Shenzhen Global Test Service Co.,Ltd.
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.247

Report Reference No.....:	**GTS20200612012-1-3-3**
FCC ID..... :	**U7GBBGRM**
Compiled by (position+printed name+signature)..:	File administrators Jimmy Wang
Supervised by (position+printed name+signature)..:	Test Engineer Aaron Tan
Approved by (position+printed name+signature)..:	Manager Jason Hu
Date of issue.....:	Jun.16, 2020
Representative Laboratory Name .:	**Shenzhen Global Test Service Co.,Ltd.**
Address.....:	No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong, China
Applicant's name.....:	**Klein Electronics, Inc.**
Address .....:	349 North Vinewood Street, Escondido, California, USA 92029
Test specification .....:	
Standard .....:	**FCC Part 15.247**
TRF Originator.....:	Shenzhen Global Test Service Co.,Ltd.

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Test item description .....:	Global IOT mobile radio
Trade Mark .....:	blackbox
Manufacturer .....:	Klein Electronics, Inc.
Model/Type reference.....:	Blackbox-BBGR-M
Listed Models .....:	N/A
Modulation Type .....:	CCK/DSSS/ OFDM
Operation Frequency.....:	From 2412 - 2462MHz
Rating .....:	DC12V
Result.....:	**PASS**

TEST REPORT

Test Report No. :	GTS20200612012-1-3-3	Jun.16, 2020 Date of issue

Equipment under Test	:	Global IOT mobile radio
Model /Type	:	Blackbox-BBGR-M
Listed Models	:	N/A
Applicant	:	**Klein Electronics, Inc.**
Address	:	349 North Vinewood Street, Escondido, California, USA 92029
Manufacturer	:	**Klein Electronics, Inc.**
Address	:	349 North Vinewood Street, Escondido, California, USA 92029

Test Result:	**PASS**

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

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices
KDB558074 D01 v05r02: Guidance for Compliance Measurements on Digital Transmission Systems (DTS) ,Frequency Hopping Spread Spectrum System(HFSS), and Hybrid System Devices Operating Under §15.247 of The FCC rules.

2 SUMMARY

2.1 General Remarks

Date of receipt of test sample	:	May.25, 2020
Testing commenced on	:	May.25, 2020
Testing concluded on	:	Jun.16, 2020

2.2 Product Description

Product Name:	Global IOT mobile radio
Model/Type reference:	Blackbox-BBGR-M
Power supply:	DC 12V
testing sample ID：	GTS20200612012-1-3-1#(Engineer sample), GTS20200612012-1-3-2#(Normal sample)
Hardware version:	DJ018_MB_V1.3
Software version:	T56
WIFI :	
Supported type:	802.11b/802.11g/802.11n(H20):
Modulation:	802.11b: DSSS 802.11g/802.11n(H20): OFDM
Operation frequency:	802.11b/802.11g/802.11n(H20): 2412MHz~2462MHz
Channel number:	802.11b/802.11g/802.11n(H20): 11
Channel separation:	5MHz
Antenna type:	FPC antenna
Antenna gain:	2.0dBi

2.3 Equipment Under Test

Power supply system utilised

Power supply voltage	:	○	230V / 50 Hz	○	120V / 60Hz
		●	12 V DC	○	24 V DC
		○	Other (specified in blank below)		

/

2.4 Short description of the Equipment under Test (EUT)

This is a Global IOT mobile radio.
For more details, refer to the user's manual of the EUT.

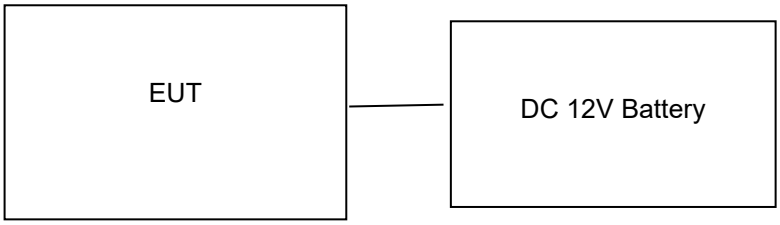
2.5 EUT operation mode

The application provider specific test software(AT command) to control sample in continuous TX and RX (Duty Cycle >98%) for testing meet KDB558074 test requirement.

IEEE 802.11b/g/n: Thirteen channels are provided to the EUT.

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

2.6 Block Diagram of Test Setup



2.7 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID:U7GBBGRM** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.8 EUT configuration

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

○ - supplied by the manufacturer

○ - Supplied by the lab

○		M/N:	
		Manufacturer:	

2.9 Modifications

No modifications were implemented to meet testing criteria.

3 TEST ENVIRONMENT

3.1 Address of the test laboratory

Shenzhen Global Test Service Co.,Ltd.
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

3.2 Test Facility

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

FCC-Registration No.: 165725

Shenzhen Global Test Service Co.,Ltd EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

A2LA-Lab Cert. No.: 4758.01

Shenzhen Global Test Service Co.,Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

CNAS-Lab Code: L8169

Shenzhen Global Test Service Co.,Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories. Date of Registration: Dec. 11, 2015. Valid time is until Dec. 10, 2018.

3.3 Environmental conditions

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

Temperature:	25 ° C
Humidity:	45 %
Atmospheric pressure:	950-1050mbar

Conducted testing：

Temperature:	25 ° C
Humidity:	44 %
Atmospheric pressure:	950-1050mbar

3.4 Test Description

FCC PART 15.247		
FCC Part 15.207	AC Power Conducted Emission	N/A
FCC Part 15.247(a)(2)	6dB Bandwidth	PASS
FCC Part 15.247(d)	Spurious RF Conducted Emission	PASS
FCC Part 15.247(b)	Maximum Conducted Output Power	PASS
FCC Part 15.247(e)	Power Spectral Density	PASS
FCC Part 15.109/ 15.205/ 15.209	Radiated Emissions	PASS
FCC Part 15.247(d)	Band Edge	PASS
FCC Part 15.203/15.247 (b)	Antenna Requirement	PASS

Data Rate Used:
Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate	Channel
Maximum Peak Conducted Output Power Power Spectral Density 6dB Bandwidth Spurious RF conducted emission Radiated Emission 9KHz~1GHz& Radiated Emission 1GHz~10th Harmonic	11b/DSSS	1 Mbps	1/6/11
	11g/OFDM	6 Mbps	1/6/11
	11n(20MHz)/OFDM	6.5Mbps	1/6/11
	11n(40MHz)/OFDM	13.5 Mbps	3/6/9
Band Edge	11b/DSSS	1 Mbps	1/11
	11g/OFDM	6 Mbps	1/11
	11n(20MHz)/OFDM	6.5Mbps	1/11
	11n(40MHz)/OFDM	13.5 Mbps	3//9

3.5 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen Global Test Service Co.,Ltd quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen GTS laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10 dB	(1)
Radiated Emission	1~18GHz	4.32 dB	(1)
Radiated Emission	18-40GHz	5.54 dB	(1)
Conducted Disturbance	0.15~30MHz	3.12 dB	(1)

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

3.6 Equipments Used during the Test

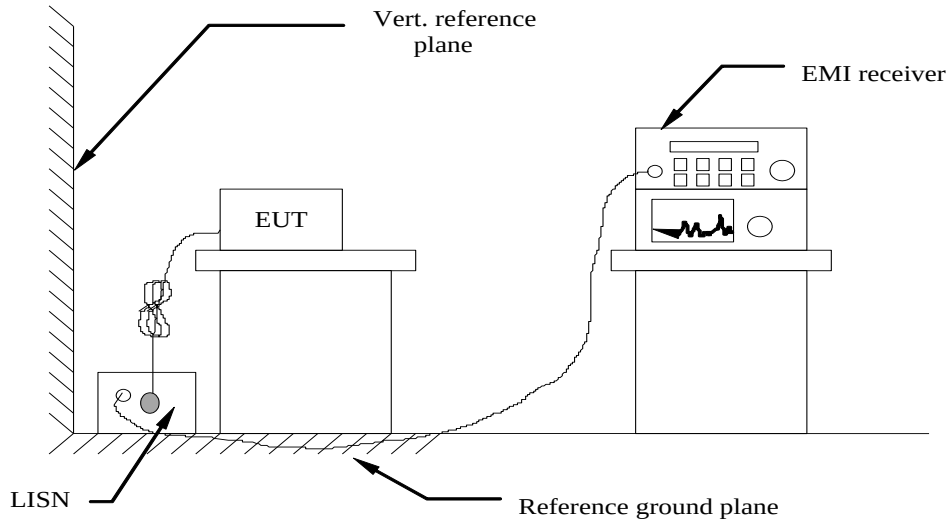
Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.08	2019/09/20	2020/09/19
LISN	R&S	ESH2-Z5	893606/008	2019/09/20	2020/09/19
EMI Test Receiver	R&S	ESPI3	101841-cd	2019/09/20	2020/09/19
EMI Test Receiver	R&S	ESCI7	101102	2019/09/20	2020/09/19
Spectrum Analyzer	Agilent	N9020A	MY48010425	2019/09/20	2020/09/19
Spectrum Analyzer	R&S	FSV40	100019	2019/09/20	2020/09/19
Vector Signal generator	Agilent	N5181A	MY49060502	2019/09/20	2020/09/19
Signal generator	Agilent	E4421B	3610AO1069	2019/09/20	2020/09/19
Climate Chamber	ESPEC	EL-10KA	A20120523	2019/09/20	2020/09/19
Controller	EM Electronics	Controller EM 1000	N/A	N/A	N/A
Horn Antenna	Schwarzbeck	BBHA 9120D	01622	2019/09/23	2020/09/22
Active Loop Antenna	Beijing Da Ze Technology Co.,Ltd.	ZN30900C	15006	2019/10/12	2020/10/11
Bilog Antenna	Schwarzbeck	VULB9163	000976	2020/05/25	2021/05/24
Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	791	2019/09/20	2020/09/19
Amplifier	Schwarzbeck	BBV 9743	#202	2019/09/20	2020/09/19
Amplifier	Schwarzbeck	BBV9179	9719-025	2019/09/20	2020/09/19
Amplifier	EMCI	EMC051845B	980355	2019/09/20	2020/09/19
Temperature/Humidity Meter	Gangxing	CTH-608	02	2019/09/20	2020/09/19
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	KL142031	2019/09/20	2020/09/19
High-Pass Filter	K&L	41H10-1375/U12750-O/O	KL142032	2019/09/20	2020/09/19
RF Cable(below 1GHz)	HUBER+SUHNER	RG214	RE01	2019/09/20	2020/09/19
RF Cable(above 1GHz)	HUBER+SUHNER	RG214	RE02	2019/09/20	2020/09/19
Data acquisition card	Agilent	U2531A	TW53323507	2019/09/20	2020/09/19
Power Sensor	Agilent	U2021XA	MY5365004	2019/09/20	2020/09/19
Test Control Unit	Tonscend	JS0806-1	178060067	2019/06/20	2020/06/19
Automated filter bank	Tonscend	JS0806-F	19F8060177	2019/06/20	2020/06/19
EMI Test Software	Tonscend	JS1120-1	Ver 2.6.8.0518	/	/
EMI Test Software	Tonscend	JS1120-3	Ver 2.5.77.0418	/	/
EMI Test Software	Tonscend	JS32-CE	Ver 2.5	/	/
EMI Test Software	Tonscend	JS32-RE	Ver 2.5.1.8	/	/

Note: The Cal.Interval was one year.

4 TEST CONDITIONS AND RESULTS

4.1 AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
2 Support equipment, if needed, was placed as per ANSI C63.10-2013
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
4 The EUT received DC 12V power from adapter, the adapter received AC120V/60Hz and AC 240V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 All support equipments received AC power from a second LISN, if any.
6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT.The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8 During the above scans, the emissions were maximized by cable manipulation.

