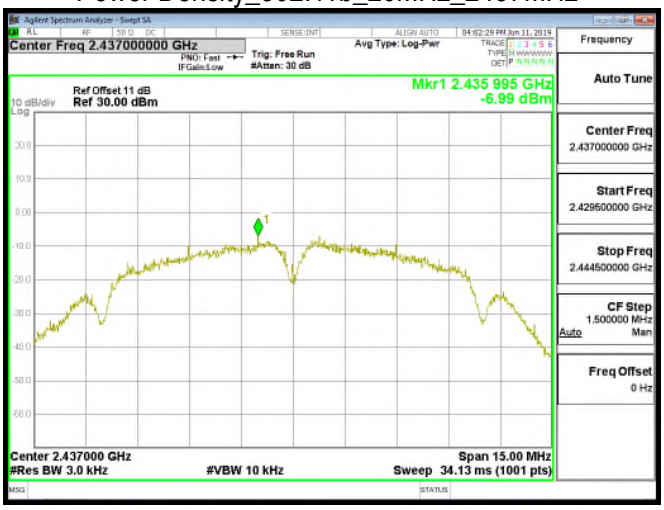
Power Density_802.11b_20MHz_2412MHz



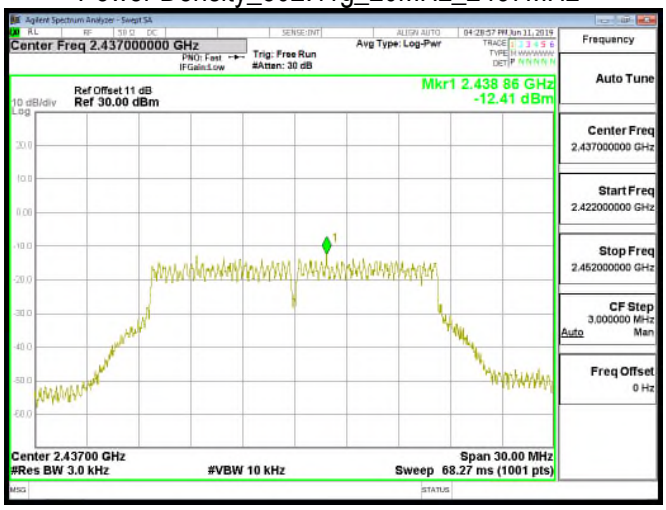
Power Density_802.11g_20MHz_2412MHz



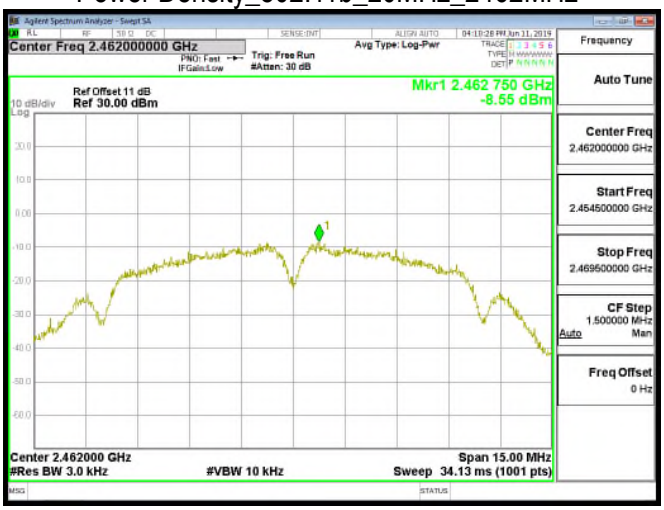
Power Density_802.11b_20MHz_2437MHz



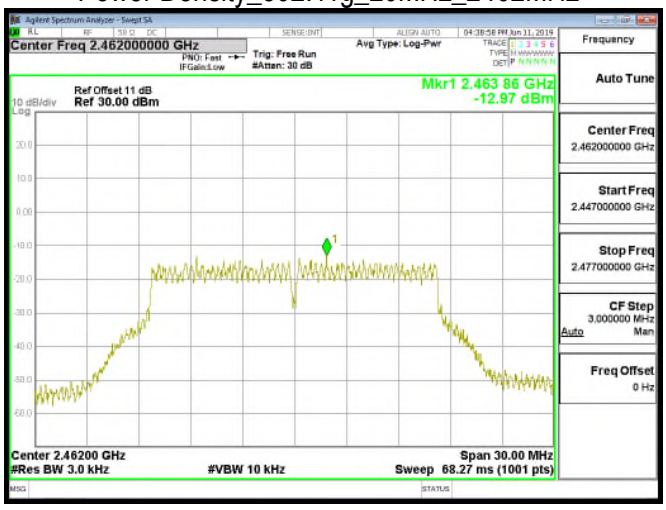
Power Density_802.11g_20MHz_2437MHz



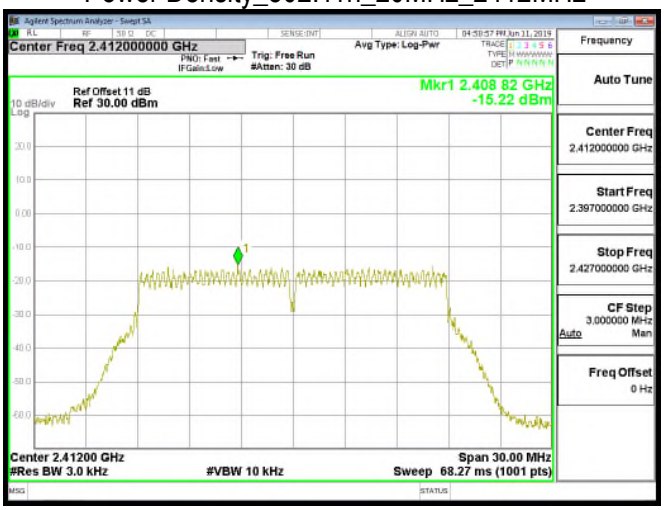
