

# Test Report

FCC ID: 2AKXB-W0202200

Date of issue: July 31, 2019

Report Number:	MTi190614E106
Sample Description:	SwitchBot Hub Mini
Model(s):	W0202200, W0202201, W0202202, W0202203, W0202204, W0202205
Applicant:	WoCao Technology (Shenzhen) Co., Ltd.
Address:	Baoanzhigu A510, Yintian Rd, Xixiang, Bao'an, Shenzhen, Guangdong, China
Date of Test:	June 04, 2019 to July 31, 2019

Shenzhen Microtest Co., Ltd.  
<http://www.mtitest.com>

## Table of Contents

<b>1</b>	<b>GENERAL INFORMATION</b>	<b>5</b>
1.1	DESCRIPTION OF EUT	5
1.2	OPERATION CHANNEL LIST	6
1.3	TEST CHANNEL LIST	6
1.4	ANCILLARY EQUIPMENT LIST	6
1.5	DESCRIPTION OF SUPPORT UNITS	6
<b>2</b>	<b>SUMMARY OF TEST RESULTS</b>	<b>7</b>
<b>3</b>	<b>TEST FACILITIES AND ACCREDITATIONS</b>	<b>8</b>
3.1	TEST LABORATORY	8
3.2	ENVIRONMENTAL CONDITIONS	8
3.3	MEASUREMENT UNCERTAINTY	8
3.4	TEST SOFTWARE	8
<b>4</b>	<b>EQUIPMENT LIST</b>	<b>9</b>
<b>5</b>	<b>TEST RESULT</b>	<b>10</b>
5.1	ANTENNA REQUIREMENT	10
5.1.1	Standard requirement	10
5.1.2	EUT Antenna	10
5.2	PEAK OUTPUT POWER	11
5.2.1	Limit	11
5.2.2	Test setup	11
5.2.3	Test procedure	11
5.2.4	Test results	12
5.3	POWER SPECTRAL DENSITY	13
5.3.1	Limit	13
5.3.2	Test Setup	13
5.3.3	Test Procedure	13
5.3.4	Test Results	14
5.4	CONDUCTED EMISSION	17
5.4.1	Limits	17
5.4.2	Test setup	17
5.4.3	Test procedure	18
5.4.4	Test results	19
5.5	RADIATED SPURIOUS	23
5.5.1	Limits	23
5.5.2	Test setup	24
5.5.3	Test procedure	25
5.5.4	Test results	25
5.5.4.1	Radiation emission	26
5.5.4.2	Band edge - radiated	41
5.6	BAND EDGE - CONDUCTED	43
5.6.1	Limits	43
5.6.2	Test setup	43
5.6.3	Test procedure	43
5.6.4	Test results	44
5.7	6DB BANDWIDTH	47
5.7.1	Limit	47
5.7.2	Test setup	47
5.7.3	Test procedure	47
5.7.4	Test results	48
5.8	DUTY CYCLE	54
5.8.1	Conformance Limit	54
5.8.2	Measuring Instruments	54
5.8.3	Test Setup	54

5.8.4 Test Procedure.....54  
5.8.5 Test Results.....55

**PHOTOGRAPHS OF THE TEST SETUP..... 56**

**PHOTOGRAPHS OF THE EUT..... 58**

## Test Result Certification

Applicant's name: WoCao Technology (Shenzhen) Co., Ltd.

Address: Baoanzhigu A510, Yintian Rd, Xixiang, Bao'an, Shenzhen, Guangdong, China

Manufacture's Name: WoCao Technology (Shenzhen) Co., Ltd.

Address: Baoanzhigu A510, Yintian Rd, Xixiang, Bao'an, Shenzhen, Guangdong, China

Product name: SwitchBot Hub Mini

Trademark: SwitchBot

Model name: W0202200, W0202201, W0202202, W0202203, W0202204, W0202205

Standards: FCC Part 15.247

Test Procedure: ANSI C63.10-2013  
KDB 558074 D01 DTS Meas Guidance v05r02

*This device described above has been tested by Shenzhen Microtest Co., Ltd. and the test results show that the equipment under test (EUT) compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.*

Tested by:



Jone Lee

July 31, 2019

Reviewed by:



Blue Zheng

July 31, 2019

Approved by:



Smith Chen

July 31, 2019

## 1 General information

### 1.1 Description of EUT

Product name:	SwitchBot Hub Mini
Model name:	W0202200
Serial Model:	W0202201, W0202202, W0202203, W0202204, W0202205
Model difference:	All the model are the same circuit and RF module, except the model No. and color.
Operation frequency:	802.11b/g/n20:2412~2462 MHz
Modulation type:	IEEE 802.11b : DSSS (DBPSK, DQPSK, CCK) IEEE 802.11g/n (HT20) : OFDM (64QAM, 16QAM, QPSK, BPSK)
Bit Rate of transmitter:	802.11b:11/5.5/2/1 Mbps 802.11g:54/48/36/24/18/12/9/6Mbps 802.11n(20MHz) use 800 ns GI: 65.0/58.5/52.0/39.0/26.0/19.5/13.0/6.5 Mbps (MCS0~MCS7)
Antenna type:	PIFA Antenna
Antenna gain:	3.66dBi
Max. output power:	10.96dBm
Power supply:	DC 5V from adapter
Battery:	N/A
Adapter information:	N/A
Hardware version:	V1.0
Software version:	V1.0

### 1.2 Operation channel list

Channel List for 802.11b/g/n(20)

Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	2412	07	2442
02	2417	08	2447
03	2422	09	2452
04	2427	10	2457
05	2432	11	2462
06	2437	\	\

### 1.3 Test channel list

Channel List for 802.11b/g/n(20)

Channel	Channel	Frequency (MHz)
Low	01	2412
Middle	06	2437
High	11	2462

### 1.4 Ancillary equipment list

Equipment	Model	S/N	Manufacturer	Certificate type
Adapter	HW-050100E01	/	HW	/

### 1.5 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Brand	Model/Type No.	Series No.	Note
/	/	/	/	/	/
/	/	/	/	/	/

Note:

(1)The support equipment was authorized by Declaration of Confirmation.

(2)For detachable type I/O cable should be specified the length in cm in 『Length』 column.

## 2 Summary of Test Results

Test procedures according to the technical standards:

No.	Standard Section	Test Item	Result	Remark
1	15.203	Antenna Requirement	Pass	
2	15.247 (b)	Peak Output Power	Pass	
3	15.247 (e)	Power Spectral Density	Pass	
4	15.207	Conducted Emission	Pass	
5	15.247 (d) & 15.209	Radiated Spurious Emission	Pass	
6	15.205	Band Edge Emission	Pass	
7	15.247 (a)(2)	6dB Bandwidth	Pass	
8	558074 D01 15.247 Meas Guidance v05r02 Chapter 6	Duty Cycle	Pass	

### 3 Test Facilities and Accreditations

#### 3.1 Test laboratory

Test Laboratory	Shenzhen Microtest Co., Ltd
Location	No.102A & 302A, East Block, Hengfang Industrial Park, Xingye Road, Xixiang, Bao'an District, Shenzhen, Guangdong, China
FCC Registration No.:	448573

#### 3.2 Environmental conditions

Temperature:	15°C~35°C
Humidity	20%~75%
Atmospheric pressure	98kPa~101kPa

#### 3.3 Measurement uncertainty

The reported uncertainty of measurement  $y \pm U$  where expanded uncertainty  $U$  is based on a standard uncertainty multiplied by a coverage factor of  $k=2$  providing a level of confidence of approximately 95 %

No.	Item	Uncertainty
1	Conducted Emission Test	$\pm 1.38\text{dB}$
2	RF power, conducted	$\pm 0.16\text{dB}$
3	Spurious emissions, conducted	$\pm 0.21\text{dB}$
4	All emissions, radiated(<1G)	$\pm 4.68\text{dB}$
5	All emissions, radiated(>1G)	$\pm 4.89\text{dB}$
6	Temperature	$\pm 0.5^\circ\text{C}$
7	Humidity	$\pm 2\%$

#### 3.4 Test software

Software Name	Manufacturer	Model	Version
RF Test System	Farad	LZ-RF	Lz_Rf 3A3



## 4 Equipment list

Equipment No.	Equipment Name	Manufacturer	Model	Serial No.	Calibration date	Due date
MTI-E001	Spectrum Analyzer	Agilent	E4407B	MY41441082	2018/09/18	2019/09/17
MTI-E003	Spectrum Analyzer	R&S	ESCI	MTI-E003	2018/09/18	2019/09/17
MTI-E004	EMI Test Receiver	Rohde&schwarz	ESPI	1000314	2018/09/18	2019/09/17
MTI-E006	Broadband antenna	schwarabeck	VULB9163	872	2018/09/18	2019/09/17
MTI-E007	Horn antenna	schwarabeck	BBHA9120D	1201	2018/09/18	2019/09/17
MTI-E014	amplifier	America	8447D	3113A06150	2018/09/18	2019/09/17
MTI-E015	Conduction Immunity Signal Generator	Schloder	CDG6000	126A1343/2015	2018/09/18	2019/09/17
MTI-E016	Coupled decoupling network	Schloder	CND M2/M3	A2210332/2015	2018/09/18	2019/09/17
MTI-E034	amplifier	Agilent	8449B	3008A02400	2018/09/18	2019/09/17
MTI-E037	Artificial power network	Schwarzbeck	NSLK8127	#841	2018/09/18	2019/09/17
MTI-E040	Spectrum analyzer	Agilent	N9020A	MY49100060	2018/09/18	2019/09/17
MTI-E041	Signal generator	Agilent	N5182A	MY49060455	2018/09/18	2019/09/17
MTI-E042	Analog signal generator	Agilent	E4421B	GB40051240	2018/09/18	2019/09/17
MTI-E043	Power sensor	Dare Instruments	RPR3006W	16I00054SN O16	2018/09/18	2019/09/17
MTI-E047	10dB attenuator	Mini-Circuits	UNAT-10+	15542	2018/09/18	2019/09/17
MTI-E049	spectrum analyzer	Rohde&schwarz	FSP-38	100019	2018/09/18	2019/09/17
MTI-E050	PSG Signal generator	Agilent	E8257D	MY46520873	2018/09/18	2019/09/17
MTI-E061	Active Loop Antenna 9kHz - 30MHz	Schwarzbeek	FMZB 1519 B	00044	2018/09/18	2019/09/17
MTI-E052	18-40GHz amplifier	Chengdu step Micro Technology	ZLNA-18-40G-21	1608001	2018/09/18	2019/09/17
MTI-E053	15-40G Antenna	Schwarzbeek	BBHA9170	BBHA9170582	2018/09/18	2019/09/17
MTI-E058	Artificial power network	Schwarzbeck	NSLK8127	#841	2018/09/18	2019/09/17

Note: the calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

## 5 Test Result

### 5.1 Antenna requirement

#### 5.1.1 Standard requirement

15.203 requirement: For intentional device, according to 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

#### 5.1.2 EUT Antenna

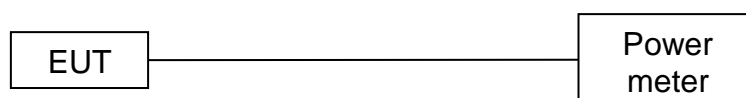
The EUT antenna is PIFA antenna (3.66dBi). It comply with the standard requirement. In case of replacement of broken antenna the same antenna type must be used.