AC Power Conducted Emission Limit

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

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

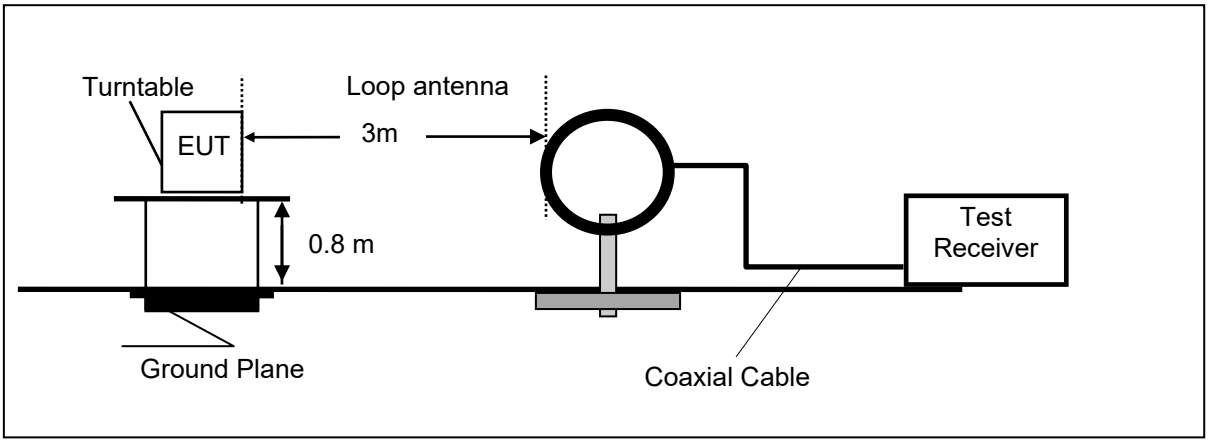
TEST RESULTS

Not Applicable

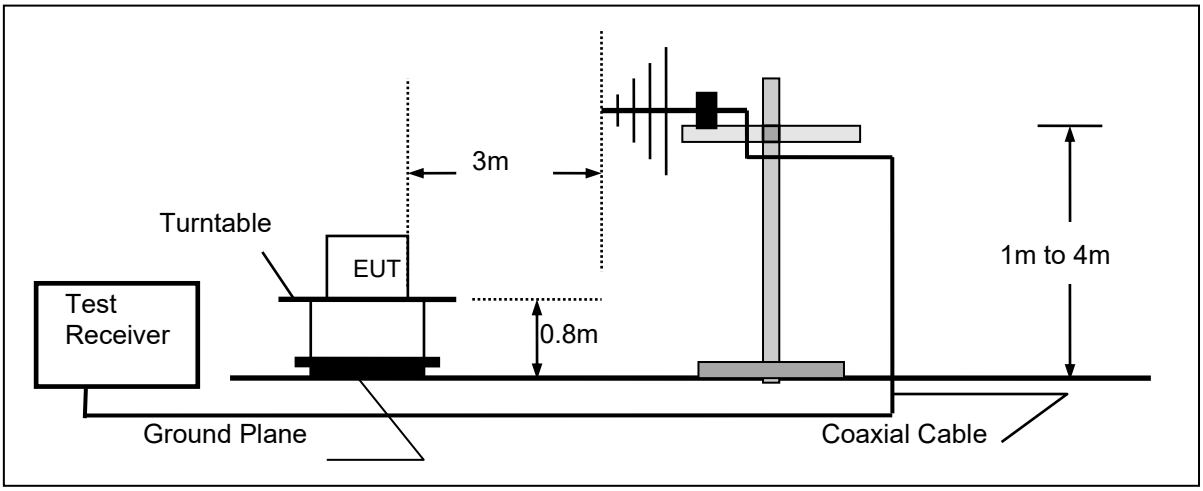
4.2 Radiated Emission

TEST CONFIGURATION

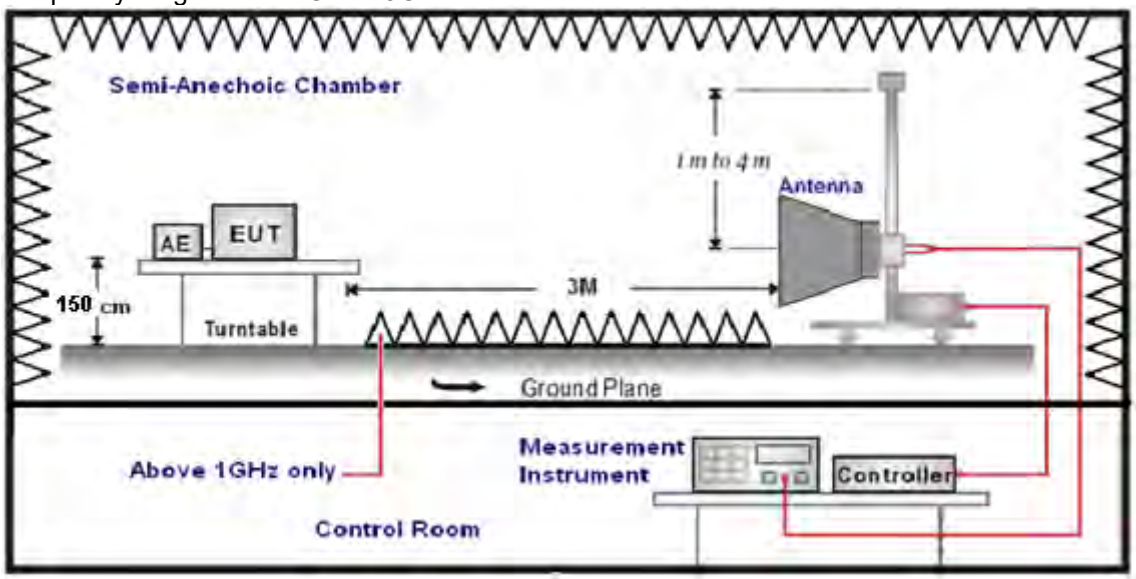
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-25GHz	Horn Anternna	1

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

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

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	

Transd=AF +CL-AG

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.

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

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

TEST RESULTS

Remark:

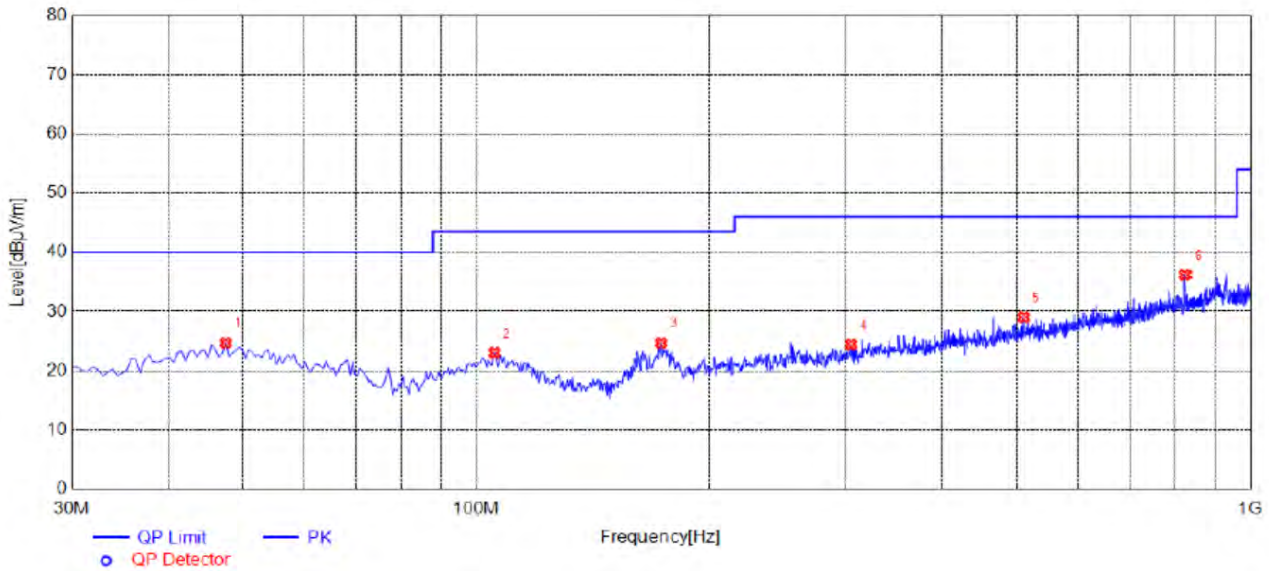
1. This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X

position.

2. All three channels (lowest/middle/highest) of each mode were measured below 1GHz and recorded worst case at 802.11b low channel.
3. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.
4. Remark: Result=Reading value+Factor

For 30MHz-1GHz

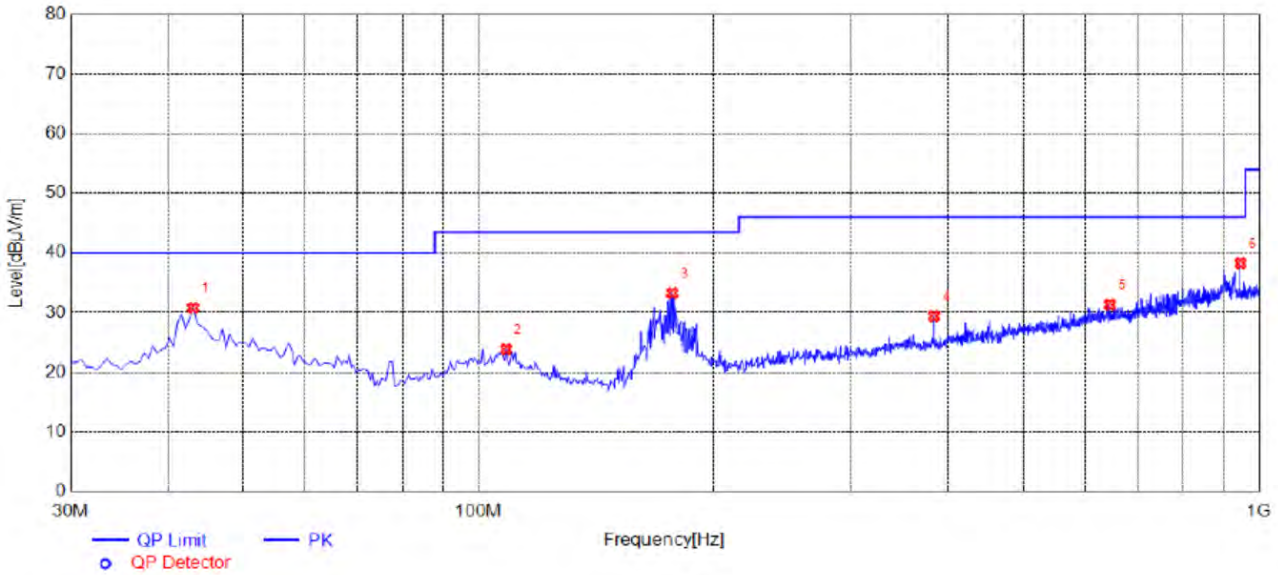
Horizontal



Suspected List

NO.	Frequency [MHz]	Reading [dBµV/m]	Factor [dB]	Result [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Detector	Polarity	Remark
1	47.4600	31.20	-6.51	24.69	40.00	15.31	100	110	PK	Horizonta	PASS
2	105.6600	31.03	-8.03	23.00	43.50	20.50	100	60	PK	Horizonta	PASS
3	173.5600	35.87	-11.19	24.68	43.50	18.82	100	240	PK	Horizonta	PASS
4	305.4800	31.73	-7.32	24.41	46.00	21.59	100	110	PK	Horizonta	PASS
5	510.6350	32.26	-3.25	29.01	46.00	16.99	100	100	PK	Horizonta	PASS
6	824.9150	34.99	1.22	36.21	46.00	9.79	100	290	PK	Horizonta	PASS

