Shenzhen Global Test Service Co.,Ltd.
1F, Building No. 13A, Zhonghaixin Science and Technology City, No.12,6 Road, Ganli Industrial Park, Buji Street, Longgang District, Shenzhen, Guangdong

FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.247

Report Reference No.....:	**GTS20190327004-1-5**
FCC ID..... :	**2AKUCMKFC05A**
Compiled by (position+printed name+signature)..:	File administrators Jimmy Wang
Supervised by (position+printed name+signature)..:	Test Engineer Peter Xiao
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Date of issue.....:	May. 7, 2019
Representative Laboratory Name .:	**Shenzhen Global Test Service Co.,Ltd.**
Address.....:	1F, Building No. 13A, Zhonghaixin Science and Technology City, No.12,6 Road, Ganli Industrial Park, Buji Street, Longgang District, Shenzhen, Guangdong
Applicant's name.....:	**Shenzhen Makerfire Technology Co.，Ltd.**
Address .....:	502 Room, Panbao Building , No.7-1 Lipu Street, Bantian, Longgang District,Shenzhen,PRC
Test specification .....:	
Standard .....:	**FCC Part 15.247**
TRF Originator.....:	Shenzhen Global Test Service Co.,Ltd.
Master TRF.....:	Dated 2014-12

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Test item description .....:	Programming building block drone
Trade Mark .....:	
Manufacturer .....:	**Shenzhen Makerfire Technology Co.，Ltd.**
Model/Type reference.....:	Ghost II-MC-1
Listed Models .....:	N/A
Operation Frequency.....:	From 2412MHz to 2472MHz
Rating .....:	DC 5V
Result.....:	**PASS**

TEST REPORT

Test Report No. :	GTS20190327004-1-5	May. 7, 2019 Date of issue

Equipment under Test	:	Programming building block drone
Model /Type	:	Ghost II-MC-1
Listed Models	:	N/A
Applicant	:	**Shenzhen Makerfire Technology Co.，Ltd.**
Address	:	502 Room, Panbao Building , No.7-1 Lipu Street, Bantian, Longgang District,Shenzhen,PRC
Manufacturer	:	**Shenzhen Makerfire Technology Co.，Ltd.**
Address	:	502 Room, Panbao Building , No.7-1 Lipu Street, Bantian, Longgang District,Shenzhen,PRC

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	:	Feb. 10, 2019
Testing commenced on	:	Feb. 22, 2019
Testing concluded on	:	Apr. 22, 2019

2.2. Product Description

Name of EUT	Programming building block drone
Trade Mark:	
Model Number	Ghost II-MC-1
Listed Models	N/A
FCC ID	2AKUCMKFC05A
Power Supply	DC 5V
WLAN	Supported 802.11b/802.11g/802.11n HT20
Modulation Type	IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK,BPSK)
Operation frequency	IEEE 802.11b:2412-2472MHz IEEE 802.11g:2412-2472MHz IEEE 802.11n HT20:2412-2472MHz
Antenna Type	FPCl Antenna
Antenna gain	2.1dBi

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)		

DC 5V

2.4. Short description of the Equipment under Test (EUT)

This is a Programming building block drone.

For more details, refer to the user's manual of the EUT.

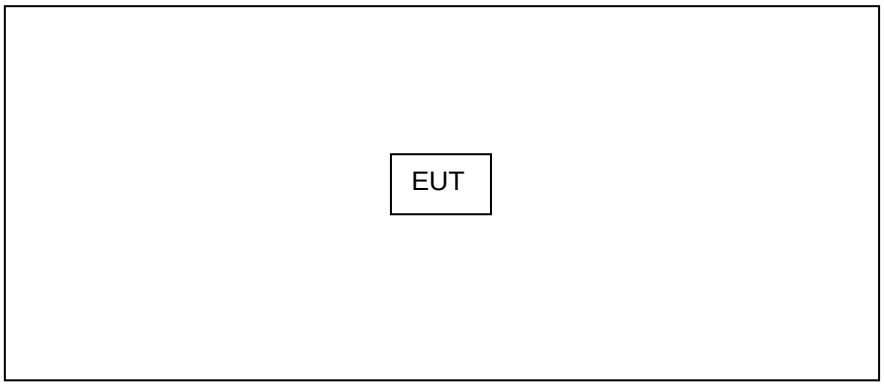
2.5. EUT operation mode

The application provider specific test software 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	12	2467
6	2437	13	2472
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: 2AKUCMKFC05A** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.8. 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.
1F, Building No. 13A, Zhonghaixin Science and Technology City, No.12,6 Road, Ganli Industrial Park, Buji Street, Longgang District, Shenzhen, Guangdong

Shenzhen CTL Testing Technology Co.,Ltd.
1/F.-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, Guangdong, China

3.2. Test Facility

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

CNAS (No. CNAS 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: 2017 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA (Certificate No. 4758.01)
Shenzhen Global Test Service Co., Ltd. has been assessed by the American Association for Laboratory Accreditation (A2LA). Certificate No. 4758.01.

3.3. Environmental conditions

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

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

3.4. Test Description

Test Specification clause	Test case	Test Mode	Test Channel	Recorded In Report		Pass	Fail	NA	NP	Remark
§15.247(b)(4)	Antenna gain	802.11b	☒ Lowest ☒ Middle ☒ Highest	802.11b	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.247(e)	Power spectral density	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Middle ☒ Highest	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.247(a)(2)	Spectrum bandwidth – 6 dB bandwidth	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Middle ☒ Highest	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(b)(1)	Maximum output power	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Middle ☒ Highest	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Middle ☒ Highest	☒ ☒ ☒	☐	☐	☐	complies
§15.247(d)	Band edge compliance conducted	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Highest	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.205	Band edge compliance radiated	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Highest	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Highest	☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions conducted	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Middle ☒ Highest	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions radiated	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Middle ☒ Highest	802.11b 802.11g 802.11n HT20	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.109	RX spurious emissions radiated	-/-	-/-	-/-	-/-	☐	☐	☒	☐	complies
§15.209(a)	TX spurious Emissions radiated < 30 MHz	802.11b	-/-	802.11b	-/-	☒	☐	☐	☐	complies
§15.107(a) §15.207	Conducted Emissions < 30 MHz	802.11b	-/-	802.11b	-/-	☒	☐	☐	☐	complies

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

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	1/7/13
	11g/OFDM	6 Mbps	1/7/13
	11n(20MHz)/OFDM	6.5Mbps	1/7/13
Band Edge	11b/DSSS	1 Mbps	1/13
	11g/OFDM	6 Mbps	1/13
	11n(20MHz)/OFDM	6.5Mbps	1/13

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

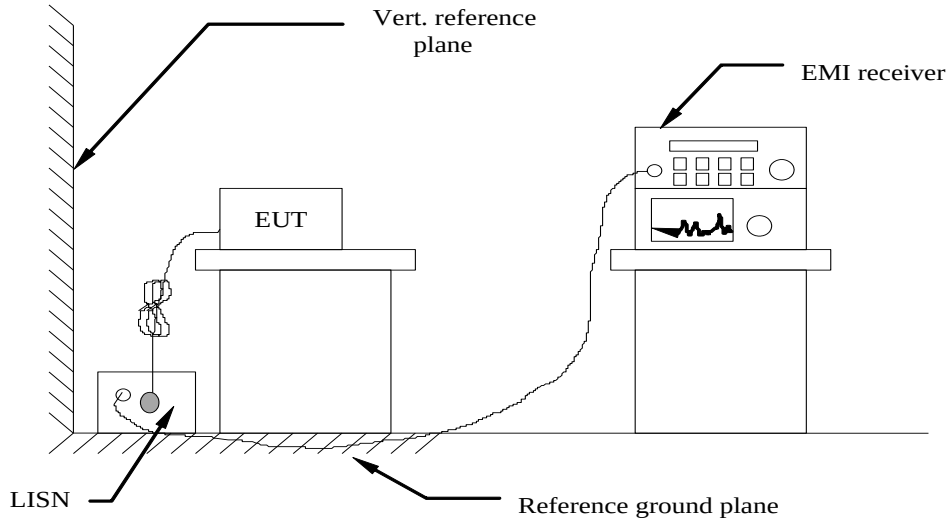
Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.08	2018/09/28	2019/09/27
LISN	R&S	ESH2-Z5	893606/008	2018/09/27	2019/09/26
By-log Antenna	SCHWARZBECK	VULB9163	000976	2018/09/29	2019/09/28
EMI Test Receiver	R&S	ESCI	101102	2018/09/26	2019/09/25
Spectrum Analyzer	Agilent	N9020A	MY48010425	2018/09/17	2019/09/16
Spectrum Analyzer	R&S	FSV40-N	101800	2018/09/17	2019/09/16
Controller	EM Electronics	Controller EM 1000	N/A	2018/09/21	2019/09/20
Double Ridged Horn Antenna (1~18GHz)	SCHWARZBECK	BBHA 9120D	01622	2018/09/19	2019/09/18
Double Ridged Horn Antenna	Rohde&Schwarz	HF907	100265	2018/09/19	2019/09/18
Active Loop Antenna	SCHWARZBECK	FMZB1519	1519-037	2018/09/19	2019/09/18
Horn Antenna (18GHz~40GHz)	ETS	3116	00086467	2018/12/29	2019/12/28
Amplifier (26.5GHz~40GHz)	EMCI	EMC2654045	980028	2018/09/18	2019/09/17
Amplifier (0.1GHz~26.5GHz)	EMCI	EMC012645SE	980355	2018/09/19	2019/09/18
Temperature/Humidity Meter	Gangxing	CTH-608	02	2018/09/20	2019/09/19
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	N/A	2018/09/20	2019/09/19
High-Pass Filter	K&L	41H10-1375/U12750-O/O	N/A	2018/09/20	2019/09/19
Data acquisition card	Agilent	U2531A	TW53323507	2018/09/20	2019/09/19
Power Sensor	Agilent	U2021XA	MY5365004	2018/09/20	2019/09/19
RF Cable	HUBER+SUHNER	RG214	N/A	2018/09/20	2019/09/19
Broadband Antenna	SCHWARZBECK	VULB 9163	00976	2018//9/29	2018//9/28
Conducted Emission	ES-K1	V1.71	N/A	N/A	N/A
Radiated Emission	JS32-RE	V2.5.0.9	N/A	N/A	N/A

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 5V 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.		