## 5.2 Peak output power

### 5.2.1 Limit

FCC Part15 Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3)	Peak output power	1 watt or 30dBm	2400-2483.5	Pass

### 5.2.2 Test setup



### 5.2.3 Test procedure

The EUT was directly connected to the Power meter.

5.2.4 Test results

802.11b

Test Channel	Frequency (MHz)	Maximum Peak Conducted Output Power(dBm)	Limit (dBm)
CH01	2412	10.29	30
CH06	2437	9.78	30
CH11	2462	10.96	30

802.11g

Test Channel	Frequency (MHz)	Maximum Peak Conducted Output Power(dBm)	Limit (dBm)
CH01	2412	8.31	30
CH06	2437	8.69	30
CH11	2462	9.30	30

802.11n20

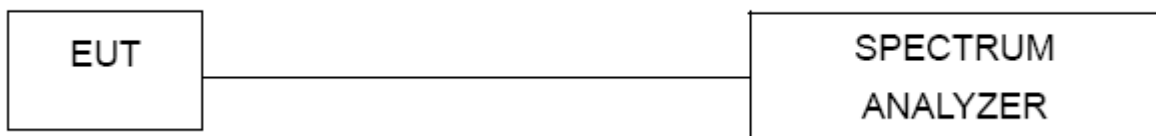
Test Channel	Frequency (MHz)	Maximum Peak Conducted Output Power(dBm)	Limit (dBm)
CH01	2412	8.31	30
CH06	2437	8.69	30
CH11	2462	9.30	30

### 5.3 Power spectral density

#### 5.3.1 Limit

FCC Part15 Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247	Power Spectral Density	8 dBm (in any 3kHz)	2400-2483.5	Pass

#### 5.3.2 Test Setup

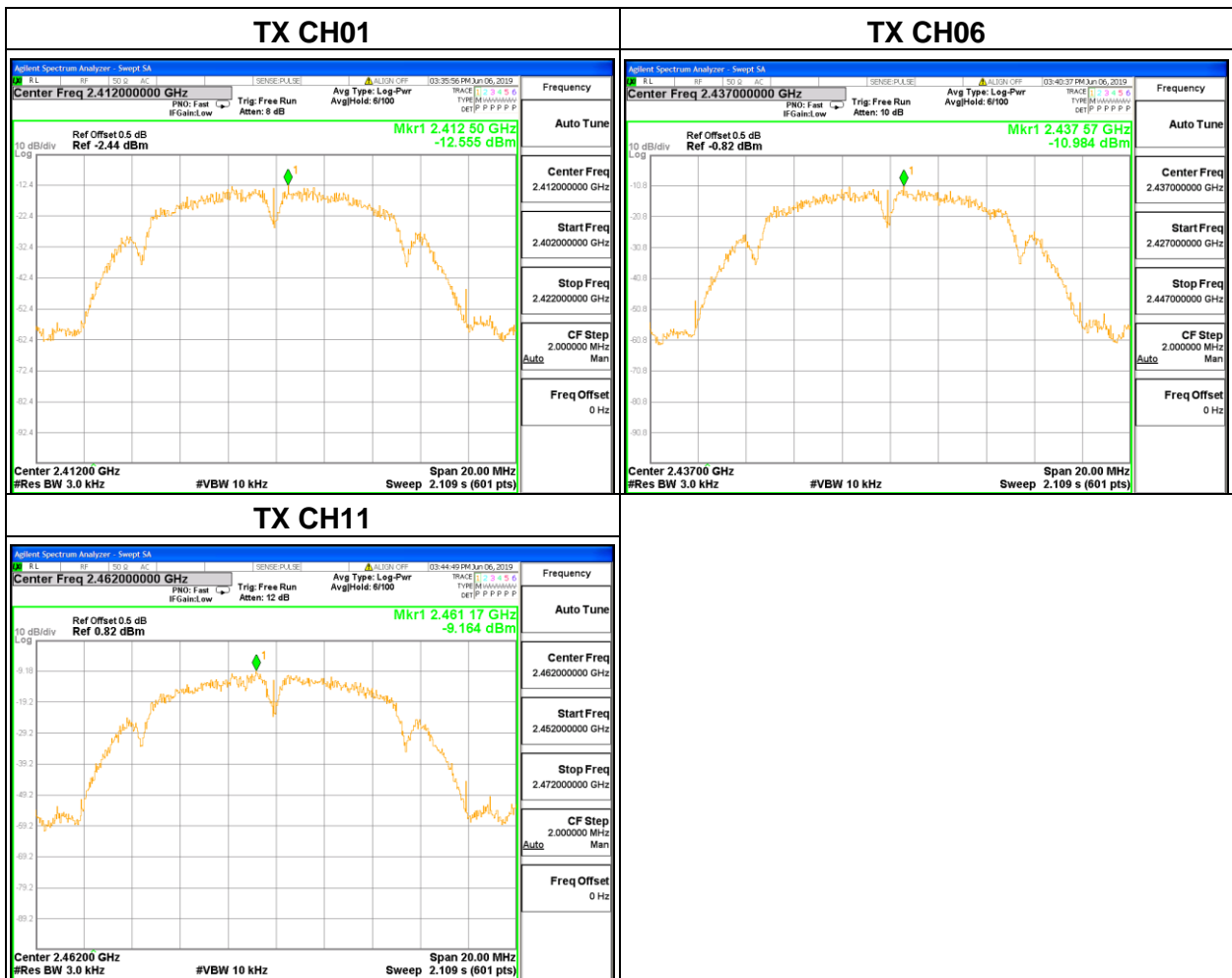


#### 5.3.3 Test Procedure

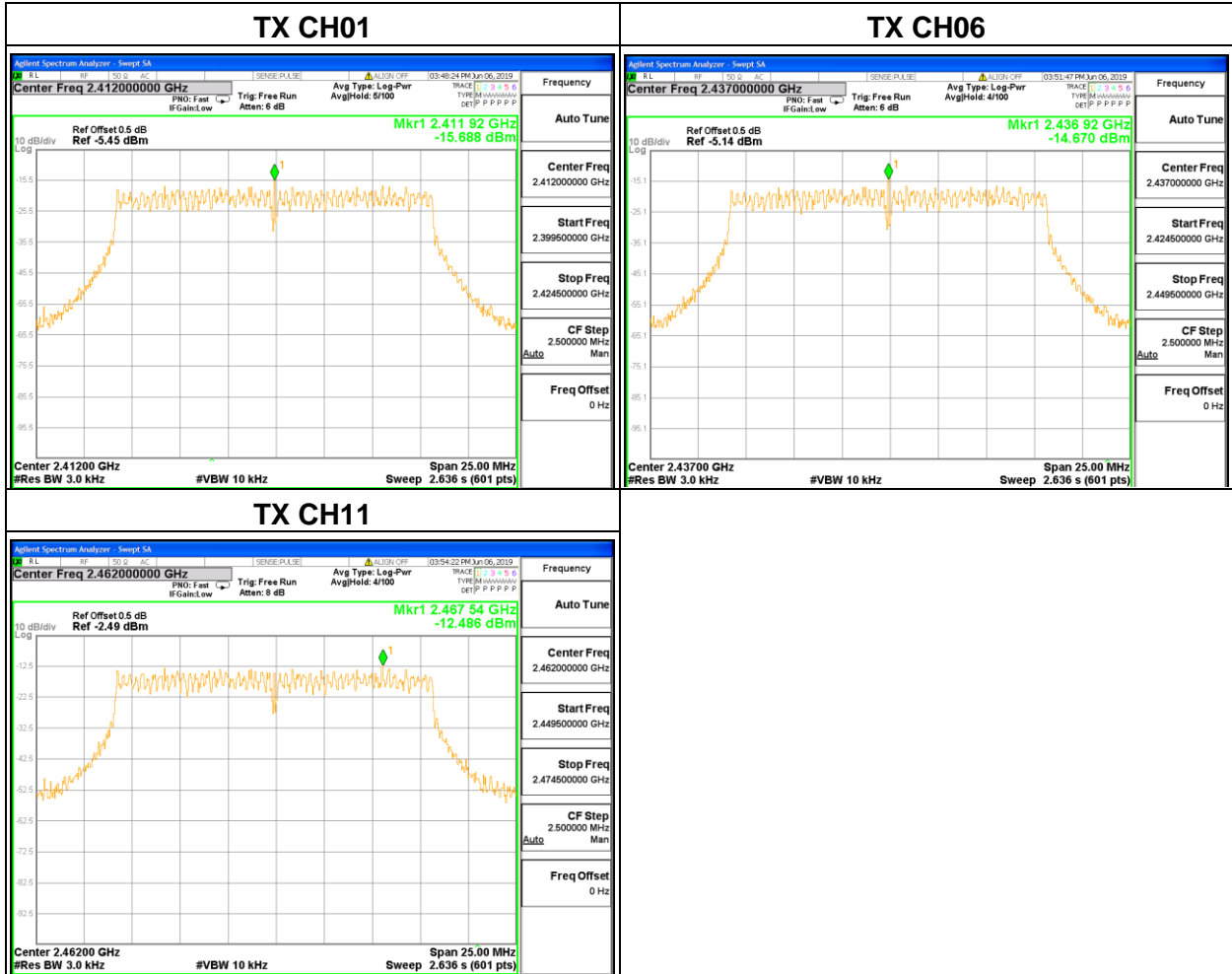
- a. The EUT tested system was configured as the statements of 2.1 unless otherwise a special operating condition is specified in the follows during the testing.
- b. Set analyzer center frequency to DTS channel center frequency.
- c. Set the span to 1.5 times the DTS channel bandwidth.
- d. Set the RBW  $\geq$  3 kHz.
- e. Set the VBW  $\geq$  3 x RBW.
- f. Detector = peak.
- g. Sweep time = auto couple.
- h. Trace mode = max hold.
- i. Allow trace to fully stabilize.
- j. Use the peak marker function to determine the maximum amplitude level.
- k. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.3.4 Test Results