Vertical



Suspected List

NO.	Frequency [MHz]	Reading [dBμV/m]	Factor [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Detector	Polarity	Remark
1	43.0950	37.36	-6.56	30.80	40.00	9.20	100	343	PK	Vertical	PASS
2	108.5700	32.39	-8.56	23.83	43.50	19.67	100	151	PK	Vertical	PASS
3	177.4400	44.51	-11.25	33.26	43.50	10.24	100	350	PK	Vertical	PASS
4	384.0500	35.19	-5.81	29.38	46.00	16.62	100	322	PK	Vertical	PASS
5	645.9500	32.46	-1.15	31.31	46.00	14.69	100	297	PK	Vertical	PASS
6	946.1650	35.91	2.37	38.28	46.00	7.72	100	260	PK	Vertical	PASS

For 1GHz to 25GHz

Note: 802.11b/802.11g/802.11n (H20)/ 802.11n (H40)all have been tested, only worse case 802.11b mode is reported

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable loss (dB)	Preamp factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
802.11b-2412MHz									
V	4824	51.75	30.28	7.01	36.5	52.54	74	21.46	PK
V	4824	42.86	30.28	7.01	36.5	43.65	54	10.35	AV
H	4824	52.39	30.28	7.01	36.5	53.18	74	20.82	PK
H	4824	42.47	30.28	7.01	36.5	43.26	54	10.74	AV
V	7236	37.58	36.59	8.91	35.3	47.78	74	26.22	PK
V	7236	29.29	36.59	8.91	35.3	39.49	54	14.51	AV
H	7236	37.73	36.59	8.91	35.3	47.93	74	26.07	PK
H	7236	28.28	36.59	8.91	35.3	38.48	54	15.52	AV
802.11b -2437MHz									
V	4874	52.62	30.36	7.62	36.5	54.1	74	19.9	PK
V	4874	42.05	30.36	7.62	36.5	43.53	54	10.47	AV
H	4874	52.37	30.36	7.62	36.5	53.85	74	20.15	PK
H	4874	41.63	30.36	7.62	36.5	43.11	54	10.89	AV
V	7311	39.16	36.61	8.84	35.3	49.31	74	24.69	PK
V	7311	29.29	36.61	8.84	35.3	39.44	54	14.56	AV
H	7311	38.73	36.61	8.84	35.3	48.88	74	25.12	PK
H	7311	29.42	36.61	8.84	35.3	39.57	54	14.43	AV
802.11b -2462MHz									
V	4924	53.25	30.43	7.94	36.2	55.42	74	18.58	PK
V	4924	41.58	30.43	7.94	36.2	43.75	54	10.25	AV
H	4924	55.96	30.43	7.94	36.2	58.13	74	15.87	PK
H	4924	41.72	30.43	7.94	36.2	43.89	54	10.11	AV
V	7386	40.18	36.78	8.45	35.3	50.11	74	23.89	PK
V	7386	28.15	36.78	8.45	35.3	38.08	54	15.92	AV
H	7386	39.47	36.78	8.45	35.3	49.4	74	24.6	PK
H	7386	30.52	36.78	8.45	35.3	40.45	54	13.55	AV

Note：

1) Emission level (dBuV/m) = Meter Reading+ antenna Factor+ cable loss- preamp factor.
2) Margin value = Limits-Emission level.
3) -- Mean the PK detector measured value is below average limit.
4) The other emission levels were very low against the limit.
5) RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.

Results of Band Edges Test (Radiated)

Note: 802.11b/802.11g/802.11n (H20)/ 802.11n (H40)all have been tested, only worse case 802.11b mode is reported

Polar (H/V)	Frequency	Meter Reading	Antenna Factor	Cable loss	Preamp factor	Emission Level	Limits	Margin	Detector Type
	(MHz)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	
802.11b -2412MHz									
V	2390	57.65	27.49	3.32	36.22	52.24	74	21.76	PK
V	2390	44.37	27.49	3.32	36.22	38.96	54	15.04	AV
H	2390	56.62	27.49	3.32	36.22	51.21	74	22.79	PK
H	2390	42.85	27.49	3.32	36.22	37.44	54	16.56	AV
V	2400	57.69	27.55	3.41	36.22	52.43	74	21.57	PK
V	2400	43.72	27.55	3.41	36.22	38.46	54	15.54	AV
H	2400	59.16	27.55	3.41	36.22	53.9	74	20.10	PK
H	2400	44.86	27.55	3.41	36.22	39.6	54	14.40	AV
802.11b -2462MHz									
V	2483.50	54.27	27.45	3.38	36.34	48.76	74	25.24	PK
V	2483.50	43.36	27.45	3.38	36.34	37.85	54	16.15	AV
H	2483.50	54.71	27.45	3.38	36.34	49.2	74	24.8	PK
H	2483.50	43.19	27.45	3.38	36.34	37.68	54	16.32	AV
V	2500.00	55.28	27.41	3.47	36.35	49.81	74	24.19	PK
V	2500.00	44.72	27.41	3.47	36.35	39.25	54	14.75	AV
H	2500.00	54.36	27.41	3.47	36.35	48.89	74	25.11	PK
H	2500.00	43.76	27.41	3.47	36.35	38.29	54	15.71	AV

Note：

1) Emission level (dBuV/m) = Meter Reading+ antenna Factor+ cable loss- preamp factor.
2) Margin value = Limits-Emission level.
3) -- Mean the PK detector measured value is below average limit.
4) The other emission levels were very low against the limit.
5) RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.

4.3 Maximum Conducted Output Power

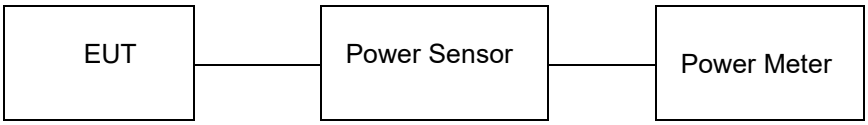
Limit

The Maximum Peak Output Power Measurement is 30dBm.

Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.

Test Configuration



Test Results

Type	Channel	Output power PK (dBm)	Limit (dBm)	Result
802.11b	01	13.51	30.00	Pass
	06	13.25		
	11	13.37		
802.11g	01	14.34	30.00	Pass
	06	14.28		
	11	14.19		
802.11n(HT20)	01	12.08	30.00	Pass
	06	13.68		
	11	13.29		
802.11n(HT40)	03	11.56	30.00	Pass
	06	12.56		
	09	12.50		

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

4.4 Power Spectral Density

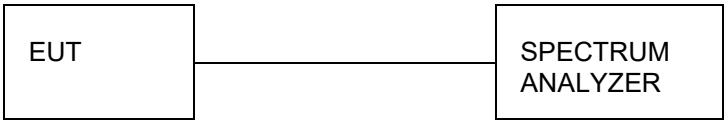
Limit

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

Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW ≥ 3 kHz.
3. Set the VBW ≥ 3× RBW.
4. Set the span to 1.5 times the DTS channel bandwidth.
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 power level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.
11. The resulting peak PSD level must be 8dBm.

Test Configuration



Test Results

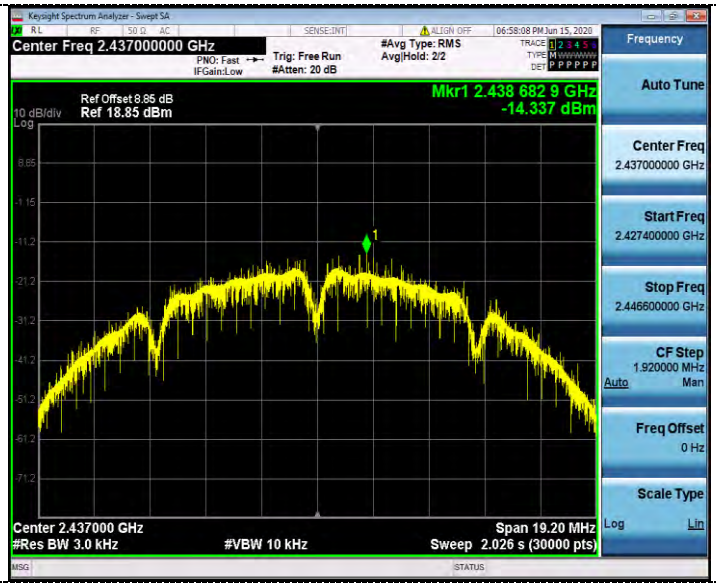
Type	Channel	Power Spectral Density (dBm/3KHz)	Limit (dBm/3KHz)	Result
802.11b	01	-14.01	8.00	Pass
	06	-14.34		
	11	-14.23		
802.11g	01	-14.44	8.00	Pass
	06	-14.49		
	11	-14.82		
802.11n(HT20)	01	-11.24	8.00	Pass
	06	-14.16		
	11	-14.27		
802.11n(HT40)	03	-18.82	8.00	Pass
	06	-19.07		
	09	-19.1		

Note:
1) Measured peak power spectrum density at difference data rate for each mode and recorded worst case for each mode.
2) Test results including cable loss;
3) Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40

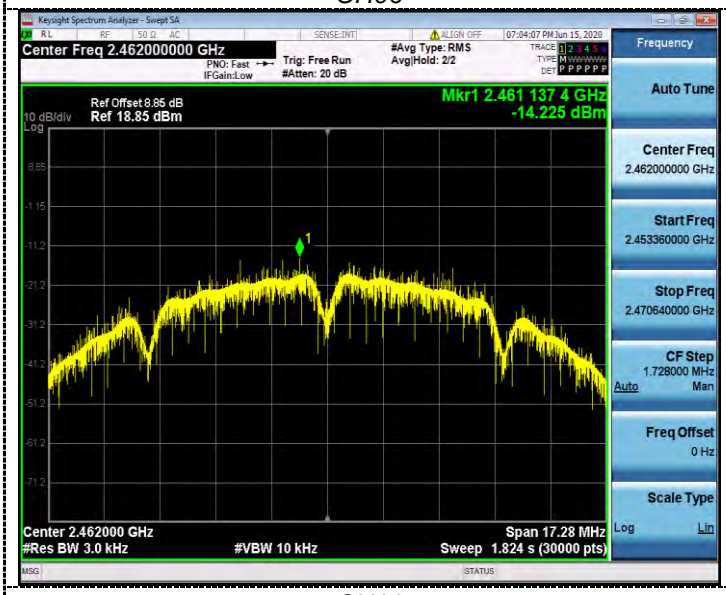
Please refer to following plots;