Power Density_802.11b_20MHz_2462MHz



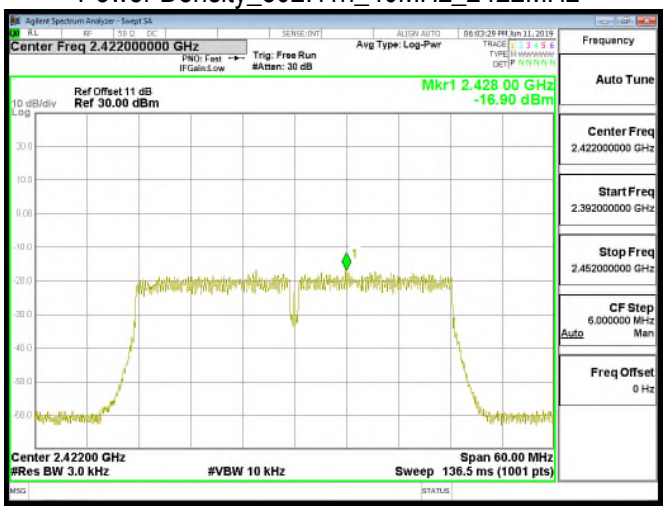
Power Density_802.11g_20MHz_2462MHz



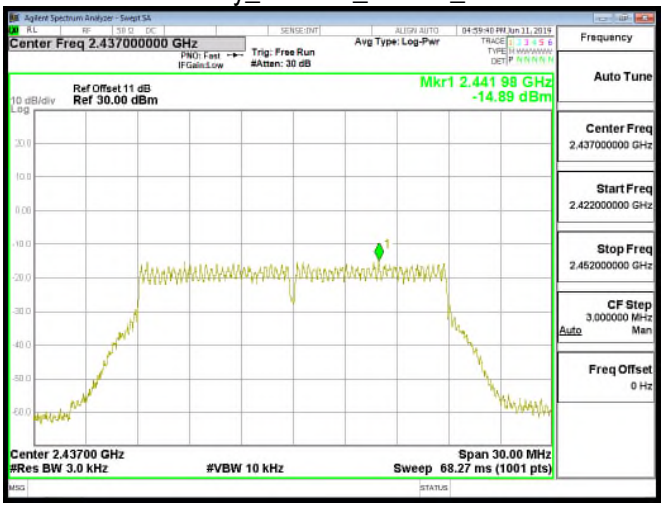
Power Density_802.11n_20MHz_2412MHz



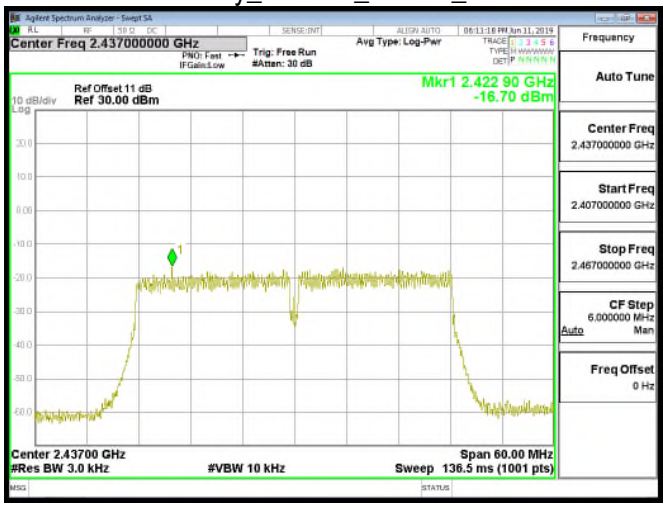
Power Density_802.11n_40MHz_2422MHz



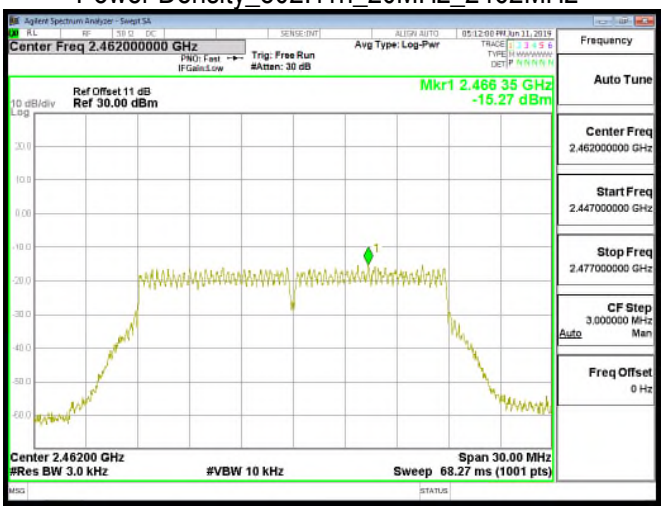