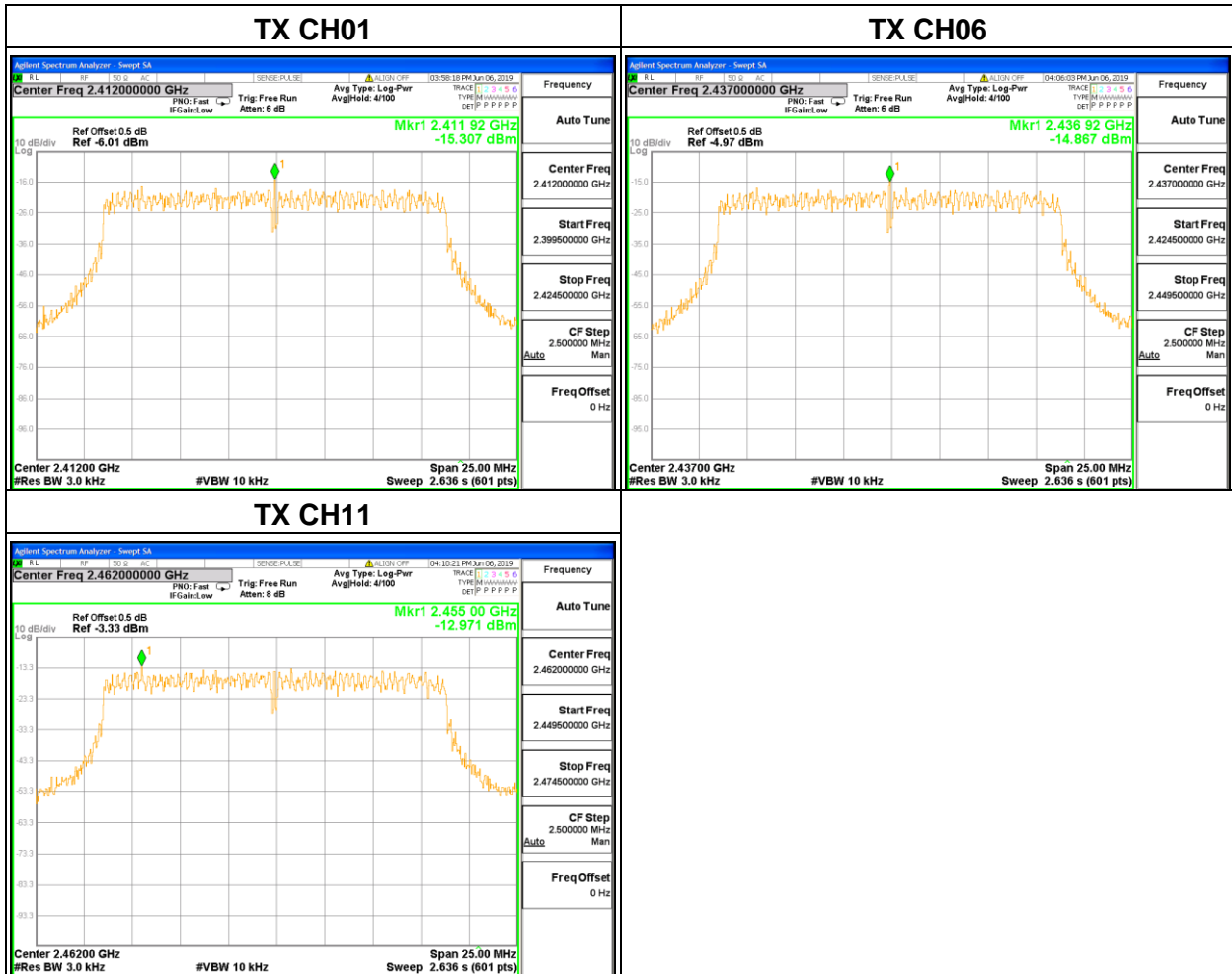
802.11b			
Frequency	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412 MHz	-12.555	8	Pass
2437 MHz	-10.984	8	Pass
2462 MHz	-9.164	8	Pass



802.11g			
Frequency	Power Density (dBm/3kHz)	Limit 8(dBm/3kHz)	Result
2412 MHz	-15.688	8	Pass
2437 MHz	-14.670	8	Pass
2462 MHz	-12.486	8	Pass



802.11n20			
Frequency	Power Density (dBm/3kHz)	Limit 8(dBm/3kHz)	Result
2412 MHz	-15.307	8	Pass
2437 MHz	-14.867	8	Pass
2462 MHz	-12.971	8	Pass





5.4 Conducted emission

5.4.1 Limits

According to FCC Part 15.207(a) and KDB 174176 D01 Line Conducted FAQ v01r01.

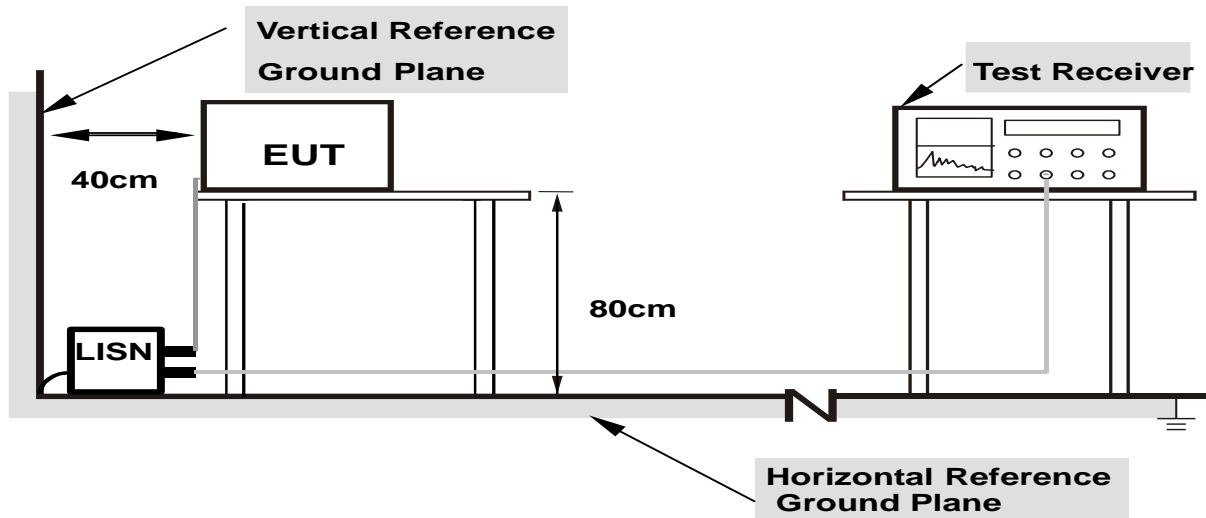
FREQUENCY (MHz)	Class B (dBuV)	
	Quasi-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

Note

(1)The tighter limit applies at the band edges.

(2)The limit of " \* " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

5.4.2 Test setup



**Note: 1.Support units were connected to second LISN.**

**2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes**

### 5.4.3 Test procedure

#### a. EUT Operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

#### b. The following table is the setting of the receiver

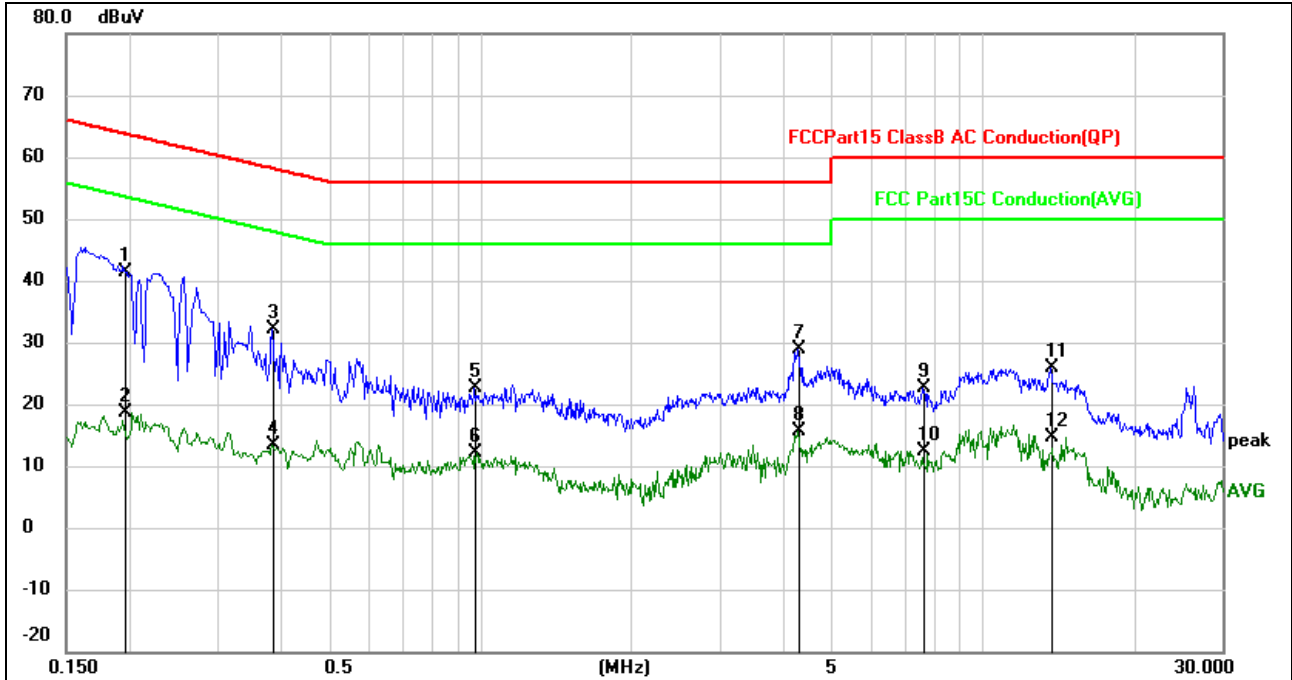
Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

- c. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- d. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- e. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- f. LISN at least 80 cm from nearest part of EUT chassis.

For the actual test configuration, please refer to the related Item –EUT Test Photos.