802.11b

CH01

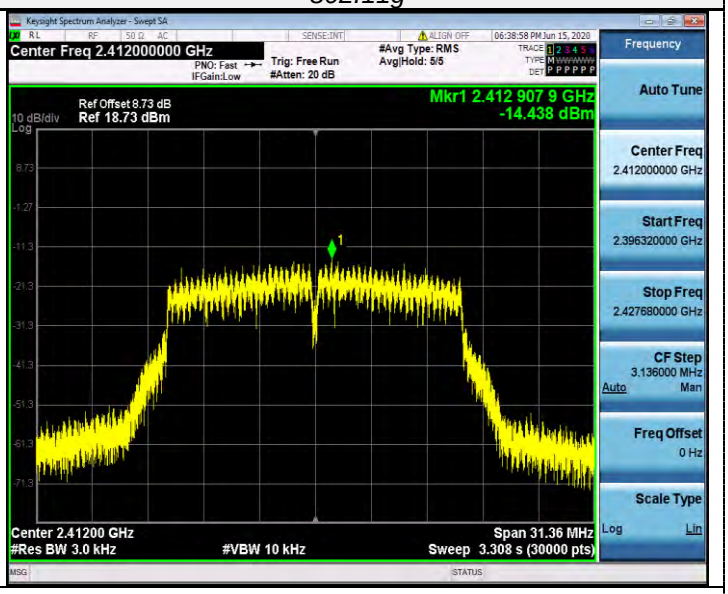


CH06

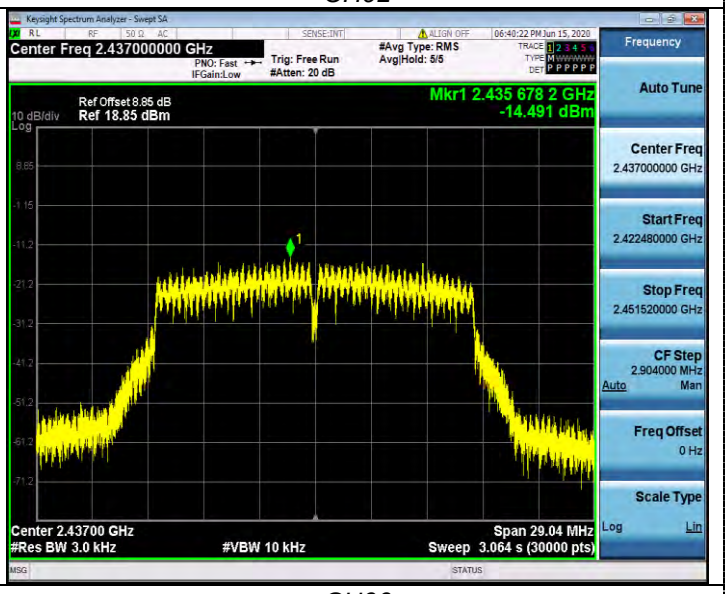


CH11

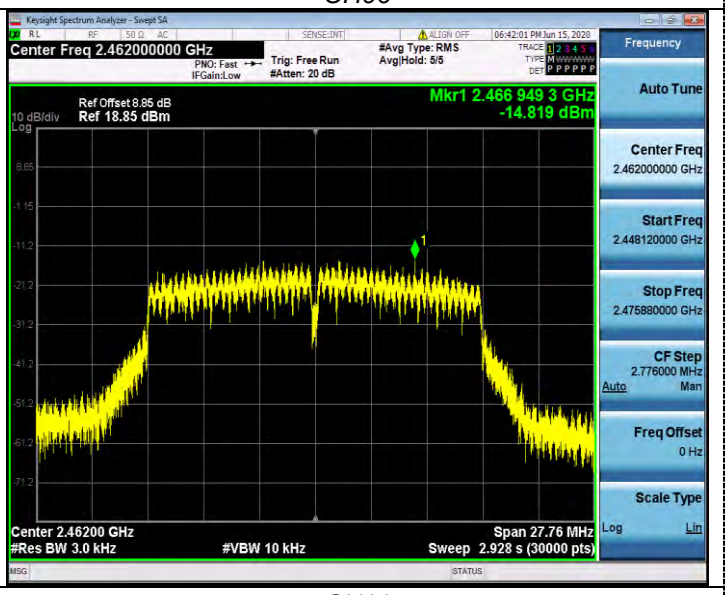
802.11g



CH01

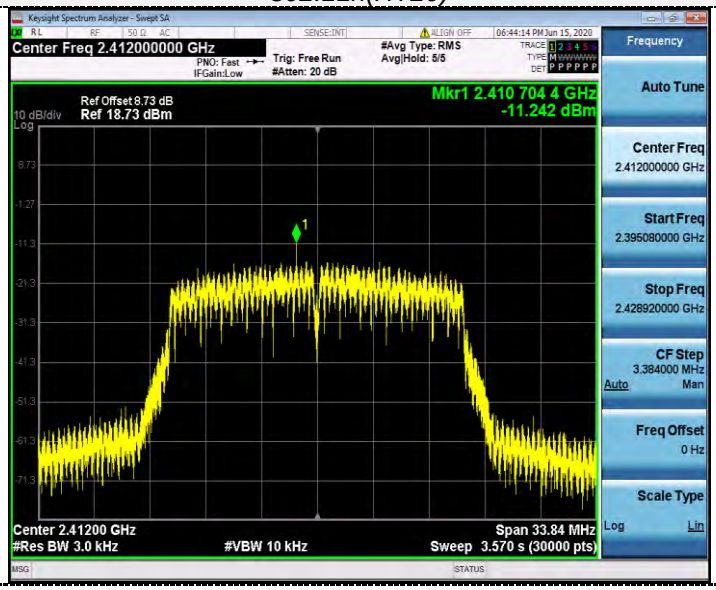


CH06



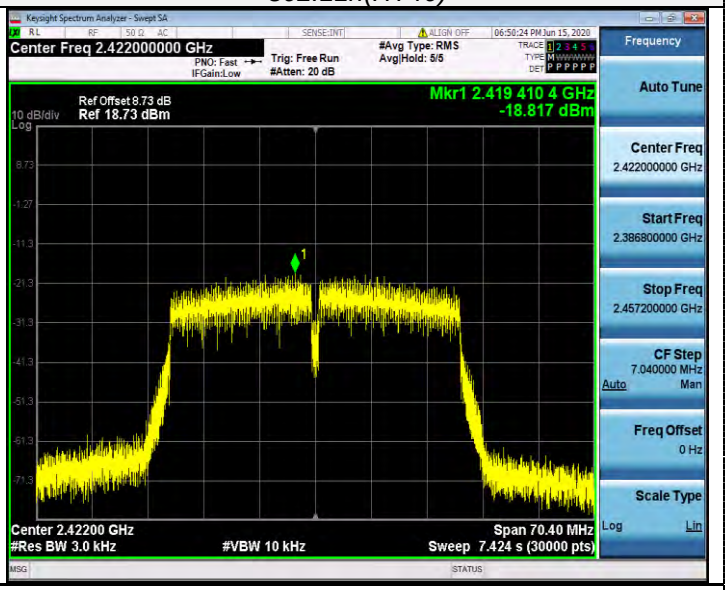
CH11

802.11n(HT20)

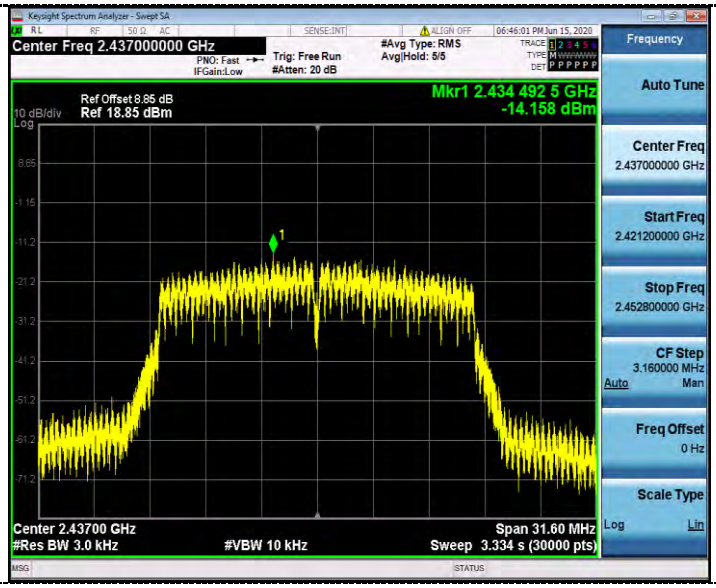


CH01

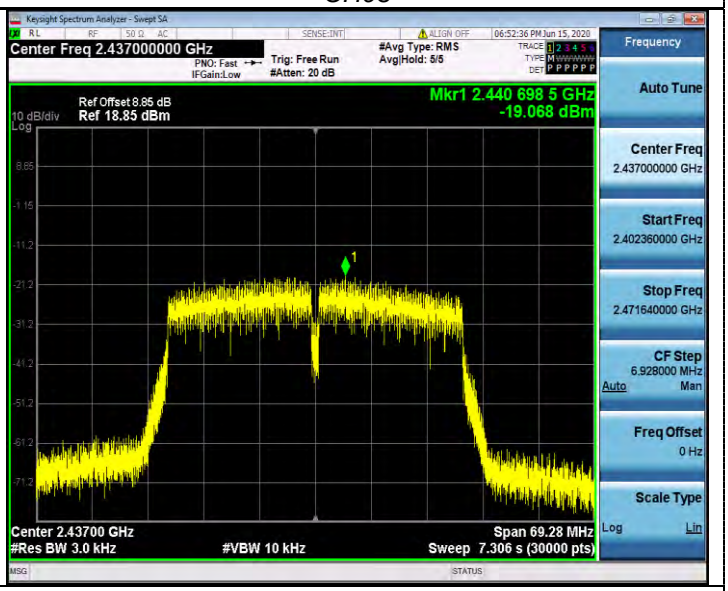
802.11n(HT40)



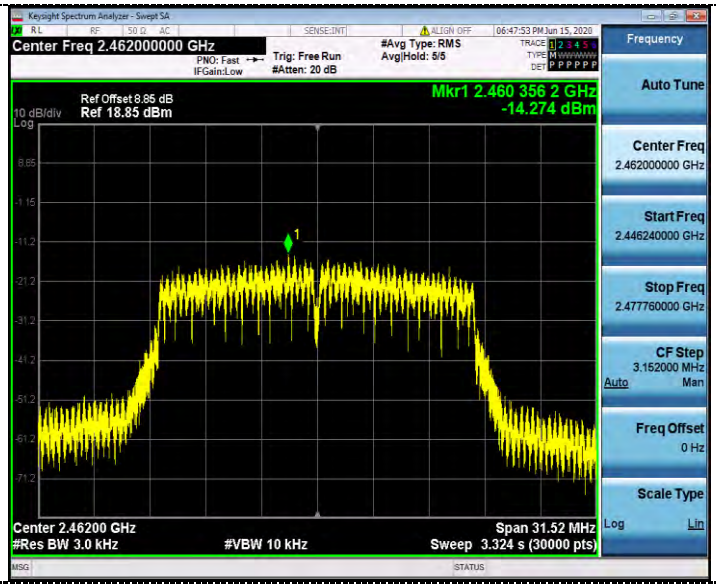
CH03



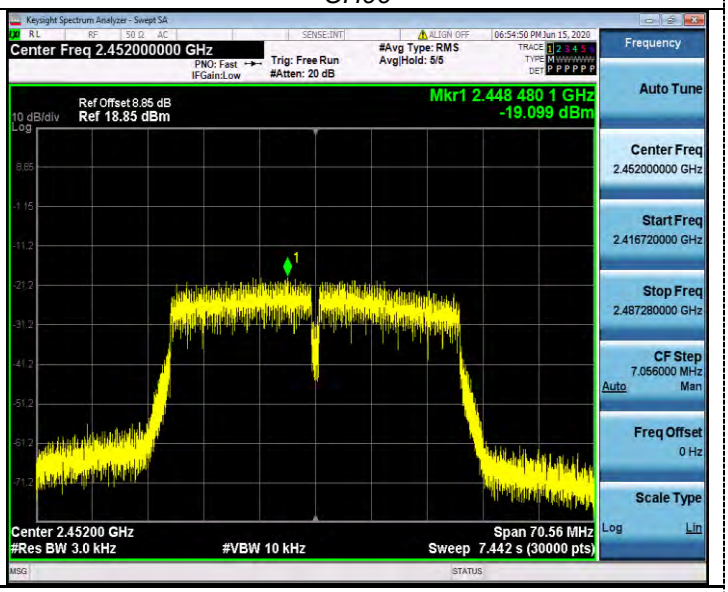
CH06



CH06



CH11



CH09

4.5 6dB Bandwidth

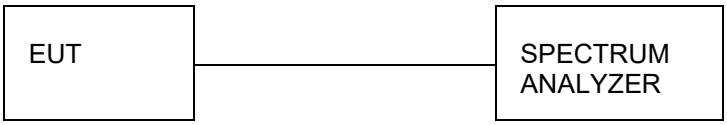
Limit

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

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 KHz RBW and 300 KHz VBW. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.