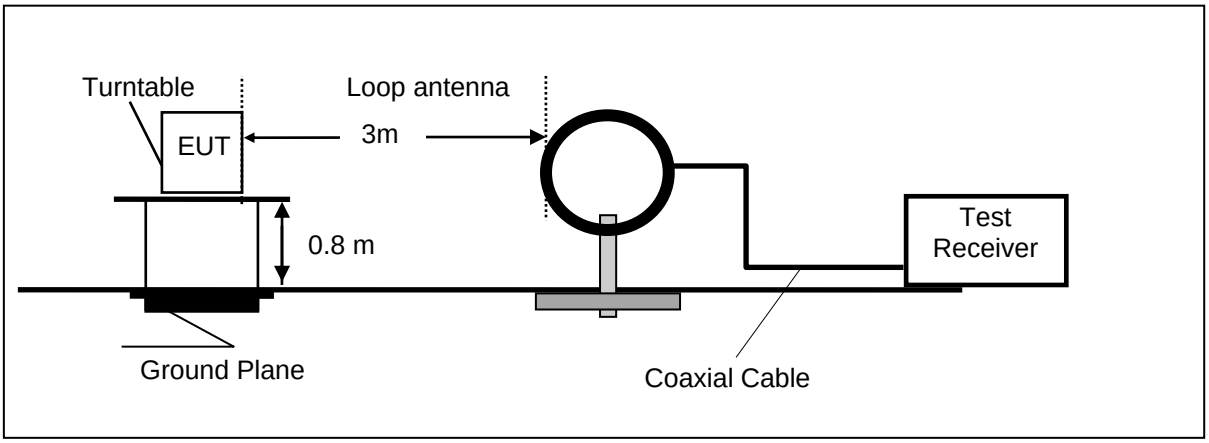
TEST RESULTS

There is no need for conduction emissions test, because the power supply of the EUT is battery only.

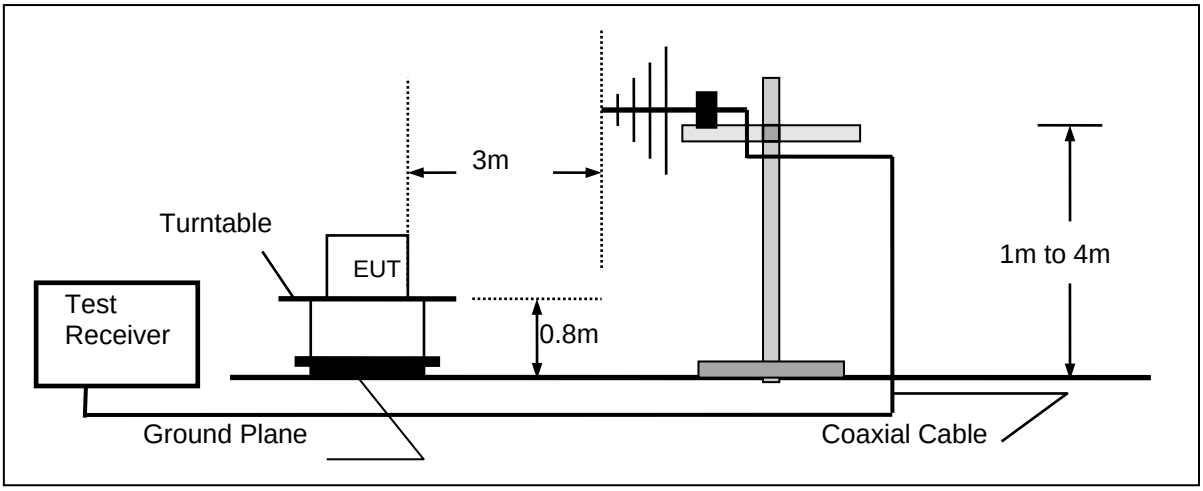
4.2. Radiated Emission

TEST CONFIGURATION

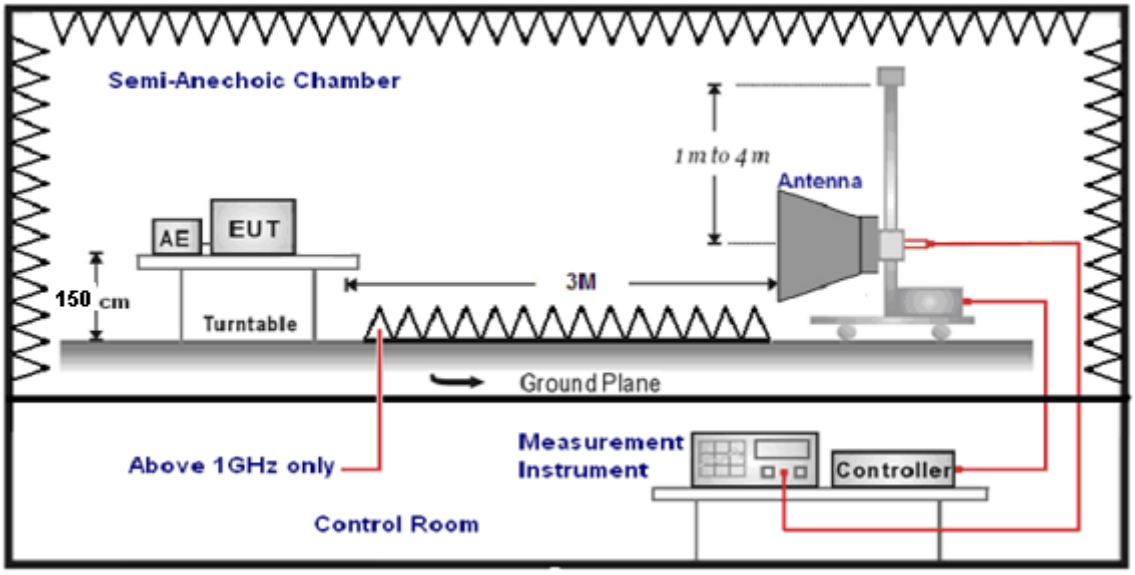
Frequency range 9 KHz – 30MHz



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)
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

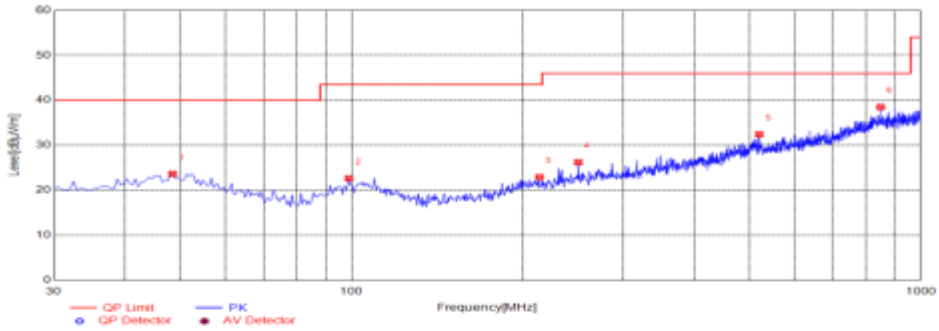
TEST RESULTS

Remark: We measured Radiated Emission at 802.11b/802.11g/802.11n HT20mode from 9 KHz to 25GHz in AC 120V/60Hz and the worst case was recorded.
Test site: Shenzhen GTS Testing Technology Co., Ltd.