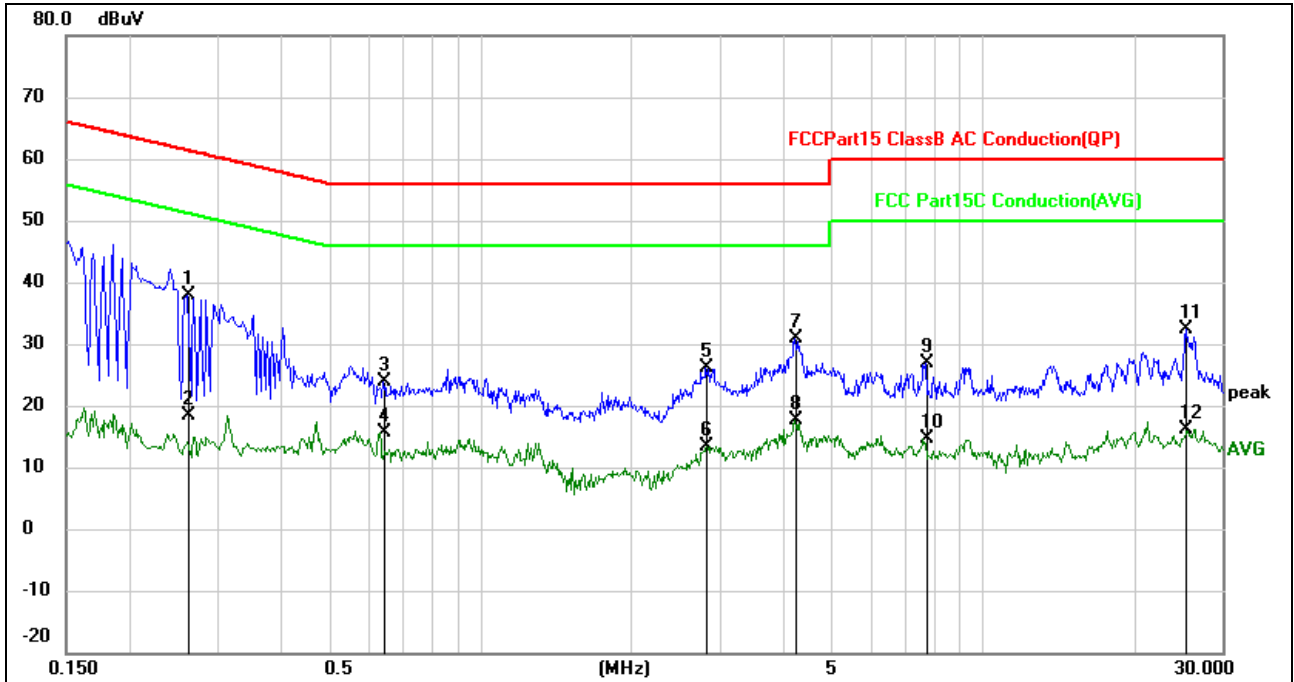
5.4.4 Test results

EUT :	SwitchBot Hub Mini	Model Name. :	W0202200
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	L
Test Voltage :	DC 5V from adapter AC 120V/60Hz	Test Mode :	Normal link



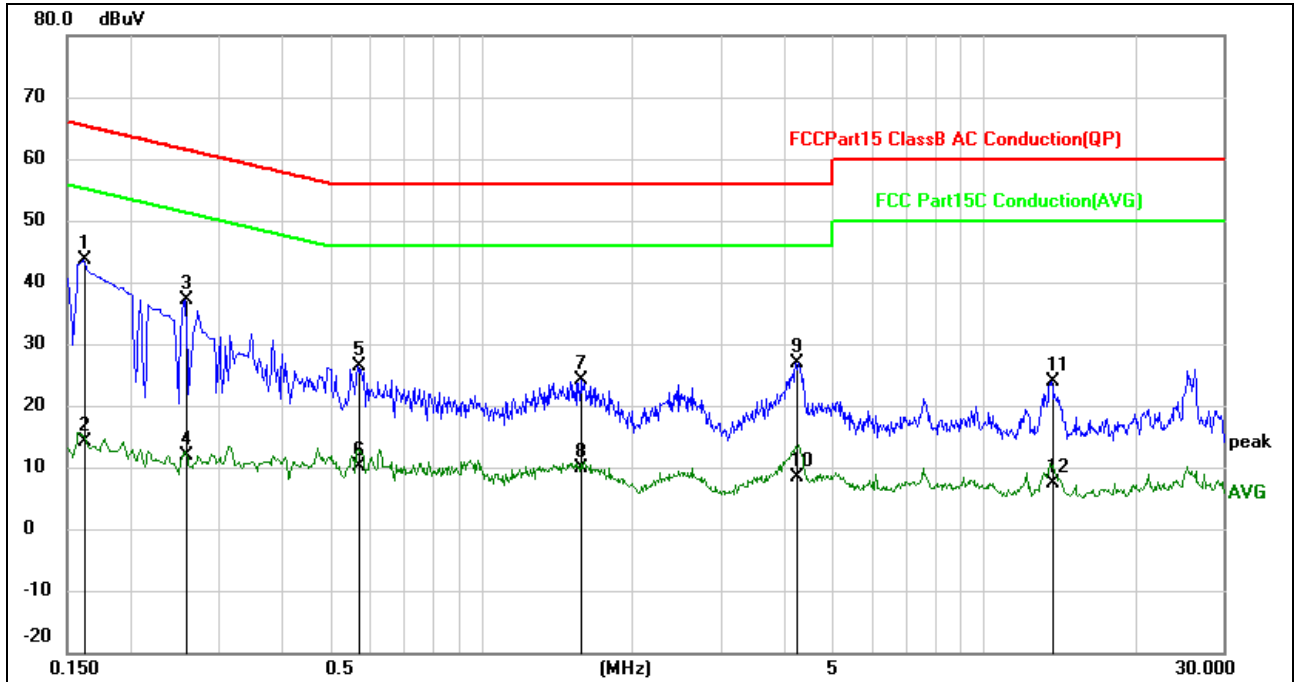
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1	*	0.1965	31.76	9.73	41.49	63.76	-22.27	QP	
2		0.1965	8.79	9.73	18.52	53.76	-35.24	AVG	
3		0.3860	22.35	9.81	32.16	58.15	-25.99	QP	
4		0.3860	3.60	9.81	13.41	48.15	-34.74	AVG	
5		0.9737	12.79	9.95	22.74	56.00	-33.26	QP	
6		0.9737	2.28	9.95	12.23	46.00	-33.77	AVG	
7		4.3059	18.76	10.03	28.79	56.00	-27.21	QP	
8		4.3059	5.66	10.03	15.69	46.00	-30.31	AVG	
9		7.6257	12.35	10.17	22.52	60.00	-37.48	QP	
10		7.6257	2.10	10.17	12.27	50.00	-37.73	AVG	
11		13.6616	15.61	10.22	25.83	60.00	-34.17	QP	
12		13.6616	4.47	10.22	14.69	50.00	-35.31	AVG	

EUT :	SwitchBot Hub Mini	Model Name. :	W0202200
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	N
Test Voltage :	DC 5V from adapter AC 120V/60Hz	Test Mode :	Normal link



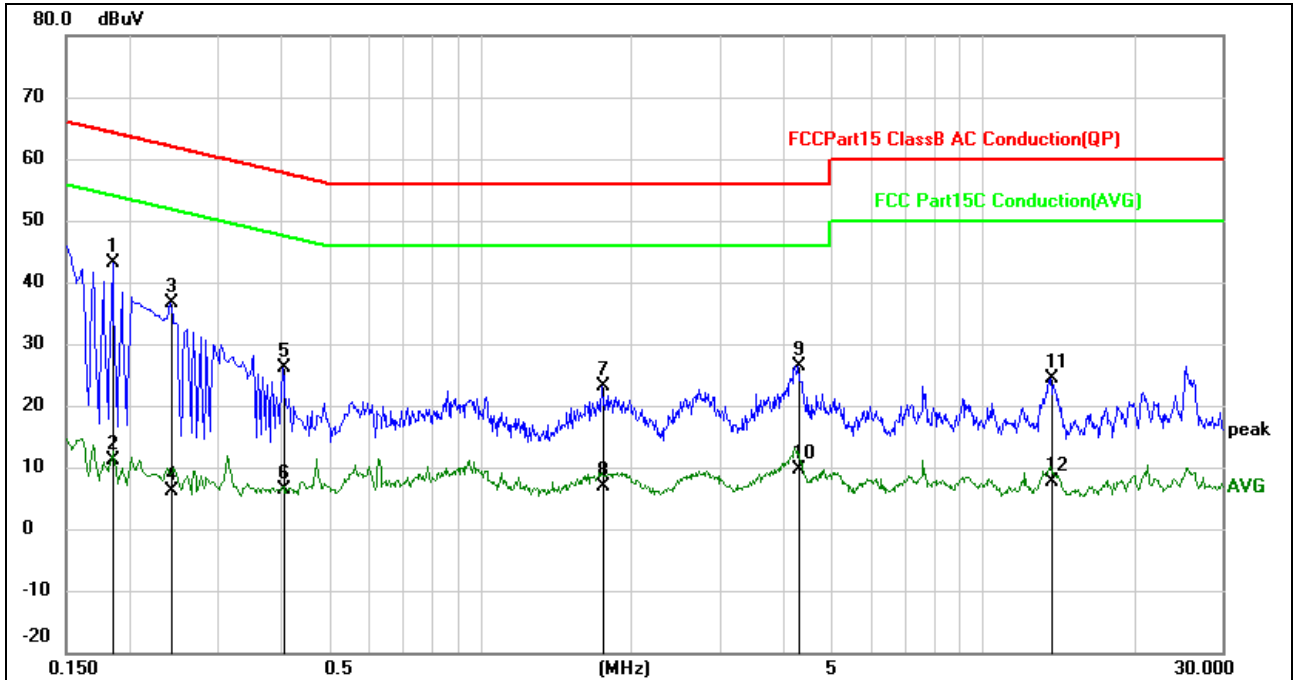
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1	*	0.2620	28.13	9.74	37.87	61.37	-23.50	QP	
2		0.2620	8.52	9.74	18.26	51.37	-33.11	AVG	
3		0.6419	13.89	9.90	23.79	56.00	-32.21	QP	
4		0.6419	5.65	9.90	15.55	46.00	-30.45	AVG	
5		2.8140	16.06	9.99	26.05	56.00	-29.95	QP	
6		2.8140	3.48	9.99	13.47	46.00	-32.53	AVG	
7		4.2378	20.79	10.03	30.82	56.00	-25.18	QP	
8		4.2378	7.62	10.03	17.65	46.00	-28.35	AVG	
9		7.6900	16.61	10.18	26.79	60.00	-33.21	QP	
10		7.6900	4.38	10.18	14.56	50.00	-35.44	AVG	
11		25.3819	22.12	10.25	32.37	60.00	-27.63	QP	
12		25.3819	5.95	10.25	16.20	50.00	-33.80	AVG	

EUT :	SwitchBot Hub Mini	Model Name. :	W0202200
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	L
Test Voltage :	DC 5V from adapter AC 240V/60Hz	Test Mode :	Normal link



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1	*	0.1620	33.82	9.73	43.55	65.36	-21.81	QP	
2		0.1620	4.42	9.73	14.15	55.36	-41.21	AVG	
3		0.2580	27.41	9.74	37.15	61.50	-24.35	QP	
4		0.2580	2.17	9.74	11.91	51.50	-39.59	AVG	
5		0.5700	16.38	9.89	26.27	56.00	-29.73	QP	
6		0.5700	0.18	9.89	10.07	46.00	-35.93	AVG	
7		1.5820	14.21	9.96	24.17	56.00	-31.83	QP	
8		1.5820	-0.02	9.96	9.94	46.00	-36.06	AVG	
9		4.2380	16.80	10.03	26.83	56.00	-29.17	QP	
10		4.2380	-1.76	10.03	8.27	46.00	-37.73	AVG	
11		13.6620	13.61	10.22	23.83	60.00	-36.17	QP	
12		13.6620	-2.86	10.22	7.36	50.00	-42.64	AVG	