Test Configuration



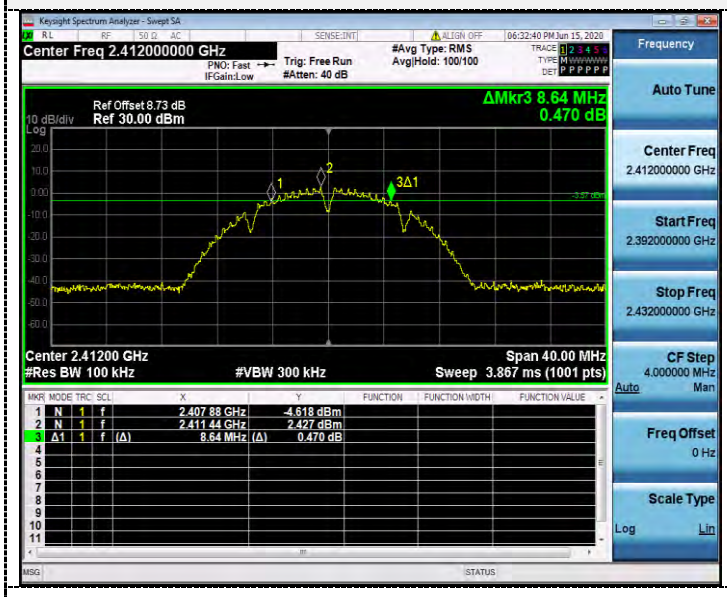
Test Results

Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11b	01	8.640	≥500	Pass
	06	9.600		
	11	8.640		
802.11g	01	15.680	≥500	Pass
	06	14.520		
	11	13.880		
802.11n(HT20)	01	16.920	≥500	Pass
	06	15.800		
	11	15.760		
802.11n(HT40)	03	35.200	≥500	Pass
	06	34.640		
	09	35.280		

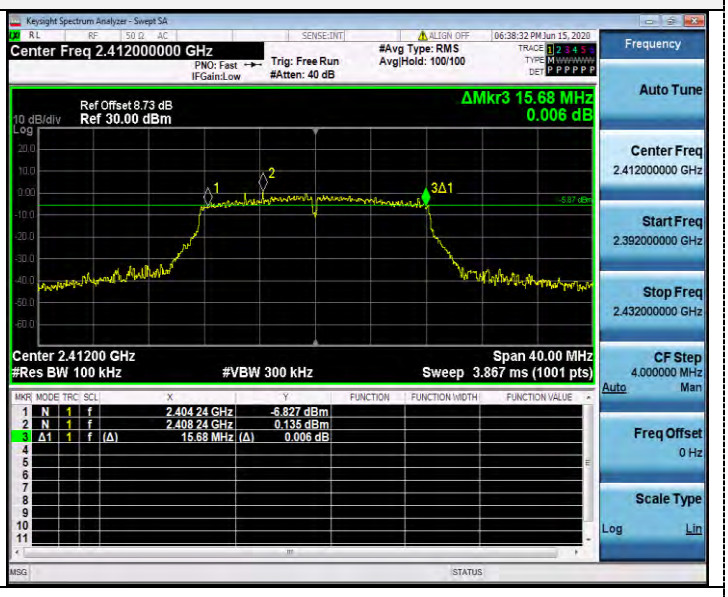
Note:
1) Measured peak power spectrum density at difference data rate for each mode and recorded worst case for each mode.
2) Test results including cable loss;
3) Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40

Please refer to following plots;

802.11b

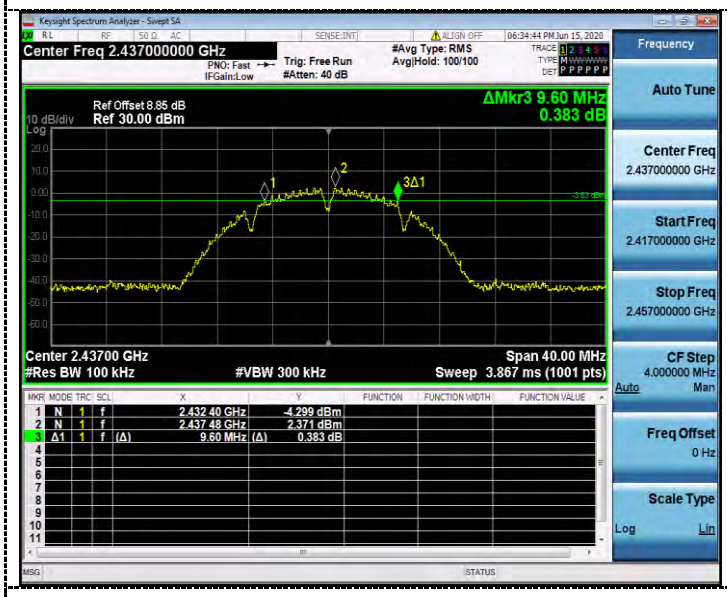


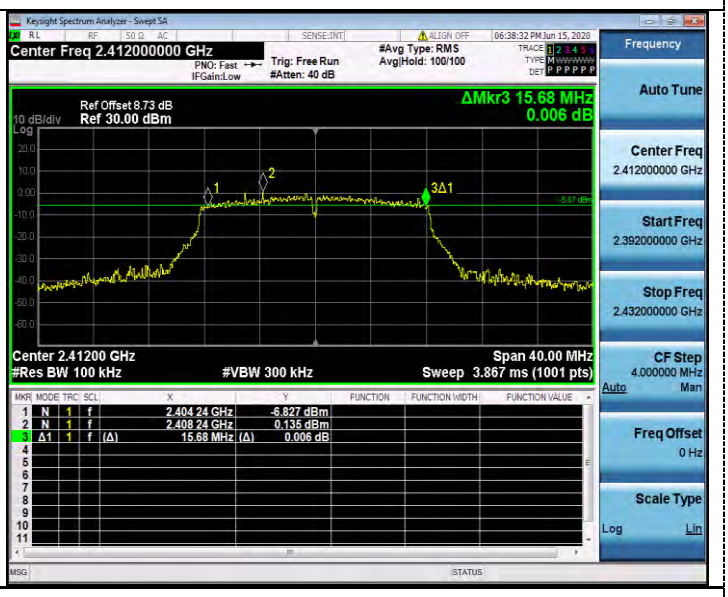
802.11g



CH01

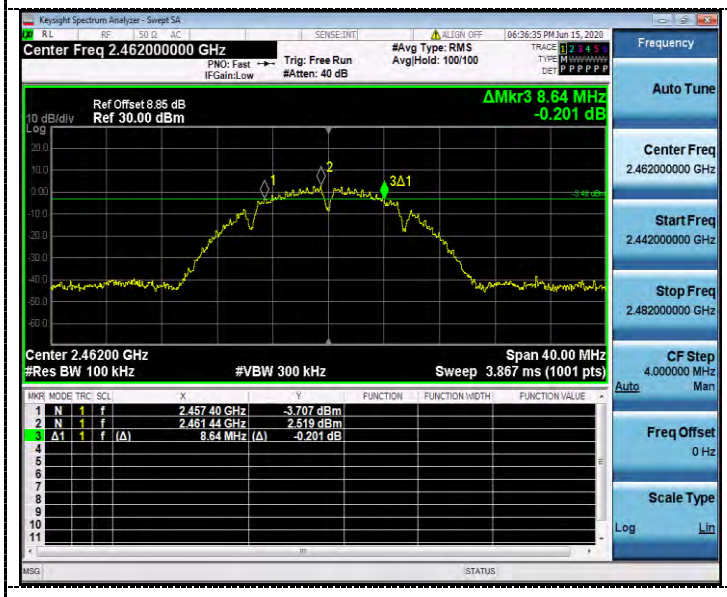
CH01

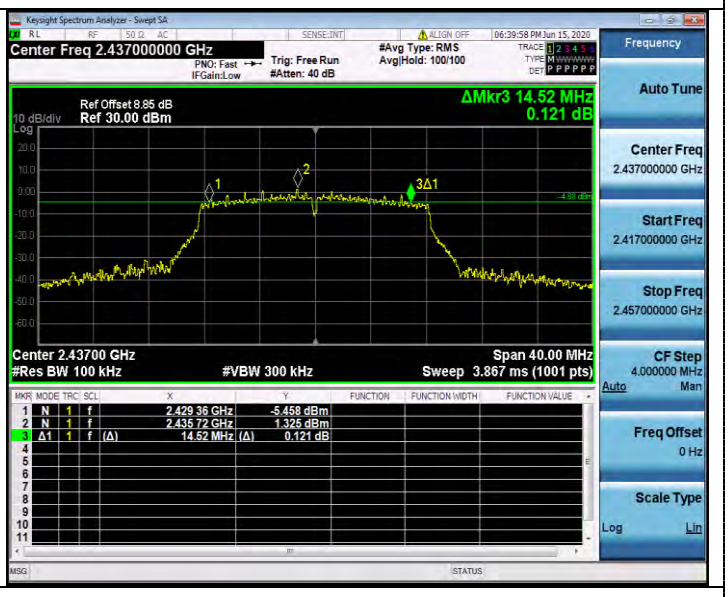




CH06

CH06

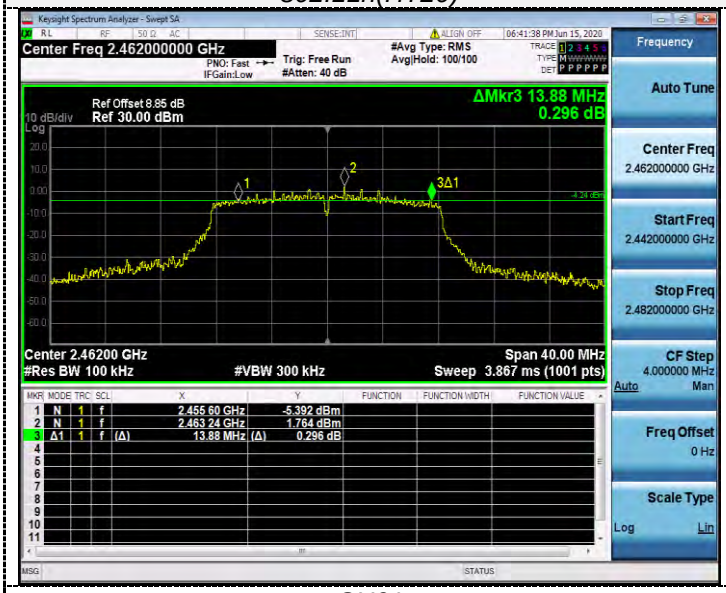




CH11

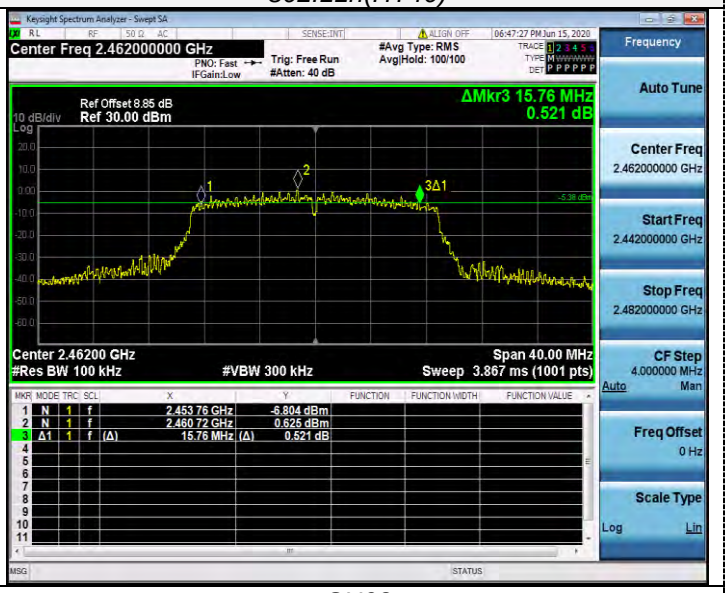
CH11

802.11n(HT20)