For 30MHz-1GHz

Horizontal

Test Graph

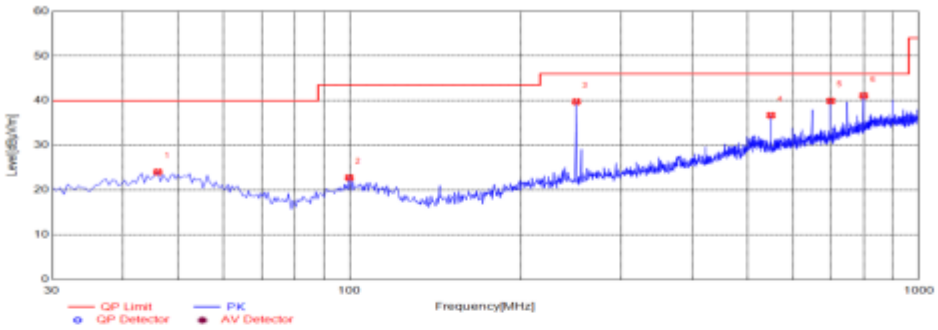


Suspected List

NO.	Freq. [MHz]	Polarity	Height [cm]	Angle [°]	Limit [dBμV/m]	Level [dBμV/m]	Factor [dB]	Readin d[dBμV /m]	Margin [dB]
1	48.4300	Horizontal	100	360	40.00	23.66	-14.83	38.49	16.34
2	98.8700	Horizontal	100	210	43.50	22.64	-17.08	39.72	20.86
3	213.815	Horizontal	100	220	43.50	22.91	-16.18	39.09	20.59
4	250.190	Horizontal	100	10	46.00	26.22	-15.12	41.34	19.78
5	520.335	Horizontal	100	250	46.00	32.42	-9.25	41.67	13.58
6	850.135	Horizontal	100	110	46.00	38.50	-4.11	42.61	7.50

Vertical

Test Graph



Suspected List

NO.	Freq. [MHz]	Polarity	Height [cm]	Angle [°]	Limit [dBμV/m]	Level [dBμV/m]	Factor [dB]	Reading[dBμV/m]	Margin [dB]
1	46.0050	Vertical	100	340	40.00	24.06	-14.78	38.84	15.94
2	99.8400	Vertical	100	340	43.50	22.78	-16.97	39.75	20.72
3	250.190	Vertical	100	180	46.00	39.77	-15.12	54.89	6.23
4	549.920	Vertical	100	210	46.00	36.72	-9.00	45.72	9.28
5	700.270	Vertical	100	50	46.00	39.96	-6.77	46.73	6.04
6	800.180	Vertical	100	360	46.00	41.12	-5.55	46.67	4.88

For 1GHz to 25GHz

B Mode (above 1GHz)

Frequency (MHz)	Reading (dB μ V)	Antenna Factor (dB)	Preamp factor (dB)	cable loss (dB)	Corrected Amplitude (dB μ V/m)	Limit (dB μ V/m)	Aprgin (dB)	ReAprk	Polar (H/V)
Low channel(2412MHz)									
4824	45.43	32.44	30.25	7.95	55.57	74	-18.43	Pk	Vertical
4824	35.08	32.44	30.25	7.95	45.22	54	-8.78	AV	Vertical
4824	39.36	32.44	30.25	7.95	49.5	74	-24.5	Pk	Horizontal
4824	30.85	32.44	30.25	7.95	40.99	54	-13.01	AV	Horizontal
Middle channel(2442MHz)									
4884	47.59	32.52	30.31	8.12	57.92	74	-16.08	Pk	Vertical
4884	33.79	32.52	30.31	8.12	44.12	54	-9.88	AV	Vertical
4884	38.64	32.52	30.31	8.12	48.97	74	-25.03	Pk	Horizontal
4884	30.94	32.52	30.31	8.12	41.27	54	-12.73	AV	Horizontal
High channel(2472MHz)									
4944	44.99	32.68	30.27	7.88	55.28	74	-18.72	Pk	Vertical
4944	34.18	32.68	30.27	7.88	44.47	54	-9.53	AV	Vertical
4944	40.34	32.68	30.27	7.88	50.63	74	-23.37	Pk	Horizontal
4944	30.51	32.68	30.27	7.88	40.8	54	-13.2	AV	Horizontal

G Mode (above 1GHz)

Frequency (MHz)	Reading (dB μ V)	Antenna Factor (dB)	Preamp factor (dB)	cable loss (dB)	Corrected Amplitude (dB μ V/m)	Limit (dB μ V/m)	Aprgin (dB)	ReAprk	Polar (H/V)
Low channel(2412MHz)									
4884	45.12	32.52	30.31	8.12	55.45	74	-18.55	Pk	Vertical
4884	35.8	32.52	30.31	8.12	46.13	54	-7.87	AV	Vertical
4884	40.32	32.52	30.31	8.12	50.65	74	-23.35	Pk	Horizontal
4884	31.18	32.52	30.31	8.12	41.51	54	-12.49	AV	Horizontal
Middle channel(2442MHz)									
4884	47.59	32.52	30.31	8.12	57.92	74	-16.08	Pk	Vertical
4884	33.79	32.52	30.31	8.12	44.12	54	-9.88	AV	Vertical
4884	38.64	32.52	30.31	8.12	48.97	74	-25.03	Pk	Horizontal
4884	30.94	32.52	30.31	8.12	41.27	54	-12.73	AV	Horizontal
High channel(2472MHz)									
4944	44.99	32.68	30.27	7.88	55.28	74	-18.72	Pk	Vertical
4944	34.18	32.68	30.27	7.88	44.47	54	-9.53	AV	Vertical
4944	40.34	32.68	30.27	7.88	50.63	74	-23.37	Pk	Horizontal
4944	30.51	32.68	30.27	7.88	40.8	54	-13.2	AV	Horizontal

N20 Mode (above 1GHz)

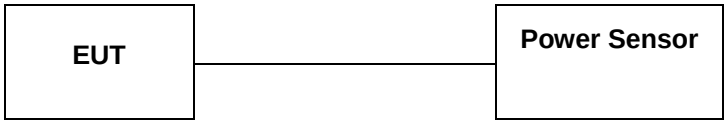
Frequency (MHz)	Reading (dB μ V)	Antenna Factor (dB)	Preamp factor (dB)	cable loss (dB)	Corrected Amplitude (dB μ V/m)	Limit (dB μ V/m)	Aprgin (dB)	ReAprk	Polar (H/V)
Low channel(2412MHz)									
4824	45.64	32.44	30.25	7.95	55.78	74	-18.22	Pk	Vertical
4824	35.04	32.44	30.25	7.95	45.18	54	-8.82	AV	Vertical
4824	39.66	32.44	30.25	7.95	49.8	74	-24.2	Pk	Horizontal
4824	31.53	32.44	30.25	7.95	41.67	54	-12.33	AV	Horizontal
Middle channel(2442MHz)									
4884	45.1	32.52	30.31	8.12	55.43	74	-18.57	Pk	Vertical
4884	34.43	32.52	30.31	8.12	44.76	54	-9.24	AV	Vertical
4884	39.51	32.52	30.31	8.12	49.84	74	-24.16	Pk	Horizontal
4884	31.44	32.52	30.31	8.12	41.77	54	-12.23	AV	Horizontal
High channel(2472MHz)									
4944	44.99	32.68	30.27	7.88	55.28	74	-18.72	Pk	Vertical
4944	34.18	32.68	30.27	7.88	44.47	54	-9.53	AV	Vertical
4944	40.34	32.68	30.27	7.88	50.63	74	-23.37	Pk	Horizontal
4944	30.51	32.68	30.27	7.88	40.8	54	-13.2	AV	Horizontal

REMARKS:

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

4.3. Maximum Peak Output Power

TEST CONFIGURATION



TEST PROCEDURE

According to KDB558074 D01 DTS Measurement Guidance Section 9.1 Maximum peak conducted output power,9.1.2. and Average conducted output power, 9.2.3.1.

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

The maximum Average conducted output power may be measured using a wideband RF power meter with a thermocouple derector or equivalent. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

LIMIT

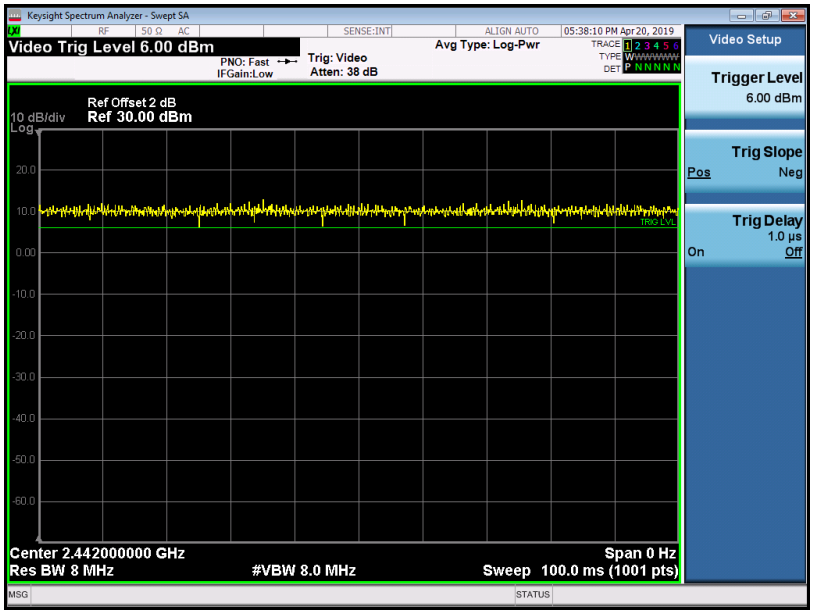
The Maximum Peak Output Power Measurement is 30dBm.