EUT :	SwitchBot Hub Mini	Model Name. :	W0202200
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	N
Test Voltage :	DC 5V from adapter AC 240V/60Hz	Test Mode :	Normal link



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1	*	0.1860	33.33	9.73	43.06	64.21	-21.15	QP	
2		0.1860	1.33	9.73	11.06	54.21	-43.15	AVG	
3		0.2420	27.00	9.73	36.73	62.03	-25.30	QP	
4		0.2420	-3.66	9.73	6.07	52.03	-45.96	AVG	
5		0.4060	16.35	9.82	26.17	57.73	-31.56	QP	
6		0.4060	-3.36	9.82	6.46	47.73	-41.27	AVG	
7		1.7460	13.11	9.97	23.08	56.00	-32.92	QP	
8		1.7460	-3.19	9.97	6.78	46.00	-39.22	AVG	
9		4.2980	16.38	10.03	26.41	56.00	-29.59	QP	
10		4.2980	-0.28	10.03	9.75	46.00	-36.25	AVG	
11		13.6700	14.06	10.22	24.28	60.00	-35.72	QP	
12		13.6700	-2.67	10.22	7.55	50.00	-42.45	AVG	

## 5.5 Radiated spurious

### 5.5.1 Limits

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequency (MHz)	Field Strength (micovolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

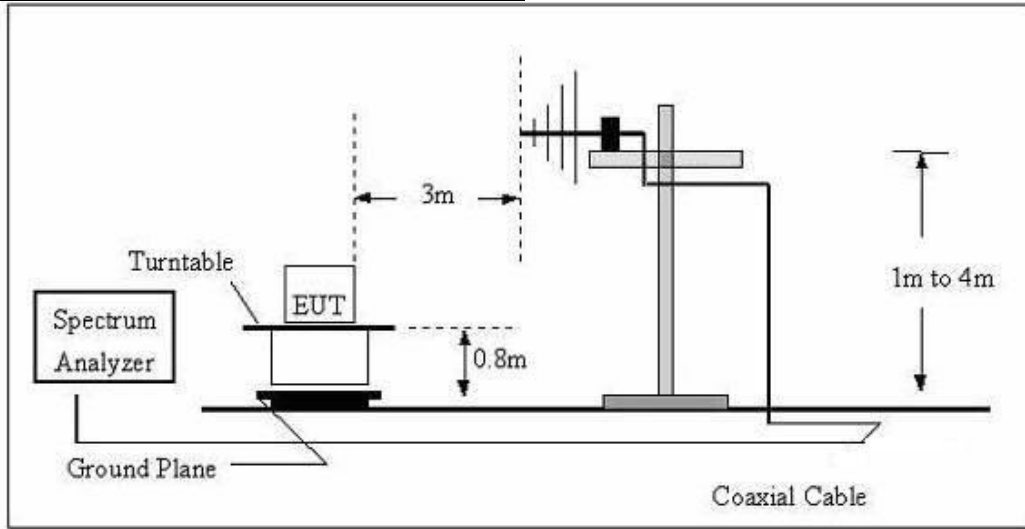
Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic

Frequency Range	RBW	VBW	Measurement
30MHz-1GHz	1MHz	3MHz	Peak
Above 1GHz	1MHz	10Hz <sup>Note1</sup>	Average
	1MHz	>1/T <sup>Note2</sup>	Average
Note1	When duty cycle is no less than 98%		
Note2	When duty cycle is less than 98%		

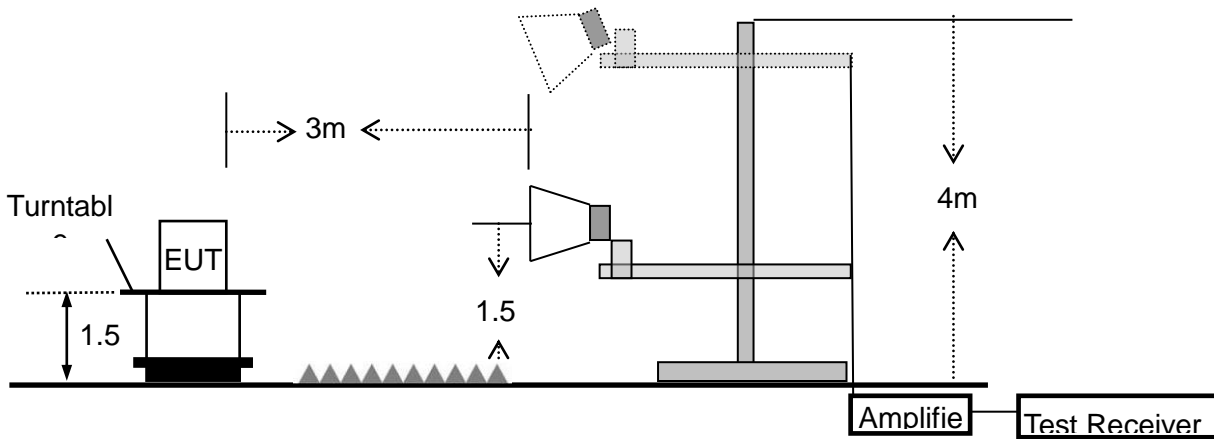
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

5.5.2 Test setup

Radiated emission test-up frequency 30MHz~1GHz



Radiated emission test-up frequency above 1GHz





### 5.5.3 Test procedure

- a. EUT operating conditions. The EUT tested system was configured as the statements of 2.4 unless otherwise a special operating condition is specified in the follows during the testing.
- b. The measuring distance of at 3 m shall be used for measurements at frequency up to 1GHz. For frequencies above 1GHz, any suitable measuring distance may be used.
- c. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter open area test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- d. The height of the equipment or of the substitution antenna shall be 0.8 m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For emission measurements above 1 GHz, the EUT shall be placed at a height of 1.5 m above the floor on a support that is RF transparent for the frequencies of interest. Final measurements for the EUT require a measurement antenna height scan of 1 m to 4 m.
- f. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- g. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- h. For the actual test configuration, please refer to the related Item –EUT Test photos.

Note: Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

Test standard reference:

Based on the data recorded in the table below, the EUT complies with FCC Title 47. Part 15. Part C sections 15205. 15209 and 15.247.

### 5.5.4 Test results

5.5.4.1 Radiation emission

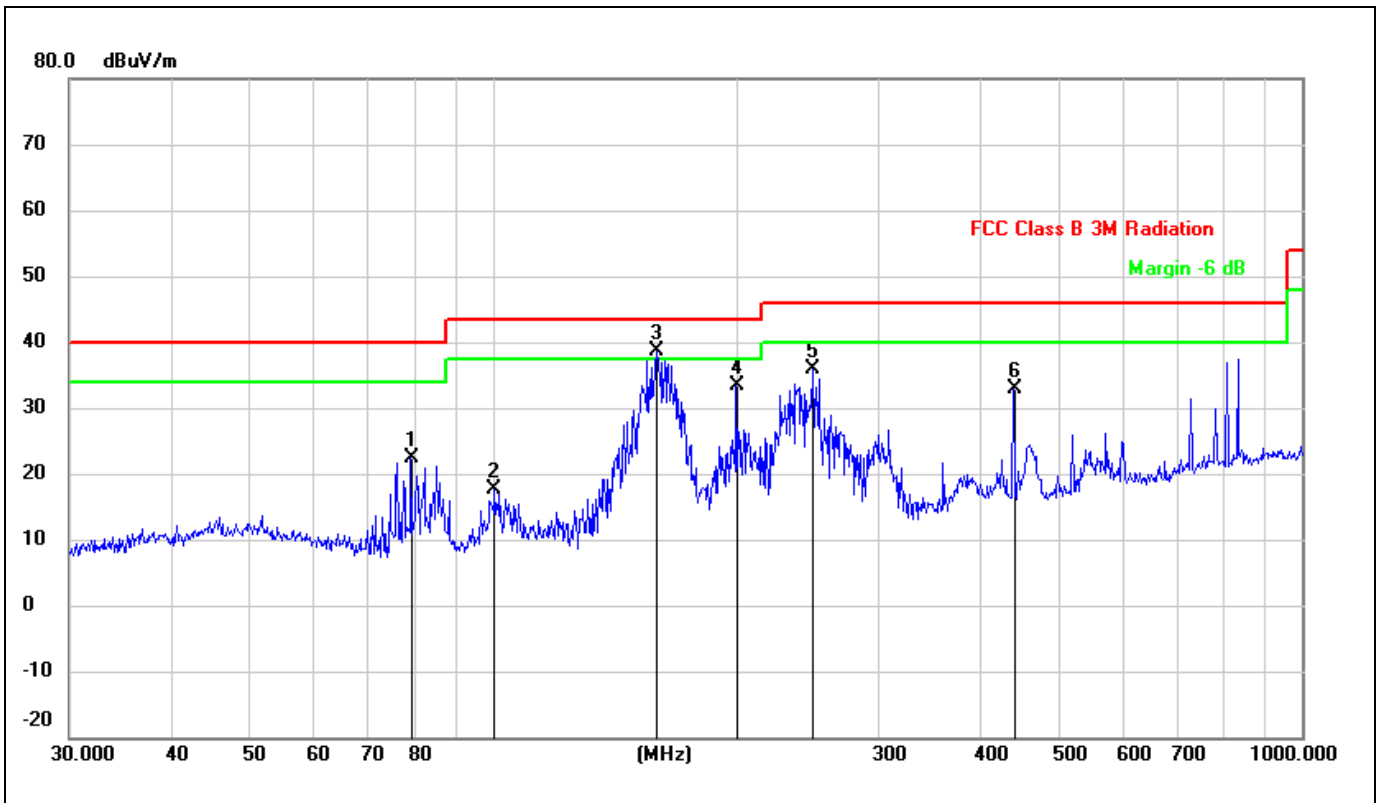
Between 30MHz – 1GHz

All the modulation modes have been tested, the report only shows the worst mode.