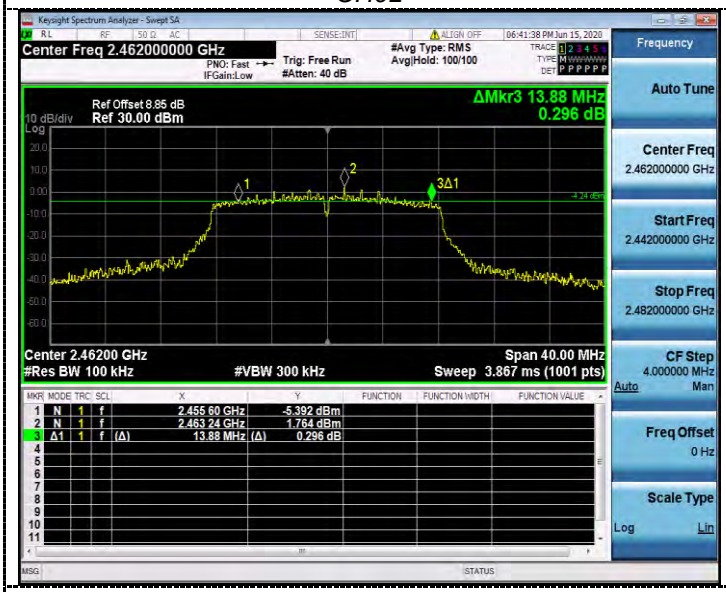


CH01

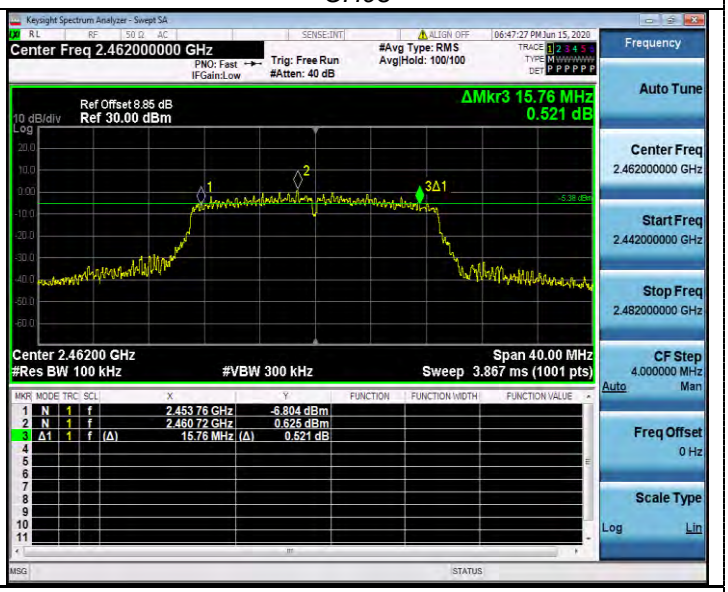
802.11n(HT40)



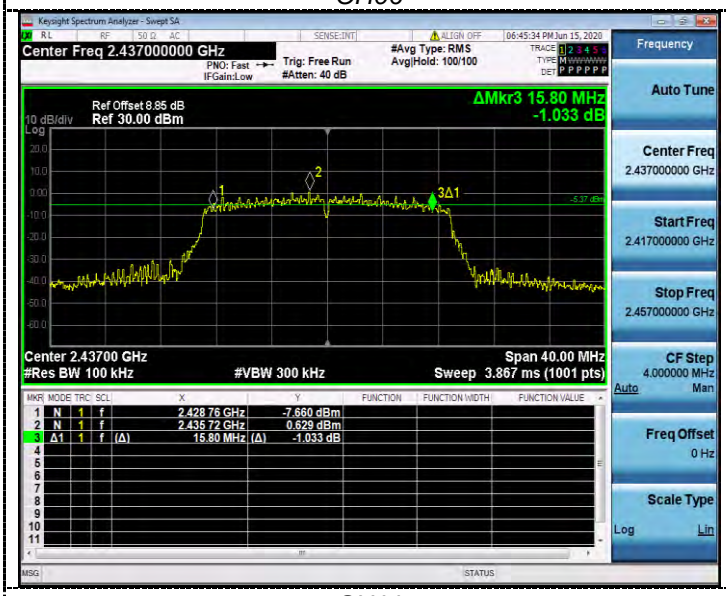
CH03



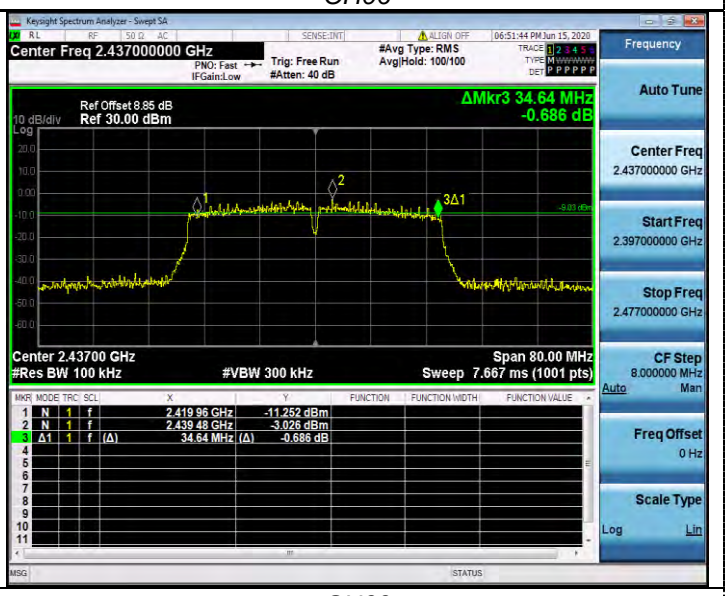
CH06



CH06



CH11



CH09

4.6 Out-of-band Emissions

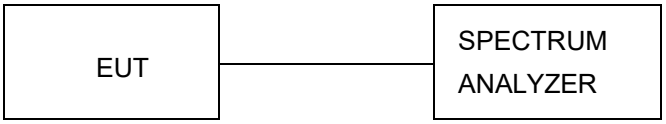
Limit

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 con-ducted or a radiated measurement, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies 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.

Test Procedure

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector , and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

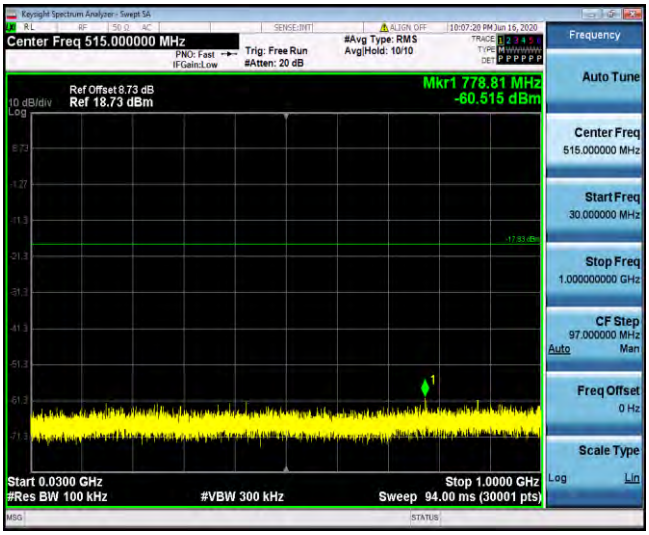
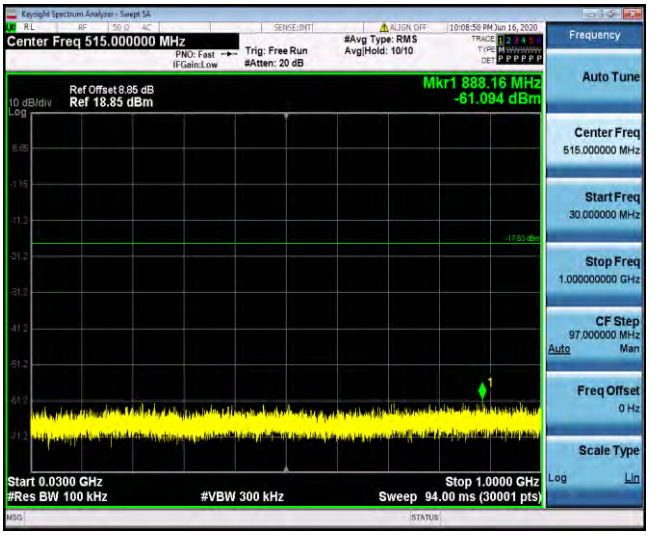
Test Configuration

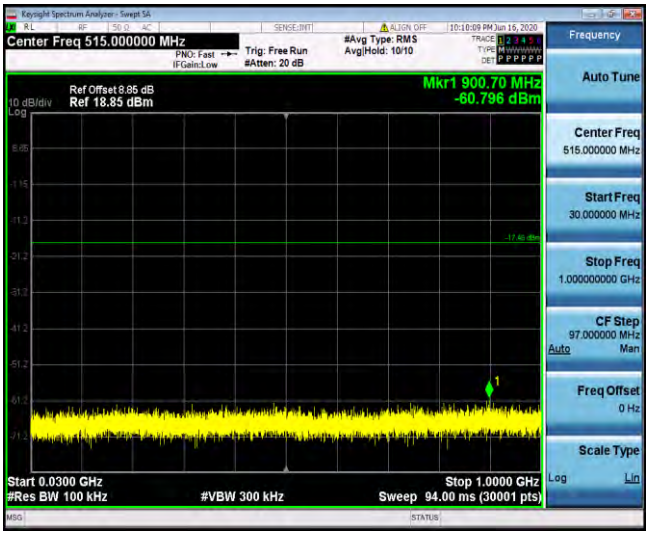
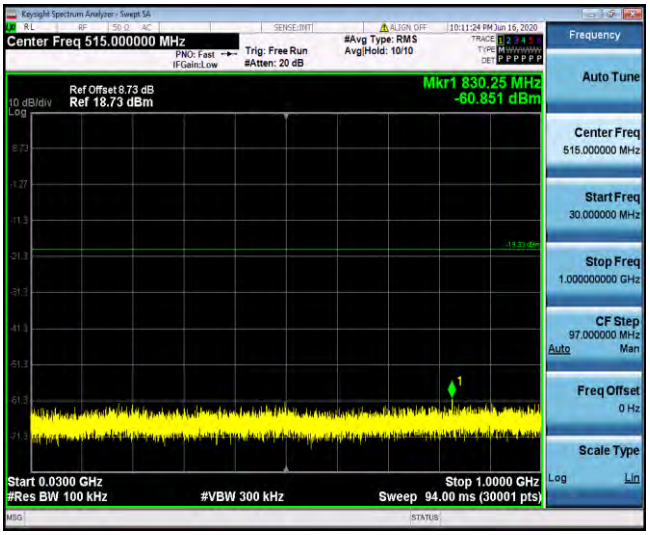