TEST RESULTS

Antenna 1

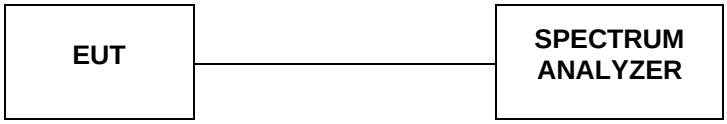
Type	Channel	Output power PK (dBm)	Output power AV (dBm)	Limit (dBm)	Result
802.11b	01	12.21	9.12	30.00	Pass
	07	12.80	9.32		
	13	12.39	9.27		
802.11g	01	13.12	9.25	30.00	Pass
	07	13.54	9.44		
	13	13.49	9.24		
802.11n(HT20)	01	12.38	8.97	30.00	Pass
	07	12.22	8.86		
	13	12.69	8.76		

Note: 1.The test results including the cable lose.
Duty cycle used in all test items: 100%



4.4. Power Spectral Density

TEST CONFIGURATION



TEST PROCEDURE

According to KDB 558074 D01 Method PKPSD (peak PSD) This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

LIMIT

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

TEST RESULTS

Antenna 1

Type	Channel	Power Spectral Density (dBm/3KHz)	Limit (dBm/3KHz)	Result
802.11b	01	-23.621	8.00	Pass
	07	-24.151		
	13	-25.712		
802.11g	01	-27.905	8.00	Pass
	07	-28.174		
	13	-29.380		
802.11n(HT20)	01	-23.888	8.00	Pass
	07	-24.349		
	13	-29.067		