EUT has two different voltage supports, reporting only the worst voltage mode

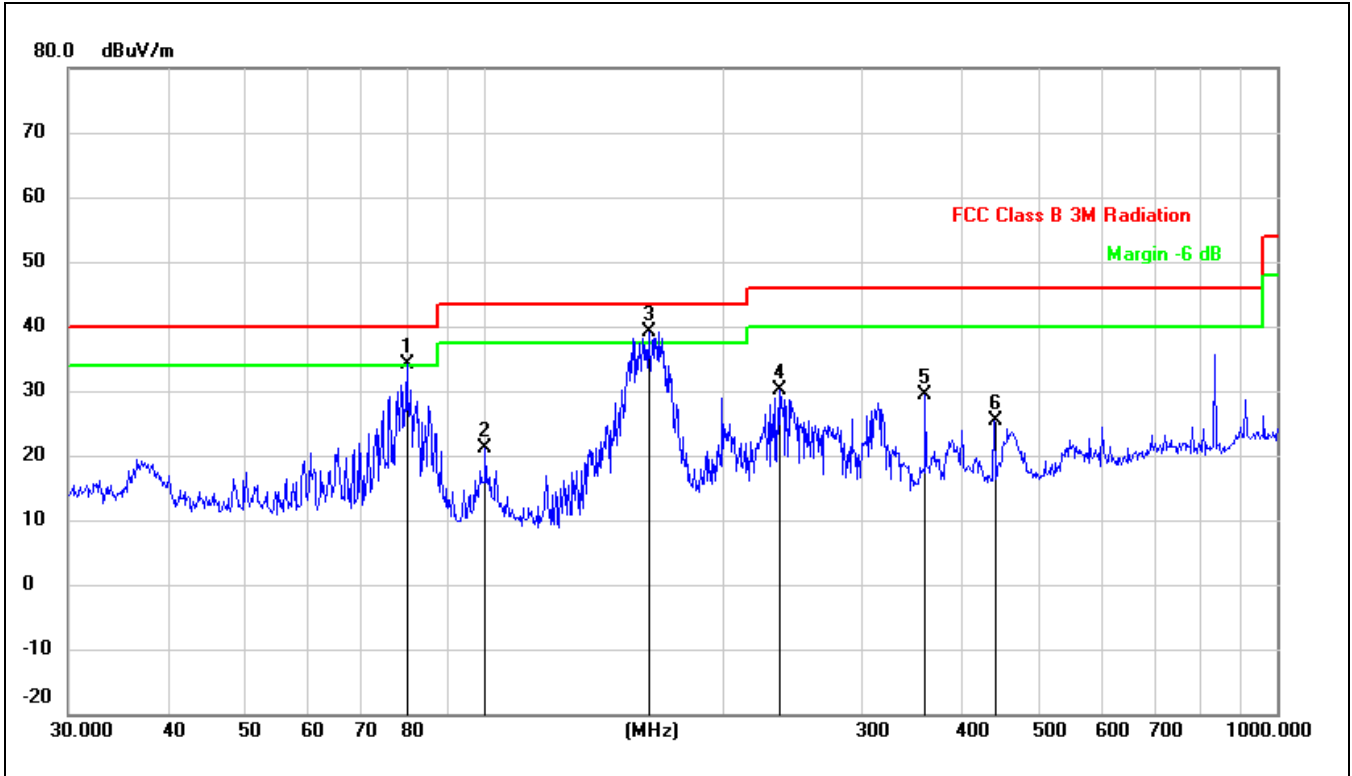
The worst mode is 802.11b CH11, the worst result was report as below:

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	H
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter AC 120V/60Hz
Test Mode :	TX		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	Detector
1		79.2426	40.05	-17.68	22.37	40.00	-17.63	QP
2		100.5806	31.34	-13.79	17.55	43.50	-25.95	QP
3	*	159.2251	54.96	-16.30	38.66	43.50	-4.84	QP
4		199.9856	46.48	-13.04	33.44	43.50	-10.06	QP
5		248.5519	47.58	-11.80	35.78	46.00	-10.22	QP
6		440.1963	41.80	-8.98	32.82	46.00	-13.18	QP

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	V
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter AC 120V/60Hz
Test Mode :	TX		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	
1	!	80.0806	52.06	-17.82	34.24	40.00	-5.76	QP
2		100.5806	34.80	-13.79	21.01	43.50	-22.49	QP
3	*	161.4742	55.35	-16.17	39.18	43.50	-4.32	QP
4		236.6447	42.59	-12.35	30.24	46.00	-15.76	QP
5		360.4476	39.23	-9.80	29.43	46.00	-16.57	QP
6		440.1963	34.43	-8.98	25.45	46.00	-20.55	QP

1G-25GHz

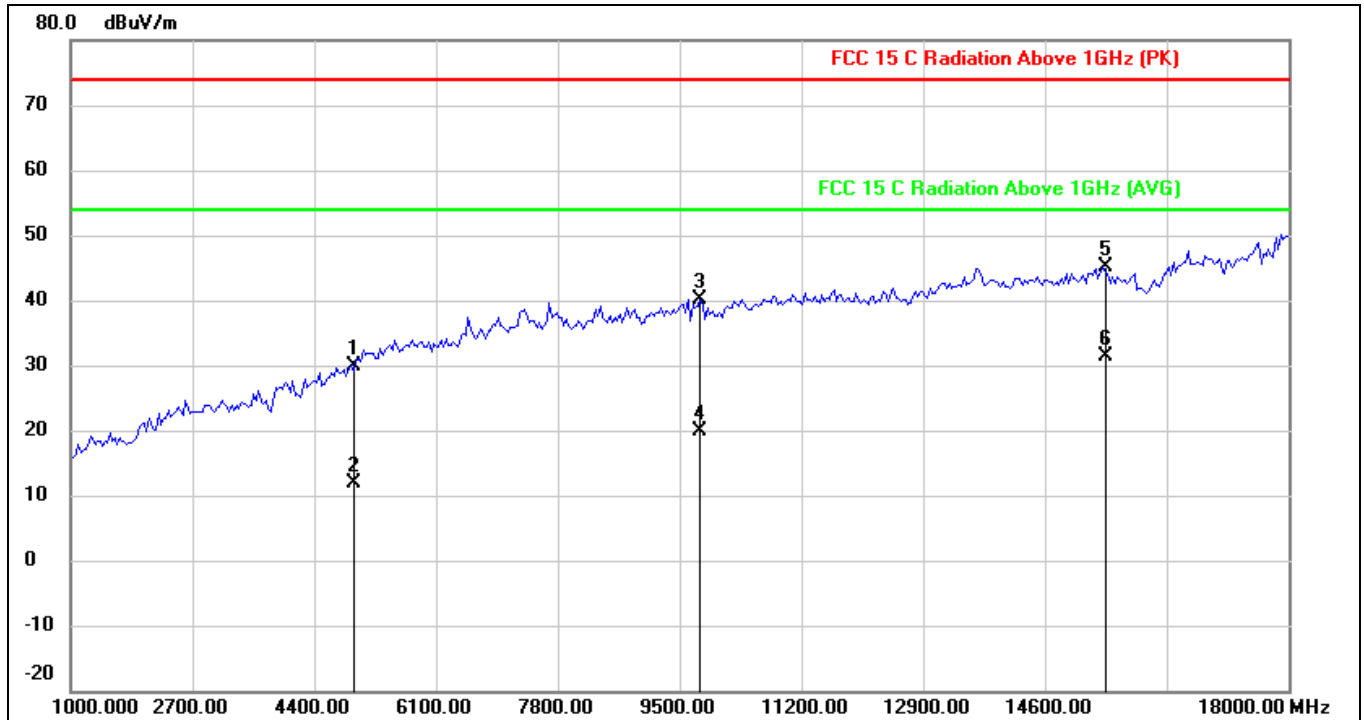
Note: (1) Emission Level= Antenna Factor + Cable Loss + Read Level - Preamp Factor  
(2) All other emissions more than 20dB below the limit.

All the modulation modes have been tested, and the worst result was report as below:

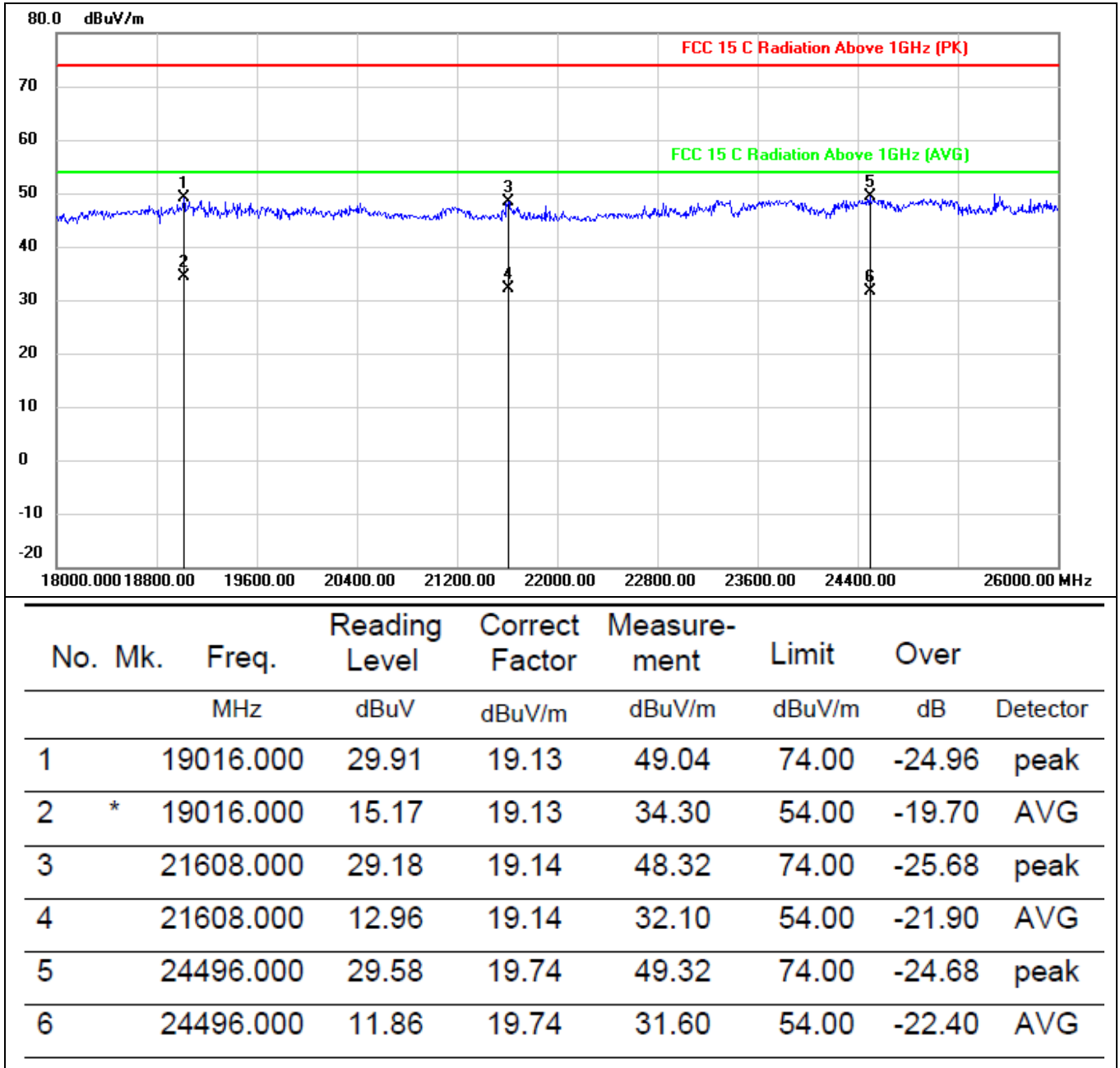
For 802.11b

Note1: The three modulated high, medium and low channels have been tested. The report only shows the worst mode. The worst mode is 802.11b.