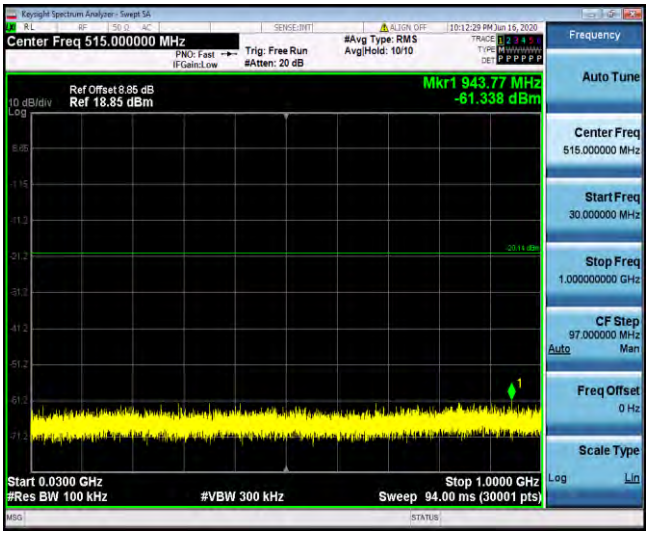
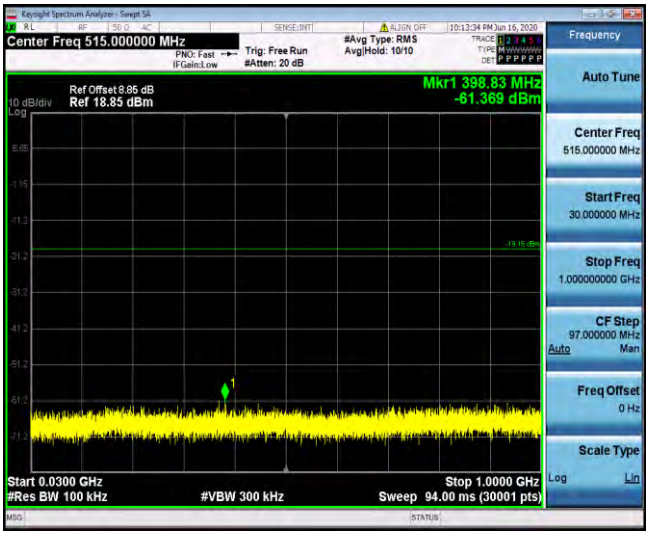
Test Results

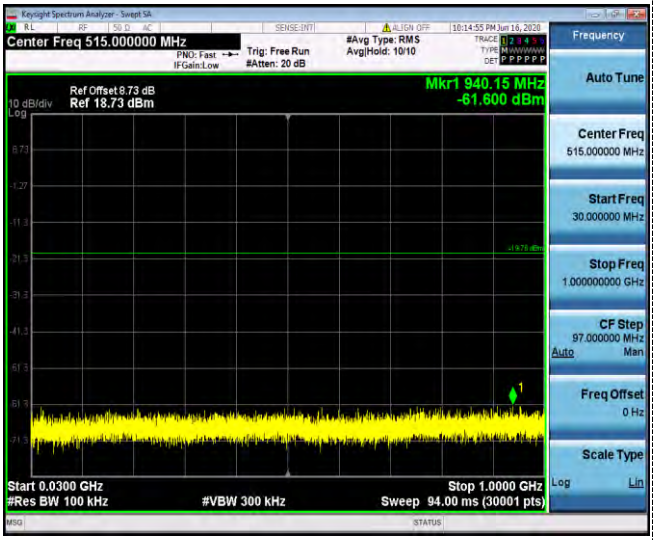
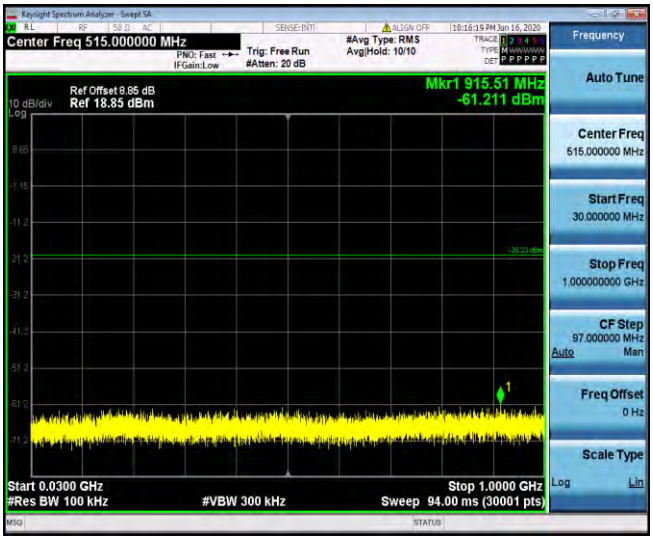
Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data. And record the worst data in the report.

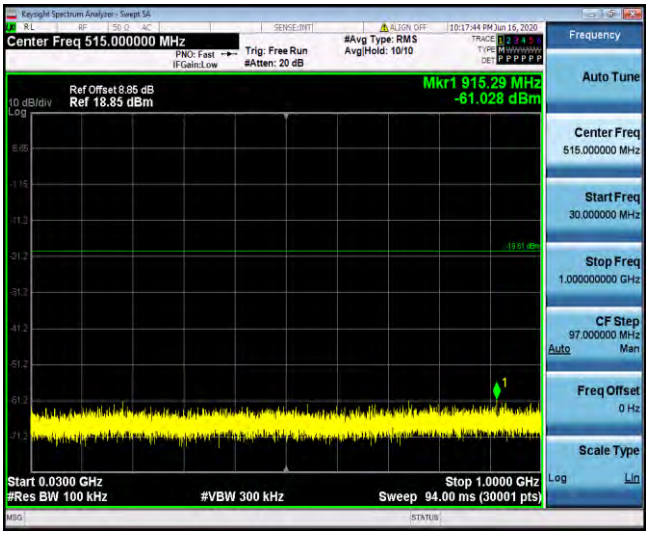
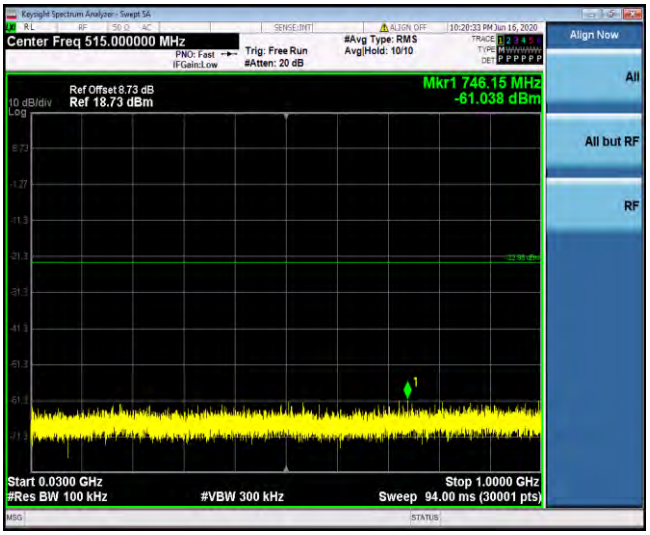
Test plot as follows:

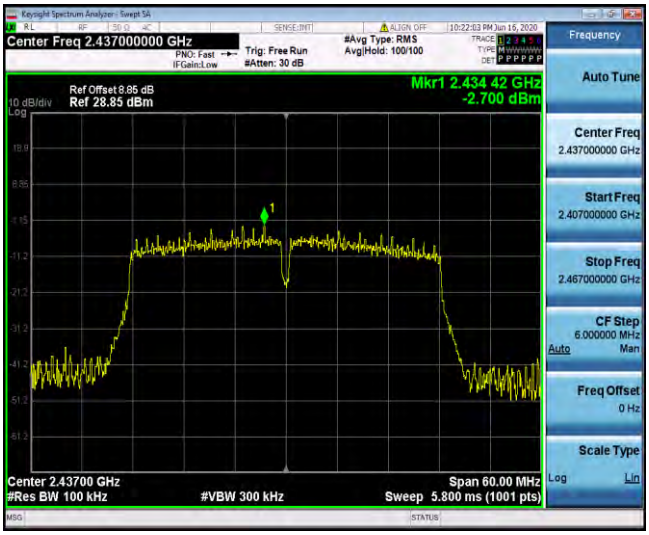
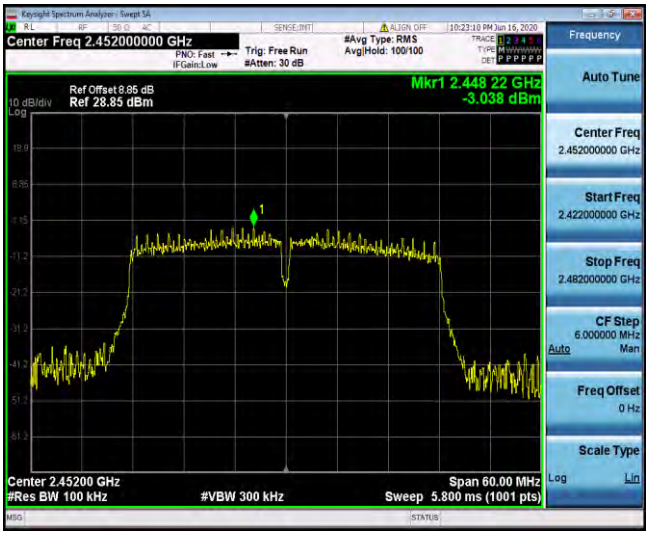
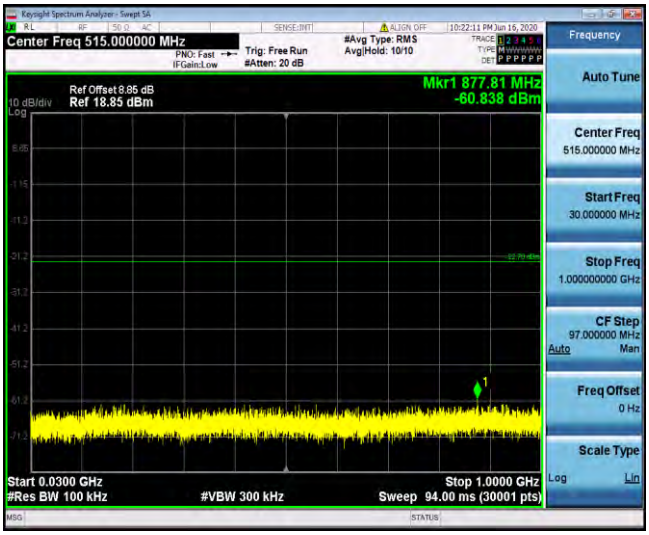
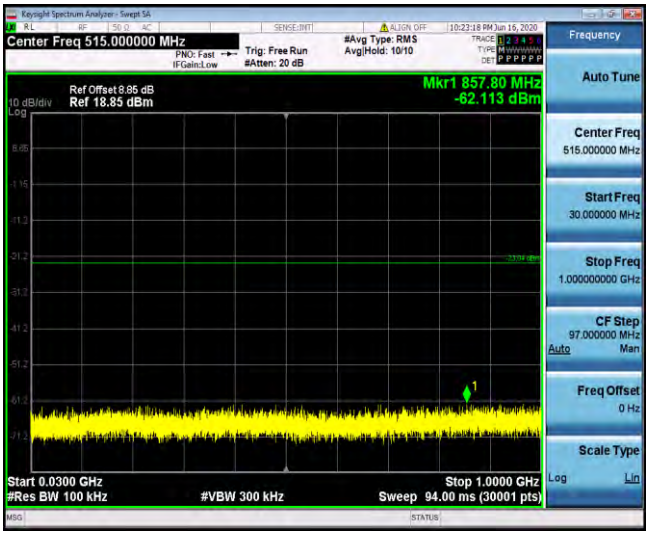
802.11b CH01	802.11b CH06
Reference	Reference
	