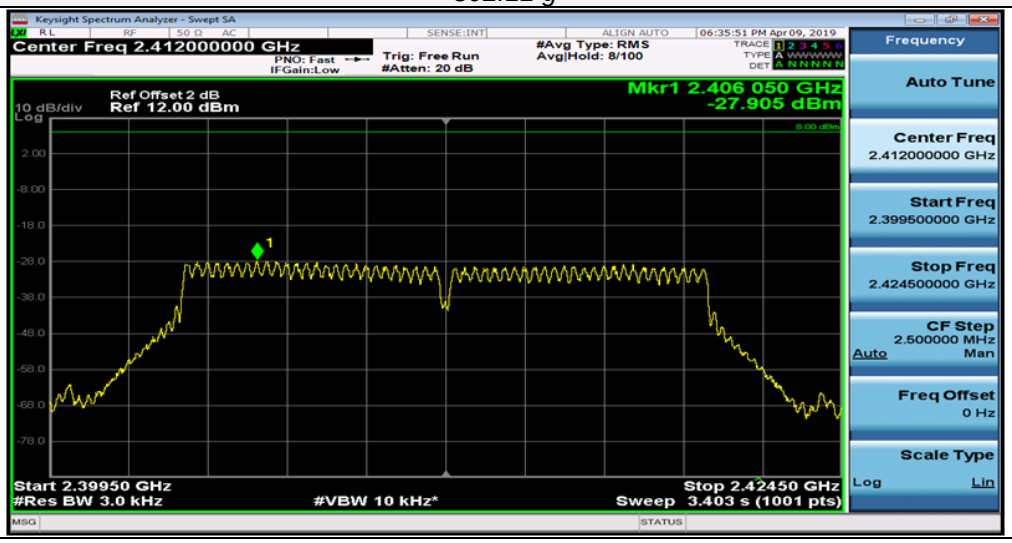
802.11b

CH01

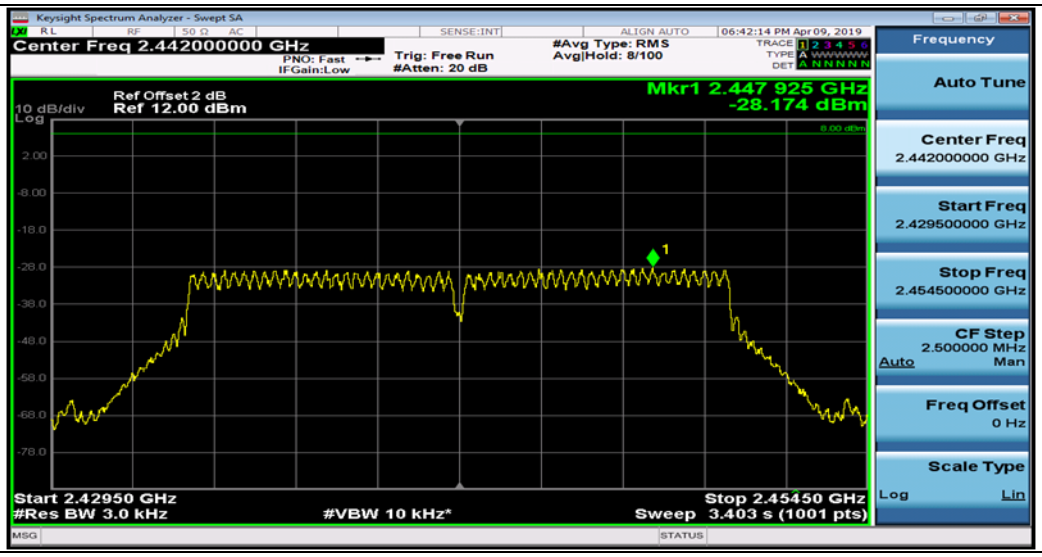
CH07

CH13

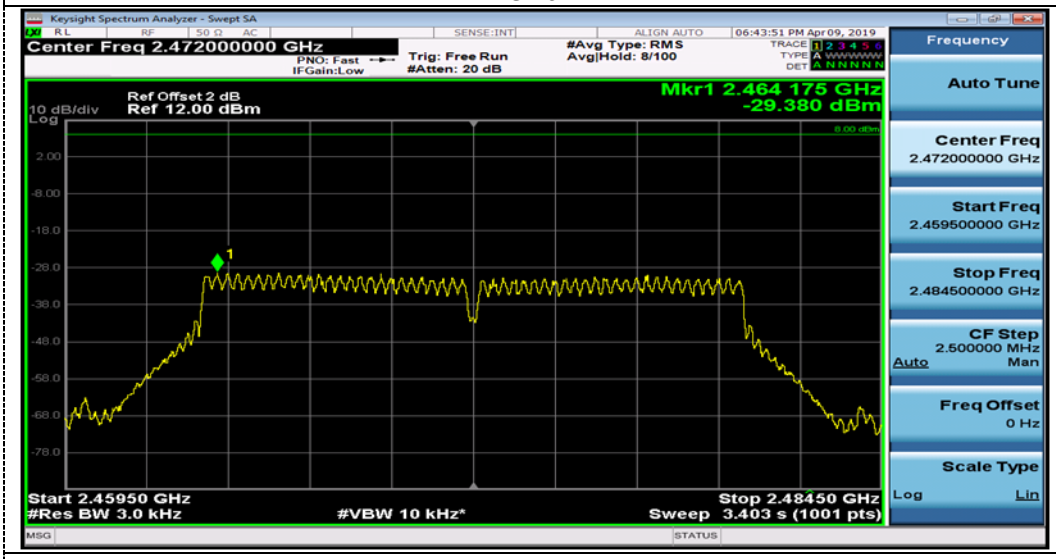
802.11 g



CH01

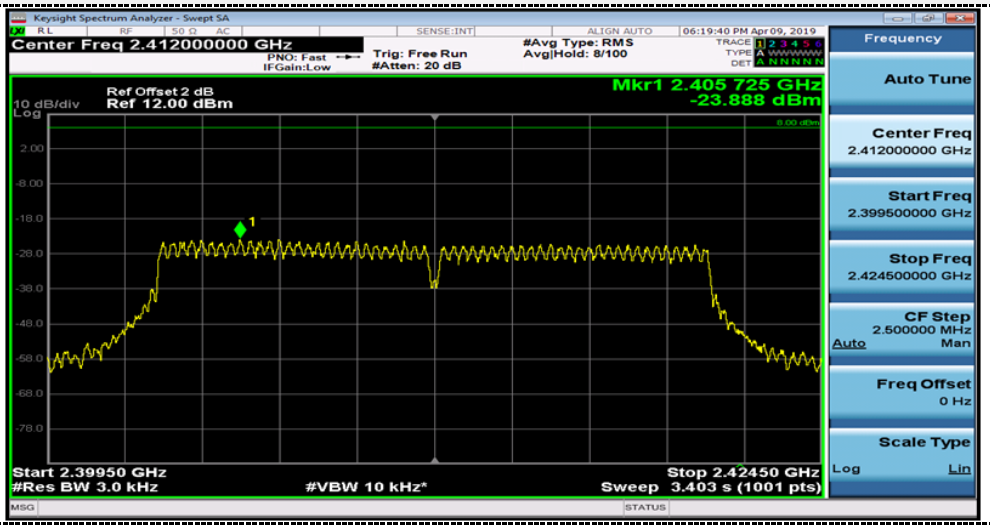


CH07



CH13

802.11nHT20



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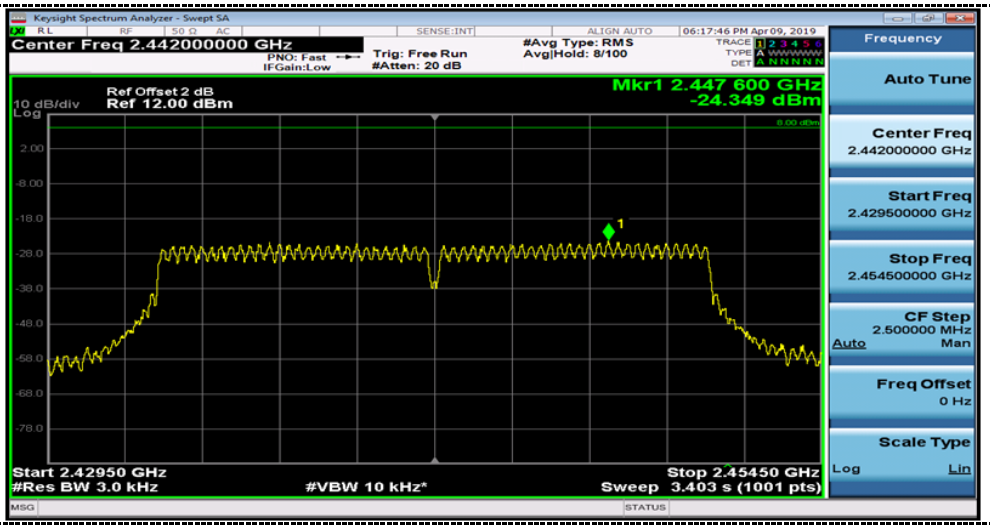
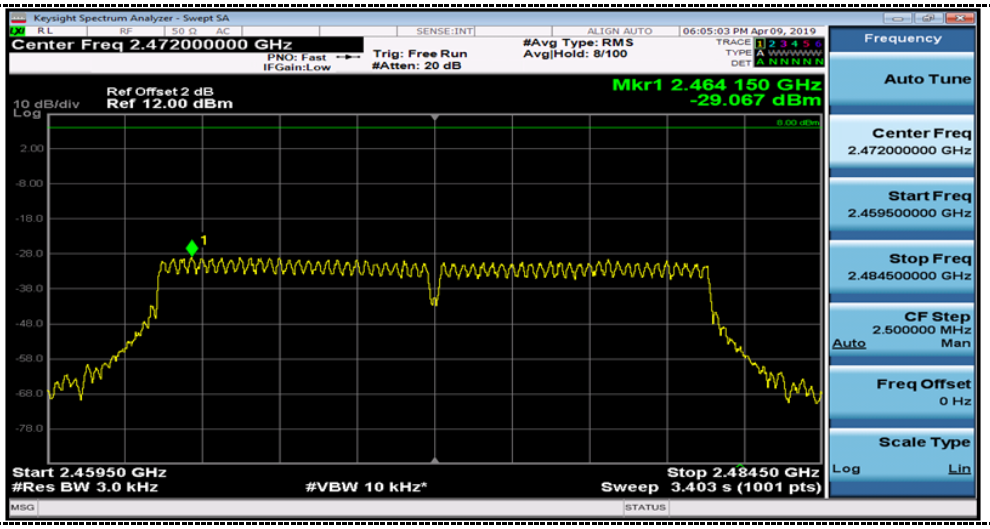


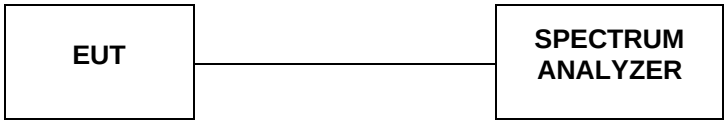
CH07



CH13

4.5. 6dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

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

LIMIT

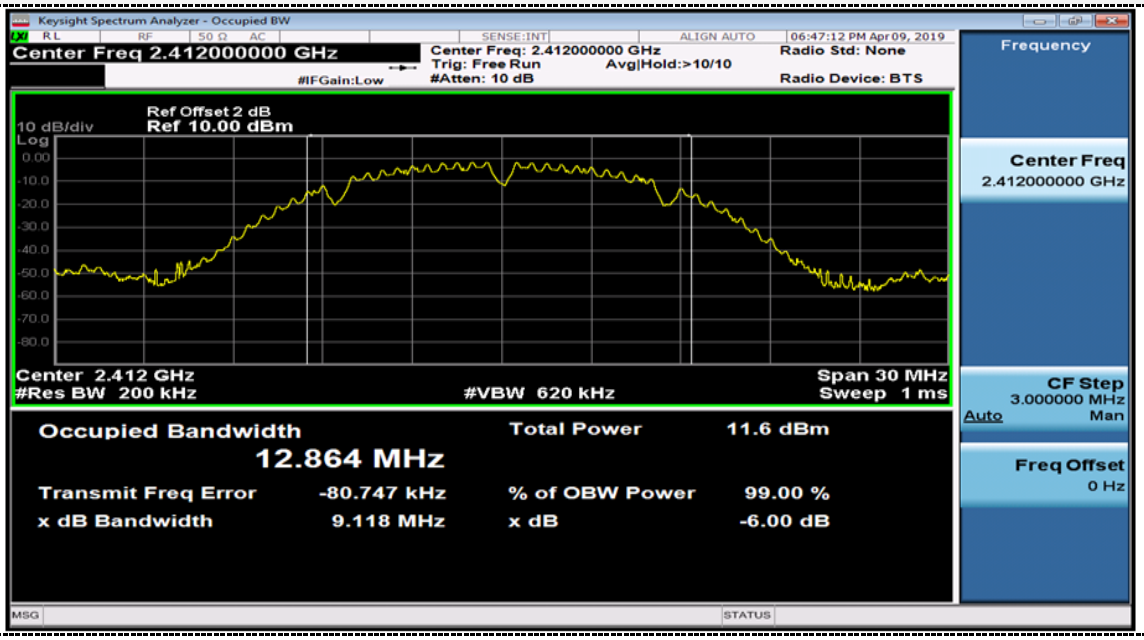
For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

TEST RESULTS

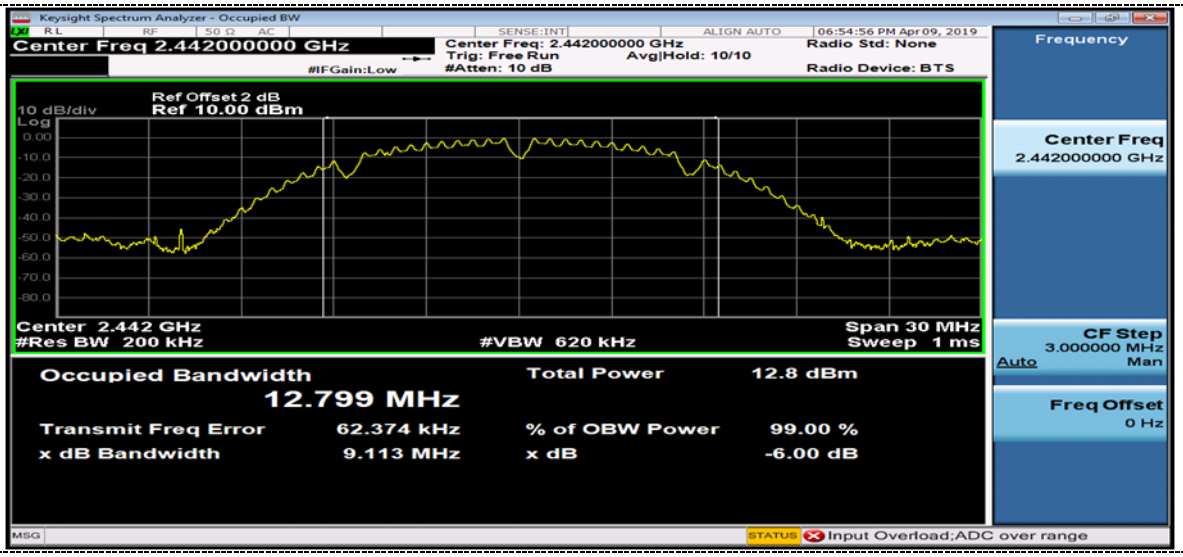
Antenna 1

Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11b	01	9.12	≥500	Pass
	06	9.11		
	11	9.12		
802.11g	01	16.45	≥500	Pass
	06	16.52		
	11	16.45		
802.11nHT20	01	17.64	≥500	Pass
	06	17.65		
	11	17.64		