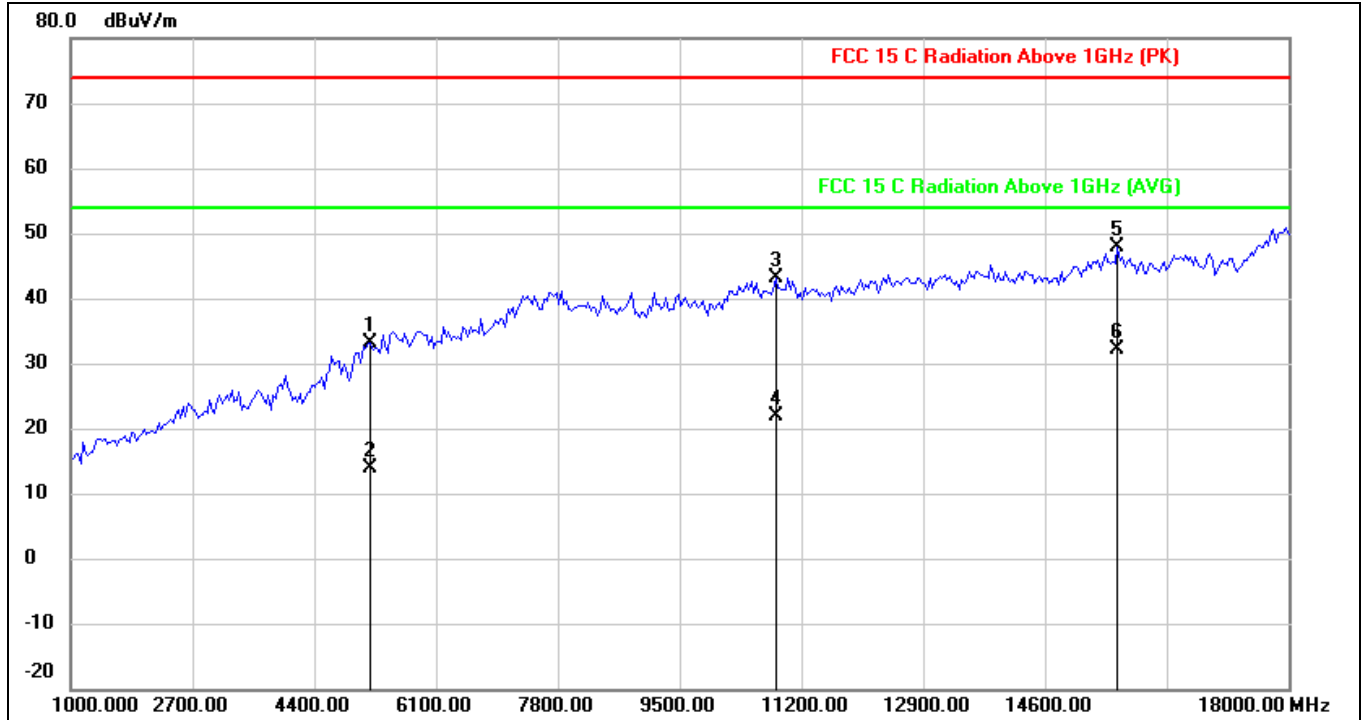
EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	H
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter AC 120V/60Hz
Test Mode :	TX-2412MHz		



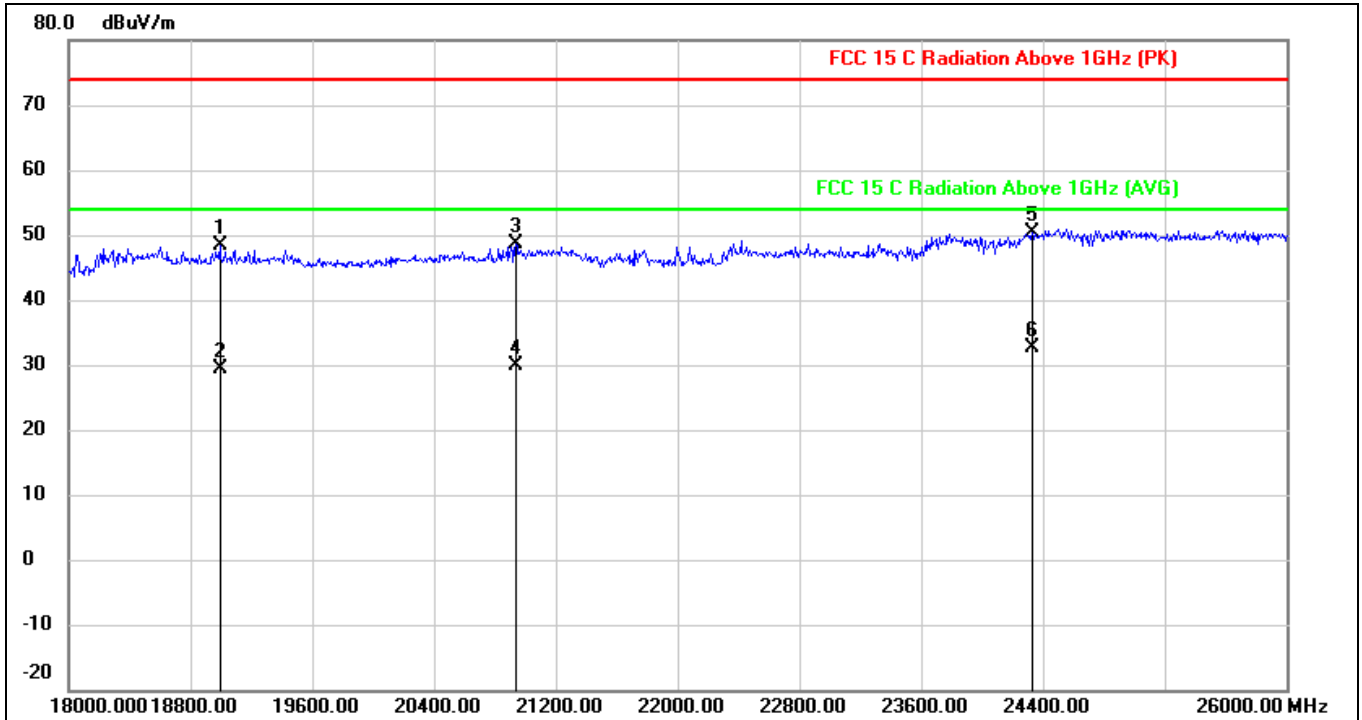
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		4917.836	37.16	-7.30	29.86	74.00	-44.14	peak
2		4917.836	19.30	-7.30	12.00	54.00	-42.00	AVG
3		9789.579	37.66	2.43	40.09	74.00	-33.91	peak
4		9789.579	17.57	2.43	20.00	54.00	-34.00	AVG
5		15410.822	40.35	4.78	45.13	74.00	-28.87	peak
6	*	15410.822	26.62	4.78	31.40	54.00	-22.60	AVG



EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	V
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter AC 120V/60Hz
Test Mode :	TX-2412MHz		



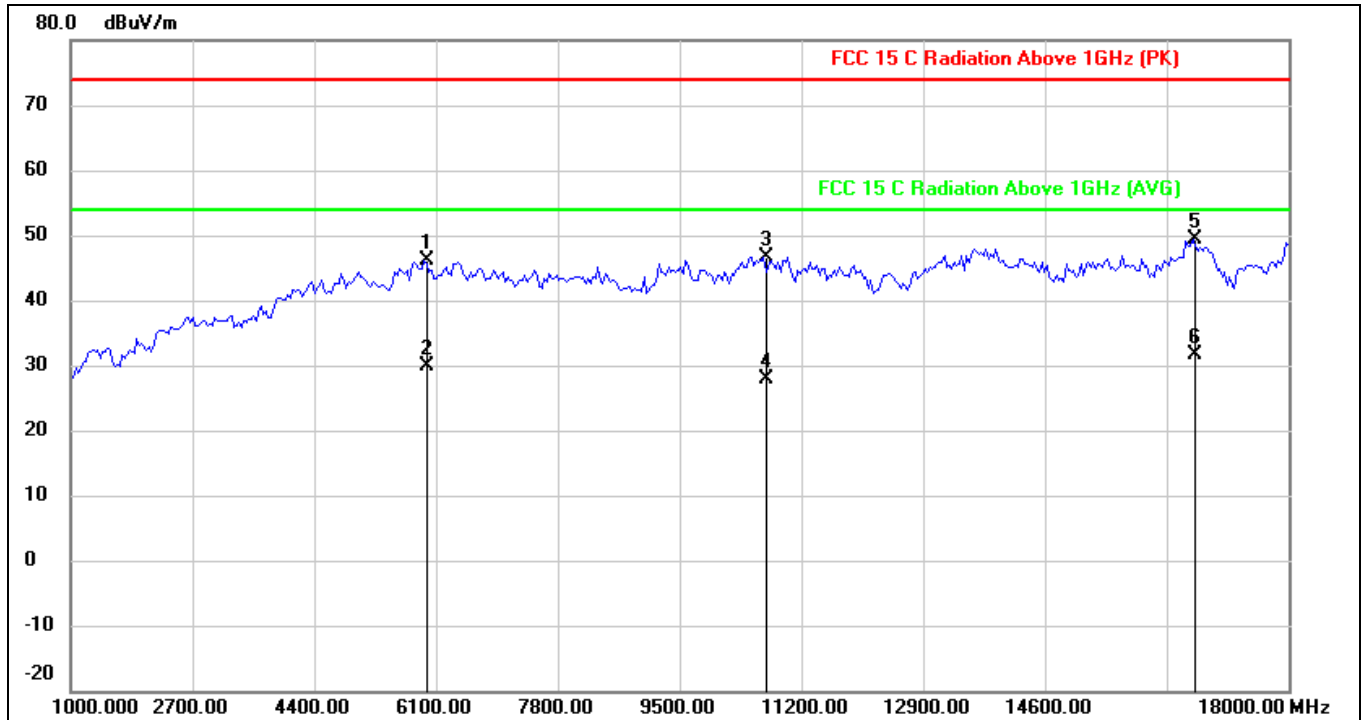
No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	
1		5156.313	39.74	-6.53	33.21	74.00	-40.79	peak
2		5156.313	20.53	-6.53	14.00	54.00	-40.00	AVG
3		10845.691	38.42	4.73	43.15	74.00	-30.85	peak
4		10845.691	17.27	4.73	22.00	54.00	-32.00	AVG
5		15615.230	43.72	4.05	47.77	74.00	-26.23	peak
6	*	15615.230	28.15	4.05	32.20	54.00	-21.80	AVG