Power Density_802.11n_20MHz_2437MHz



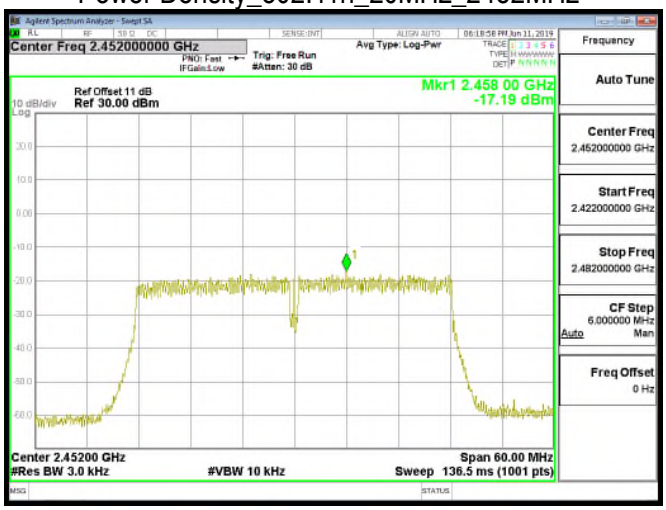
Power Density_802.11n_20MHz_2437MHz



Power Density_802.11n_20MHz_2462MHz



Power Density_802.11n_20MHz_2452MHz



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.

13.2 Antenna Connected Construction

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

~ End of Report ~