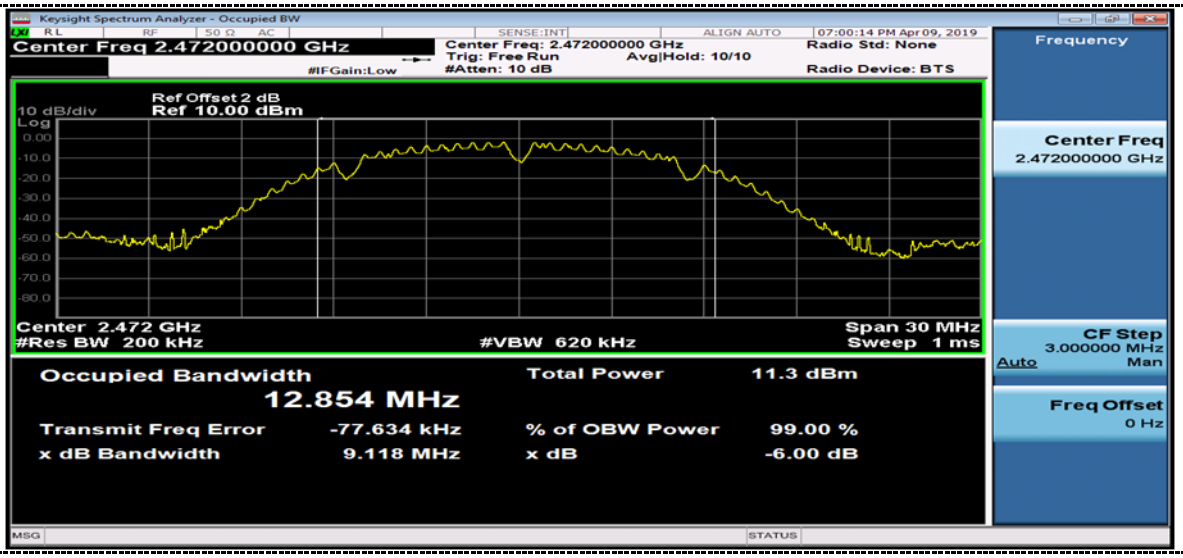
802.11b



CH01

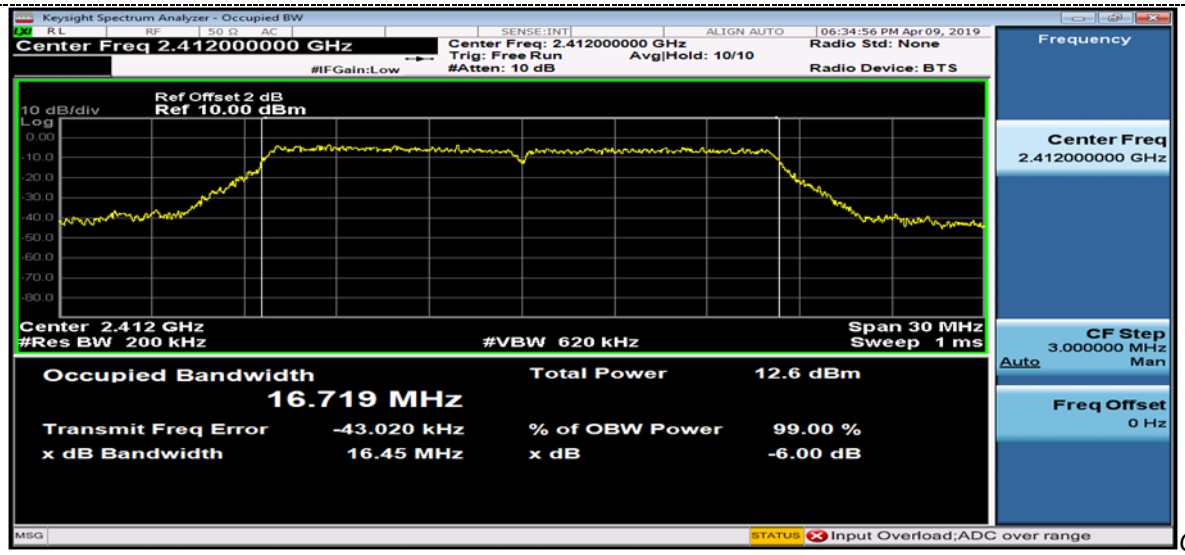


CH07



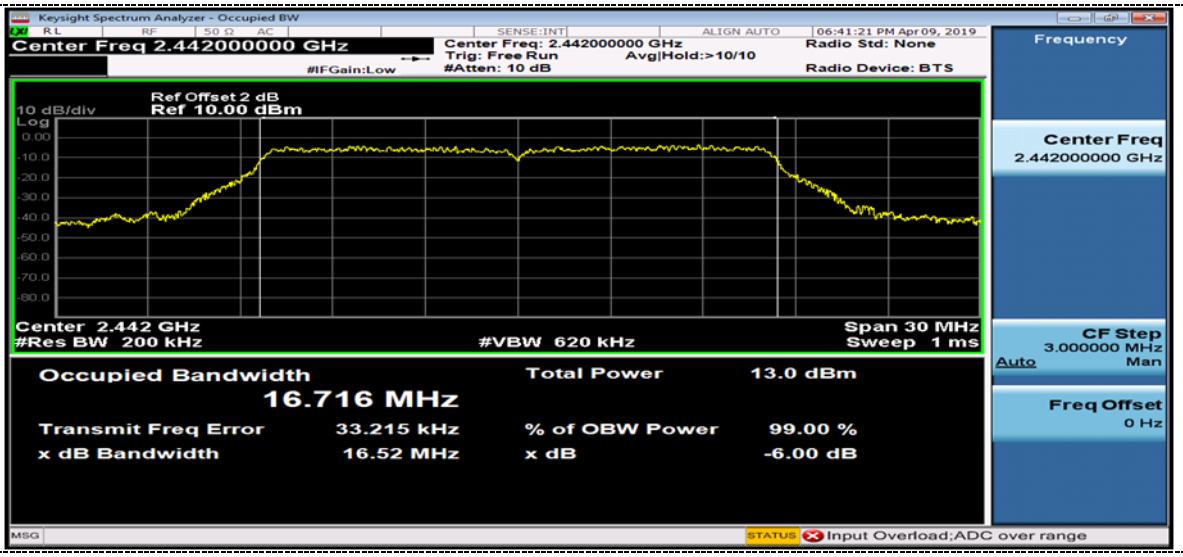
CH13

802.11g

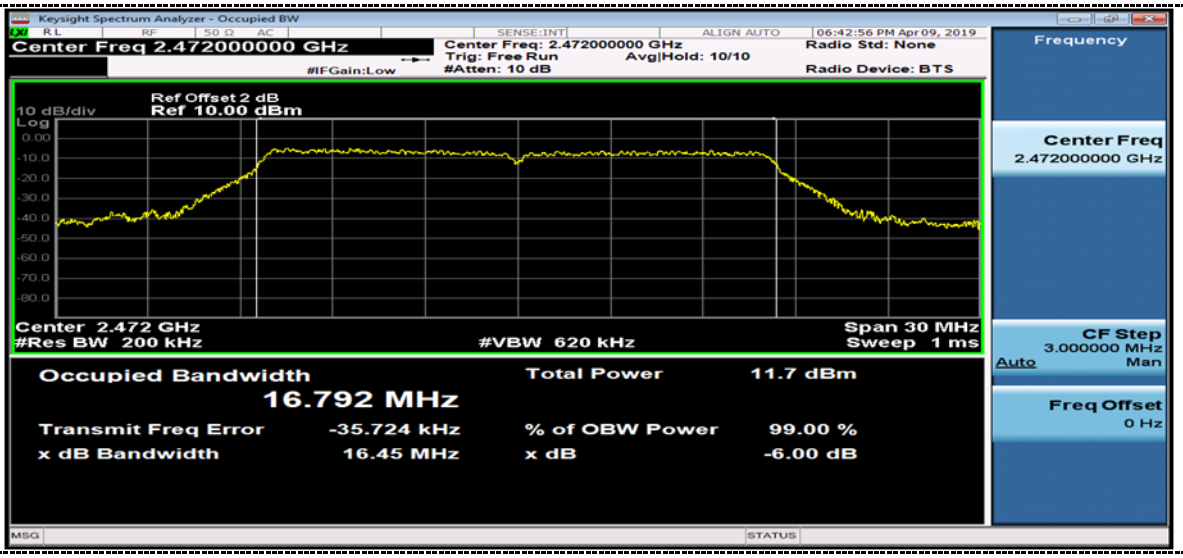


C

H01

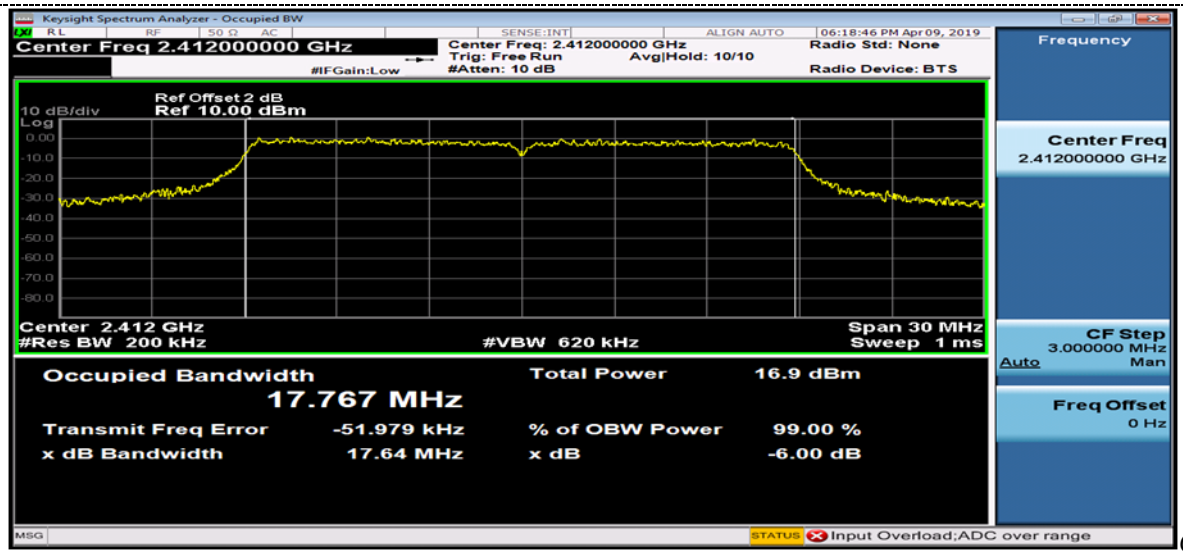


CH07



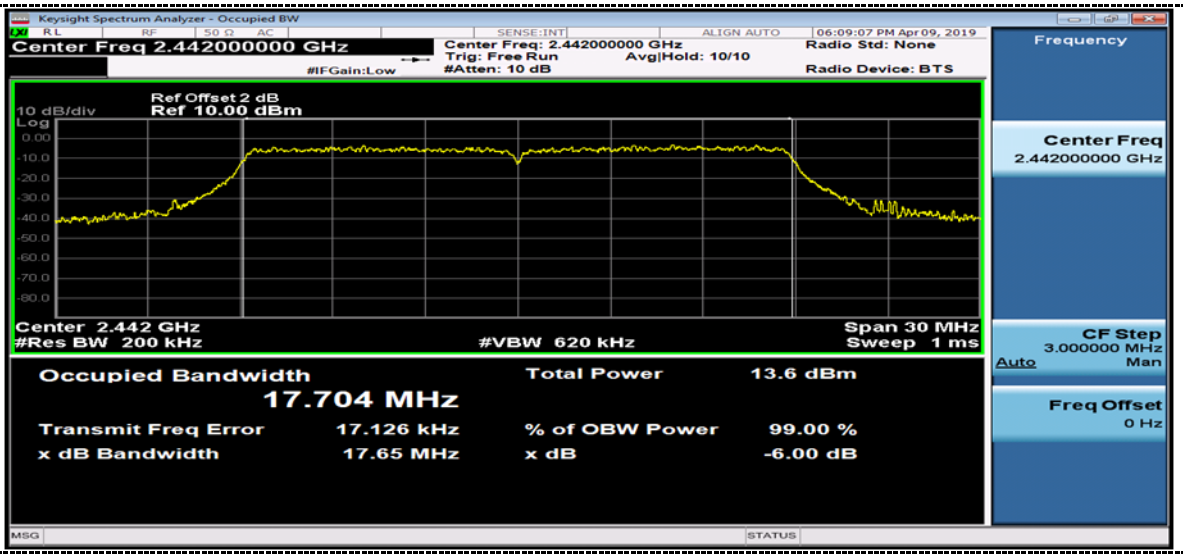
CH13

802.11nHT20

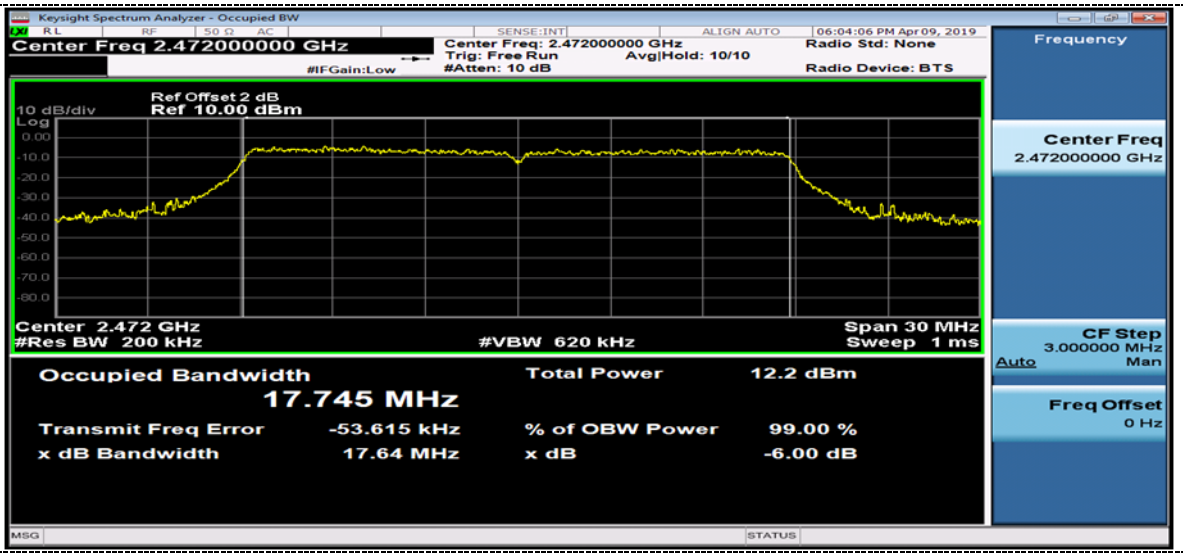


C

H01



CH07



CH13

4.6. Band Edge Compliance of RF Emission

TEST REQUIREMENT

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

TEST PROCEDURE

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

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

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

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

LIMIT

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

TEST RESULTS

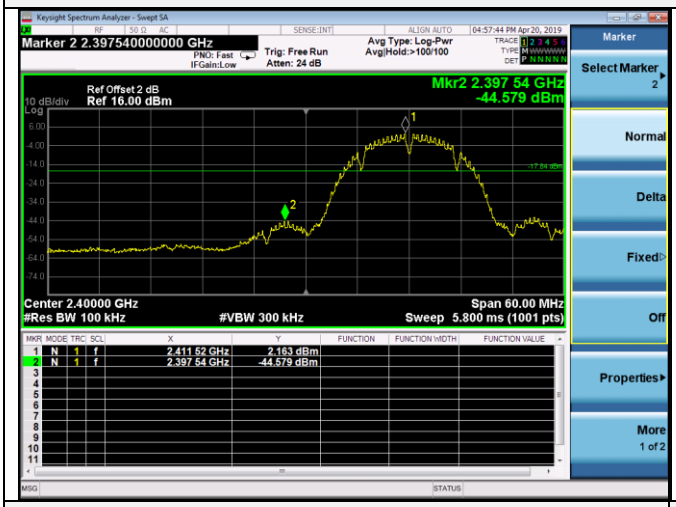
Remark: Test site: Shenzhen GTS Testing Technology Co., Ltd.

4.6.1 For Radiated Bandedge Measurement

Frequency	Meter Reading	Antenna Factor	Preamp factor	cable loss	Emission Level	Limits	Aprgin	Detector Type	Comment