30MHz-1GHz	30MHz-1GHz
1GHz-25GHz	1GHz-25GHz

802.11b CH11	802.11g CH01
Reference	Reference
	
30MHz-1GHz	30MHz-1GHz
1GHz-25GHz	1GHz-25GHz

802.11g CH06	802.11g CH11
Reference	Reference
	
30MHz-1GHz	30MHz-1GHz
1GHz-25GHz	1GHz-25GHz

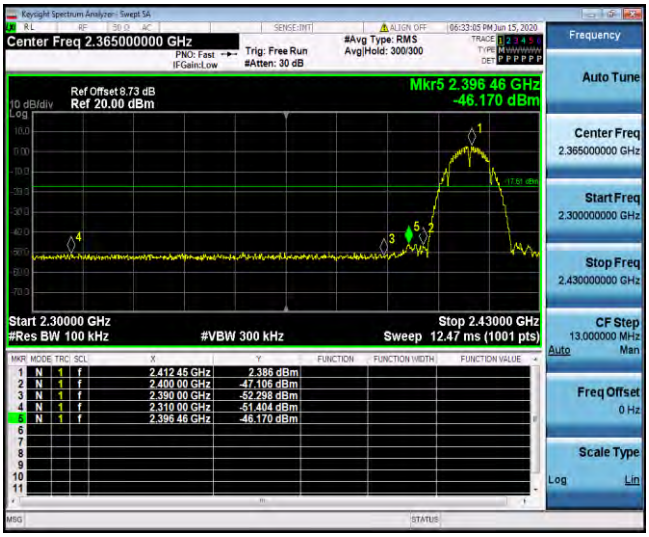
802.11n(HT20) CH01	802.11n(HT20) CH06
Reference	Reference
	
30MHz-1GHz	30MHz-1GHz
1GHz-25GHz	1GHz-25GHz

802.11n(HT20) CH11	802.11n(HT40) CH03
Reference	Reference
	
30MHz-1GHz	30MHz-1GHz
1GHz-25GHz	1GHz-25GHz

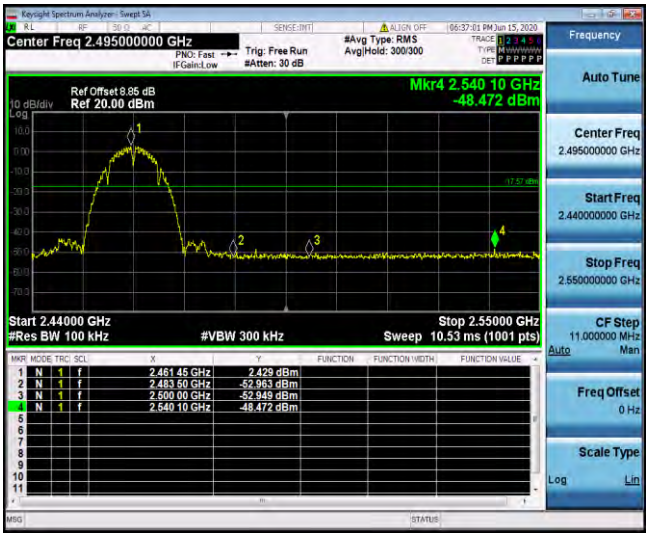
802.11n(HT40) CH06	802.11n(HT40) CH09
	
Reference	Reference
	
30MHz-1GHz	30MHz-1GHz
1GHz-25GHz	1GHz-25GHz

Band-edge Measurements for RF Conducted Emissions:

802.11b



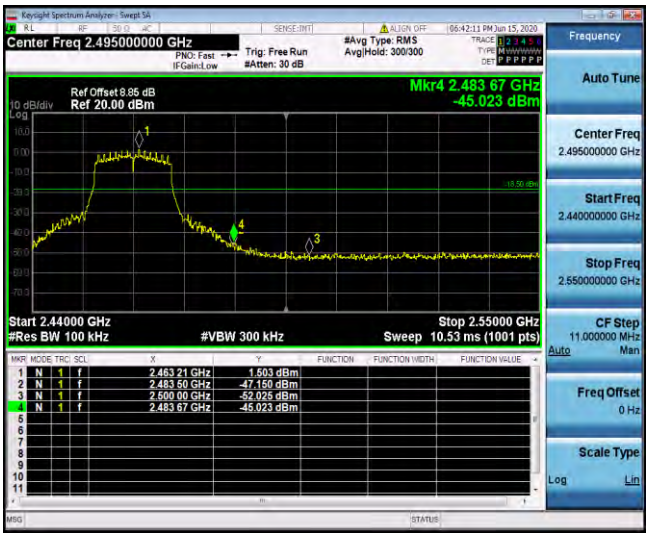
Left bandedge



Right bandedge

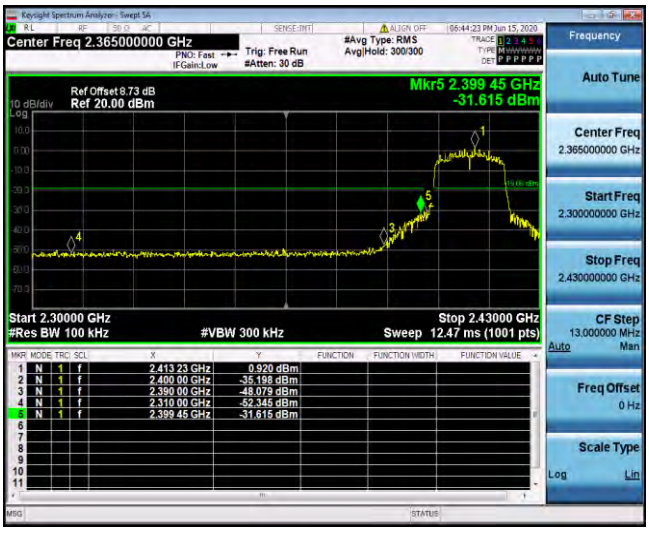
802.11g

Left bandedge

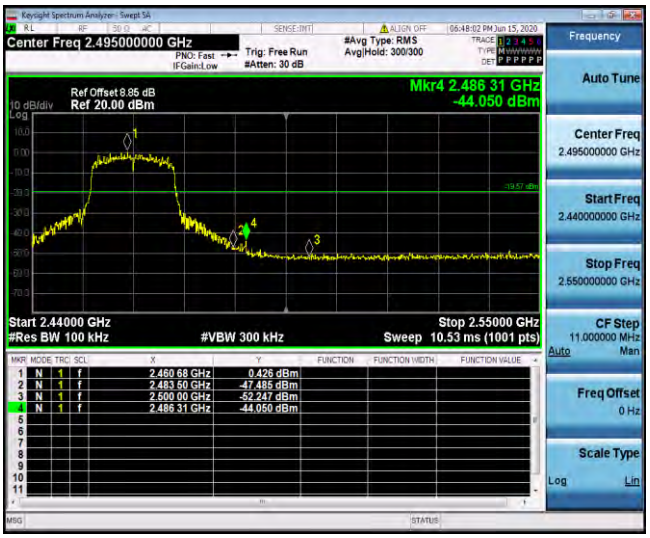


Right bandedge

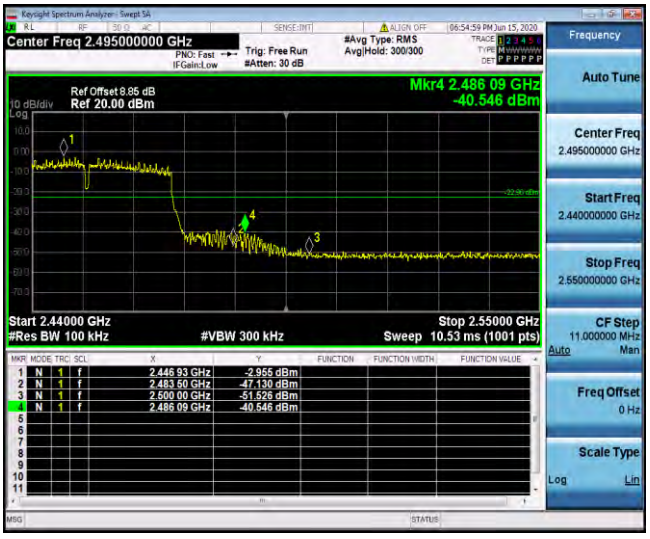
802.11n(HT20)



Left bandedge



Right bandedge

802.11n(HT40)	
	
Left bandedge	Right bandedge

4.7 Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited

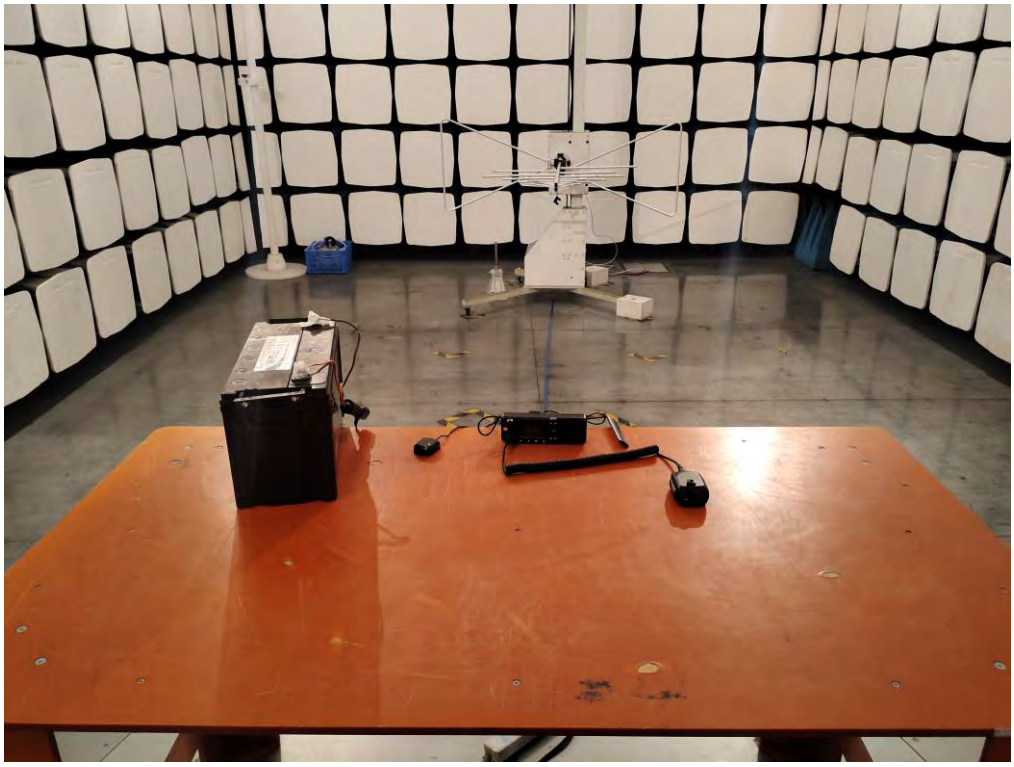
FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1) (I):

(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

Test Result:

The maximum gain of antenna was 2.00 dBi for 2.4GHz WIFI.

5 Test Setup Photos of the EUT



6 Photos of the EUT

Reference to the test report No. GTS20200612012-1-3-1

********** End of Report **********