(MHz)	(dBμV)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		
802.11b									
2390	36.71	37.88	30.45	5.63	49.77	74	-24.23	peak	Vertical
2390	37.46	37.88	30.45	5.63	50.52	74	-23.48	peak	Horizontal
2483.5	39.45	37.45	30.38	5.71	52.23	74	-21.77	peak	Vertical
2483.5	38.96	37.45	30.38	5.71	51.74	74	-22.26	peak	Horizontal
802.11g									
2390	36.66	37.88	30.45	5.63	49.72	74	-24.28	peak	Vertical
2390	38.83	37.88	30.45	5.63	51.89	74	-22.11	peak	Horizontal
2483.5	40.28	37.45	30.38	5.71	53.06	74	-20.94	peak	Vertical
2483.5	39.03	37.45	30.38	5.71	51.81	74	-22.19	peak	Horizontal
802.11nHT20									
2390	36.31	37.88	30.45	5.63	49.37	74	-24.63	peak	Vertical
2390	38.81	37.88	30.45	5.63	51.87	74	-22.13	peak	Horizontal
2483.5	40.73	37.45	30.38	5.71	53.51	74	-20.49	peak	Vertical
2483.5	38.98	37.45	30.38	5.71	51.76	74	-22.24	peak	Horizontal

4.6.2 For Conducted Bandedge Measurement

802.11b



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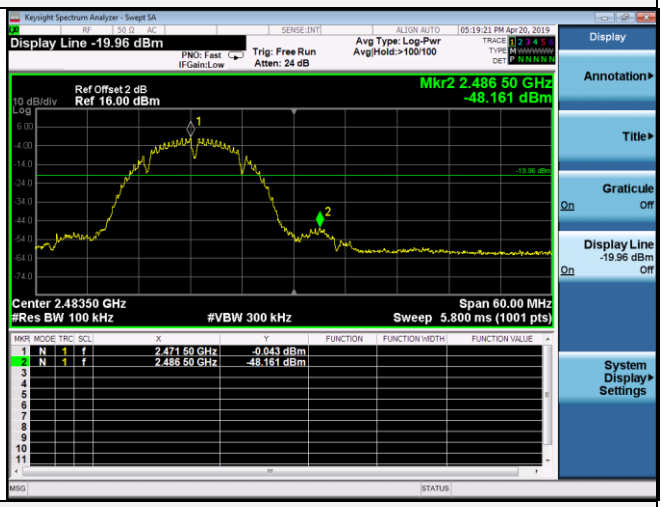
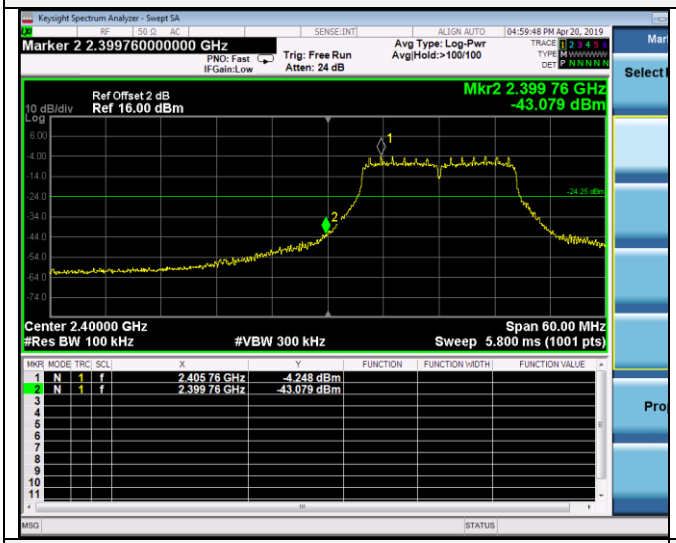


2472

802.11g



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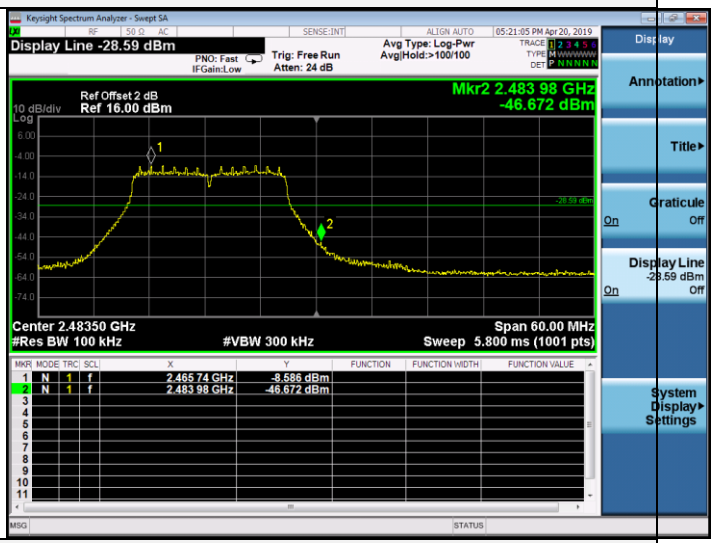
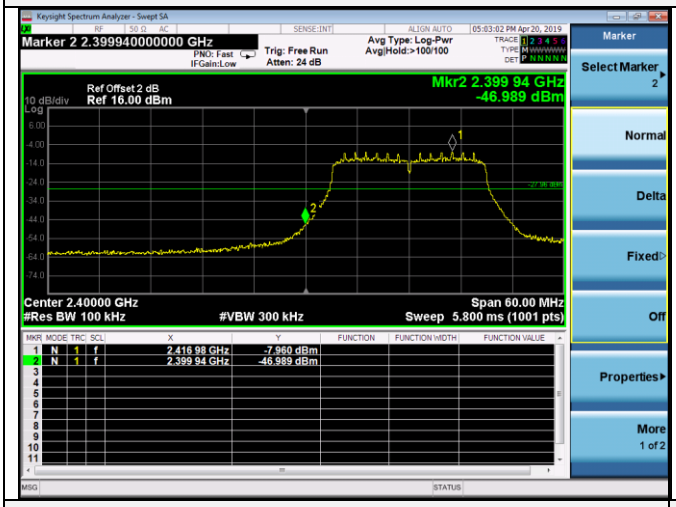


2472

802.11n HT20



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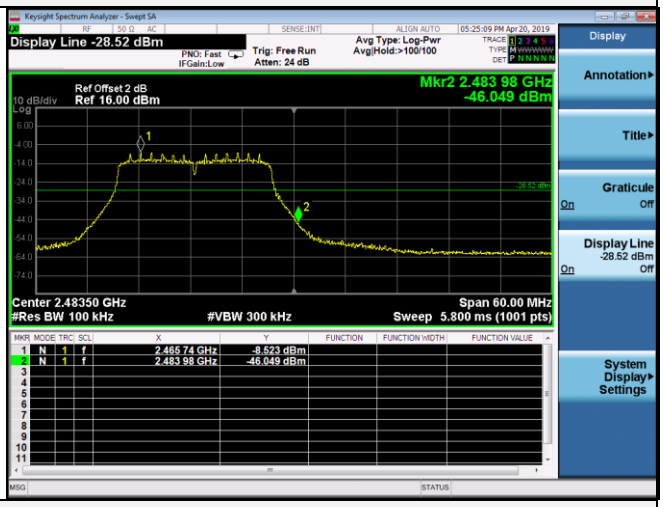


2472

4.7. Antenna Requirement

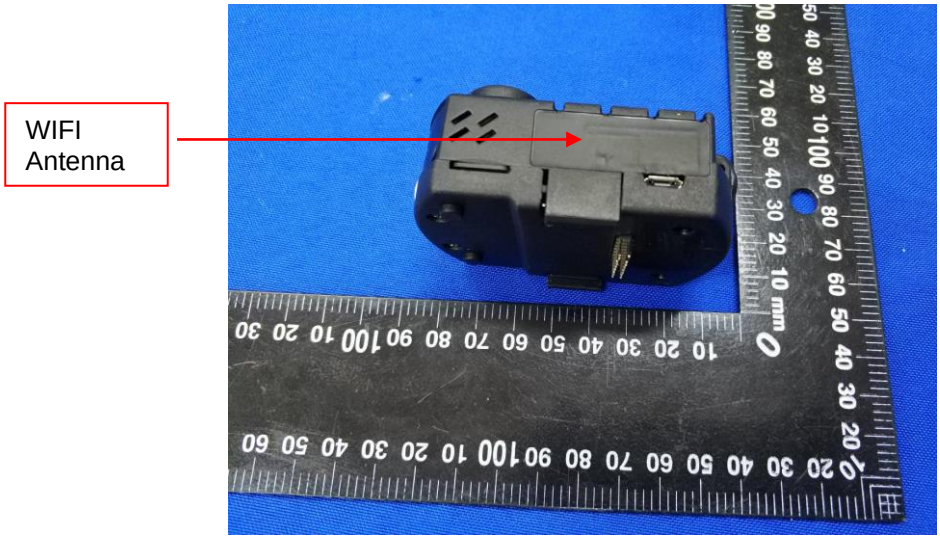
Standard Applicable

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.

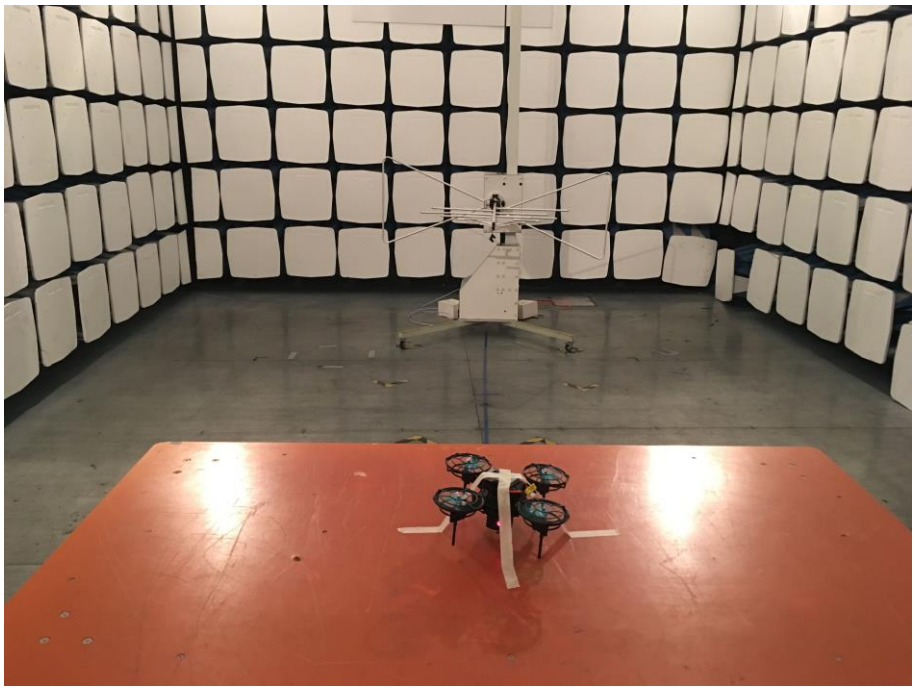
And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

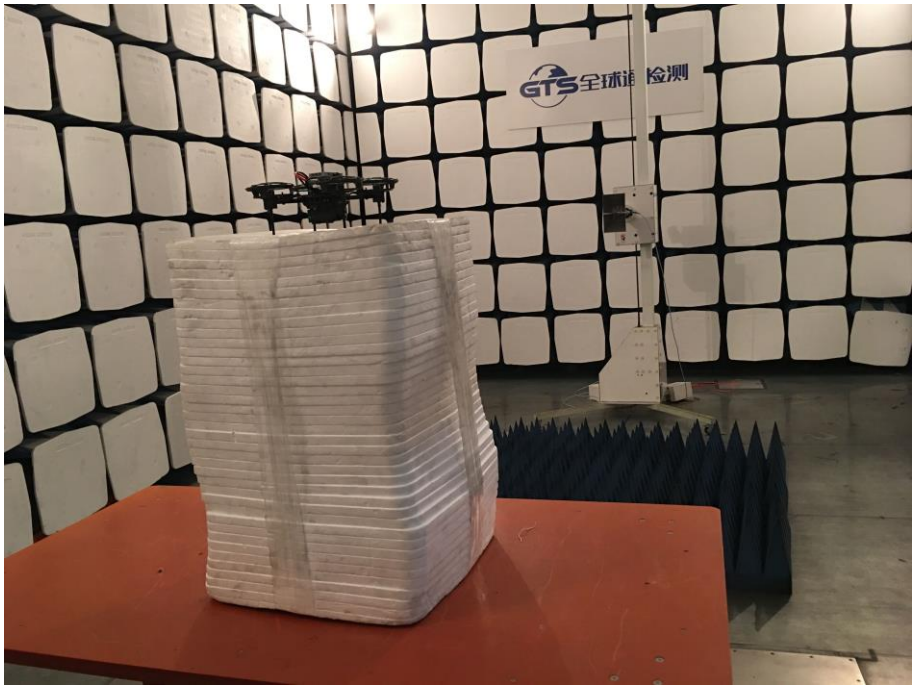
Antenna Information

The antenna is FPC antenna, through the buckle stretched out, The directional gains of antenna used for transmitting is 2.1dBi.



5. Test Setup Photos of the EUT





6. External and Internal Photos of the EUT

Reference to the test report No. GTS20190427004-1-3

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