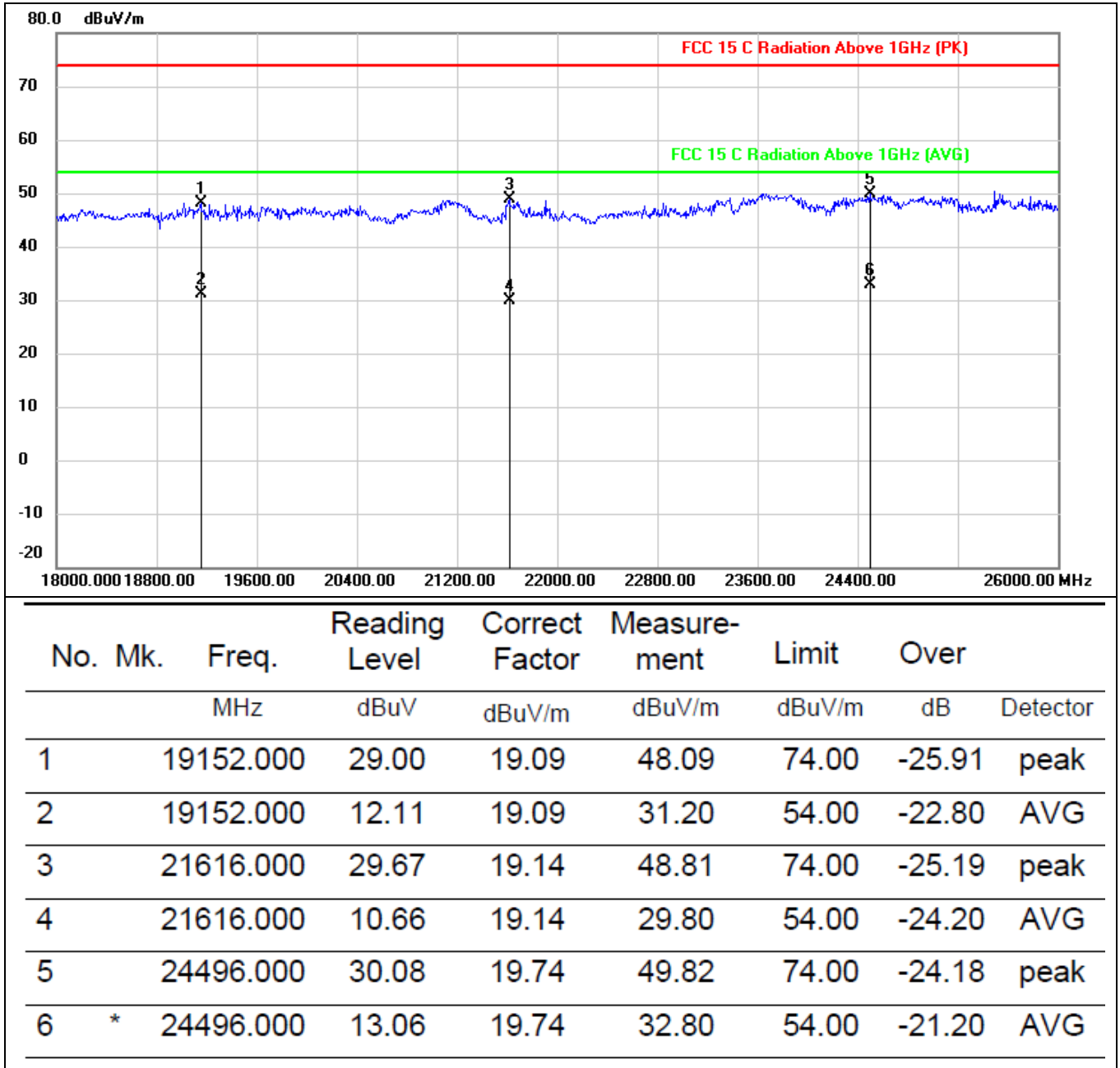
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		18992.000	29.27	19.12	48.39	74.00	-25.61	peak
2		18992.000	10.18	19.12	29.30	54.00	-24.70	AVG
3		20936.000	29.65	19.00	48.65	74.00	-25.35	peak
4		20936.000	11.00	19.00	30.00	54.00	-24.00	AVG
5		24328.000	30.67	19.70	50.37	74.00	-23.63	peak
6	*	24328.000	12.90	19.70	32.60	54.00	-21.40	AVG



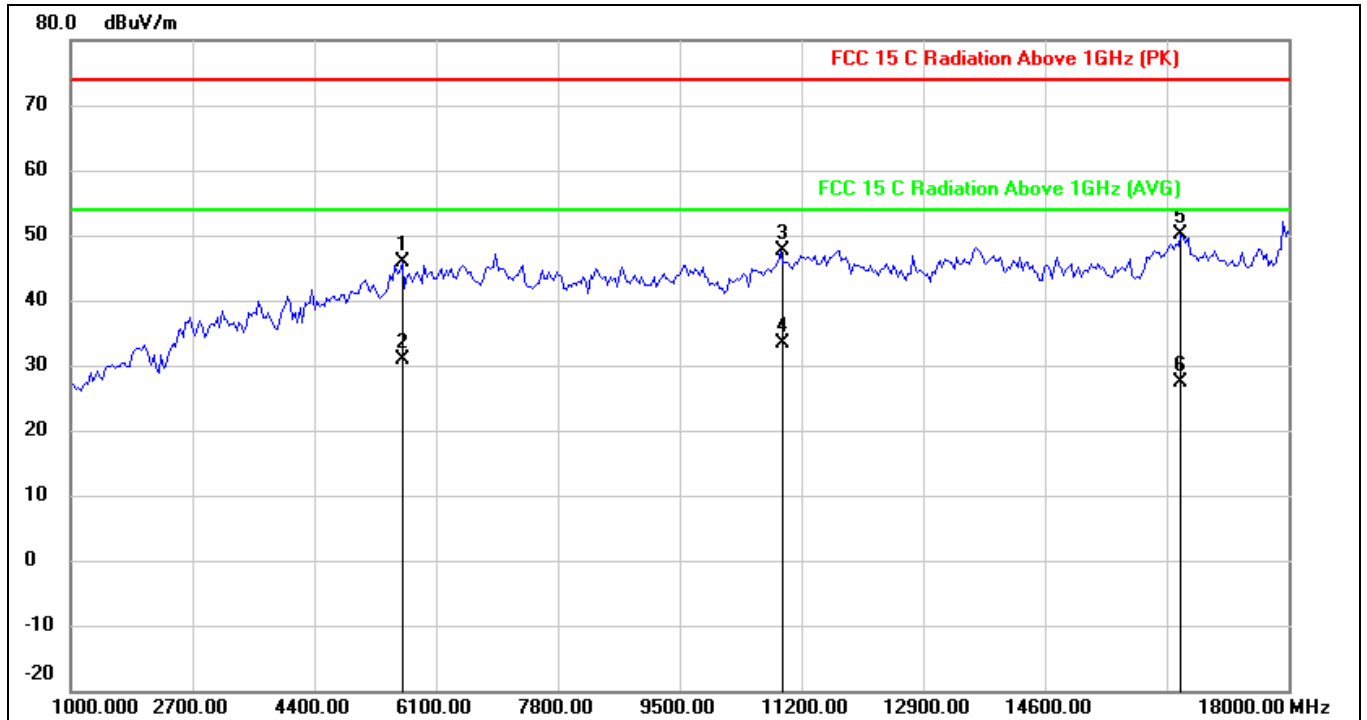
EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	H
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter AC 120V/60Hz
Test Mode :	TX-2437MHz		



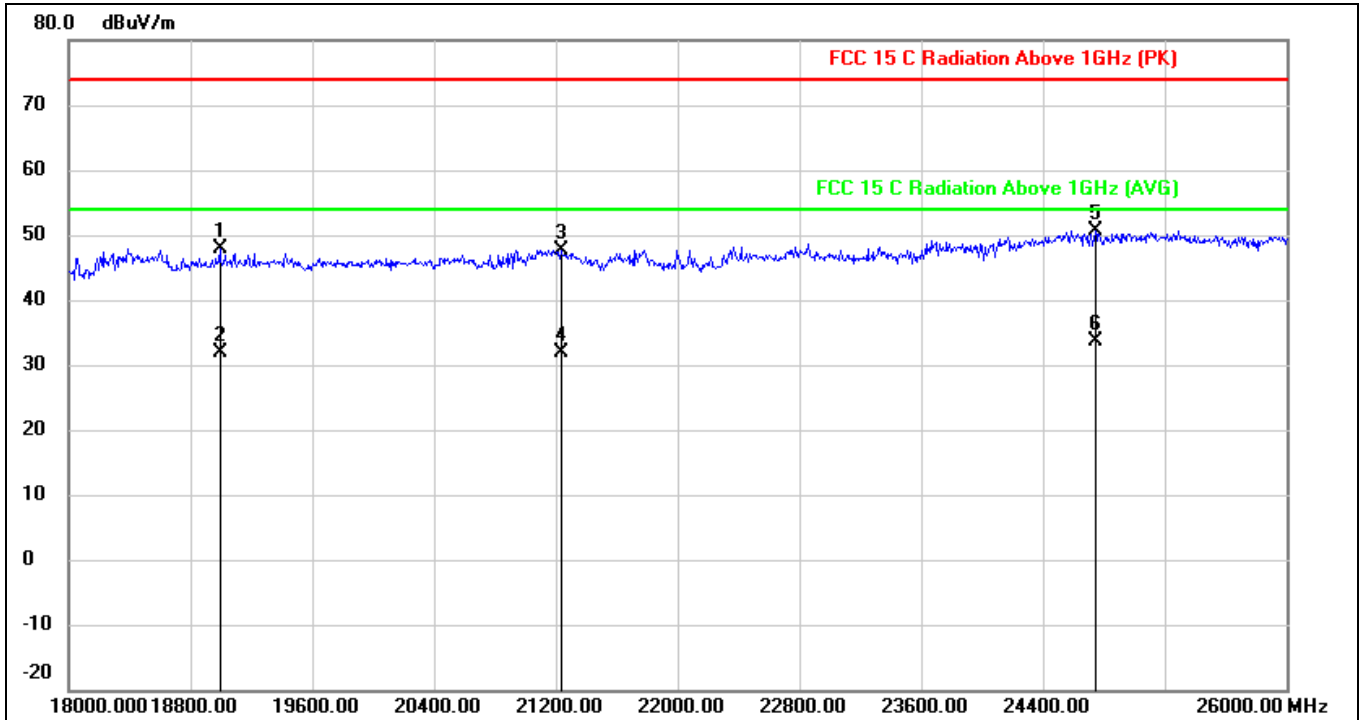
No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	Detector
1		5939.880	51.26	-5.18	46.08	74.00	-27.92	peak
2		5939.880	35.18	-5.18	30.00	54.00	-24.00	AVG
3		10675.351	42.37	4.35	46.72	74.00	-27.28	peak
4		10675.351	23.65	4.35	28.00	54.00	-26.00	AVG
5		16671.343	44.22	5.10	49.32	74.00	-24.68	peak
6	*	16671.343	26.50	5.10	31.60	54.00	-22.40	AVG



EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	V
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter AC 120V/60Hz
Test Mode :	TX-2437MHz		

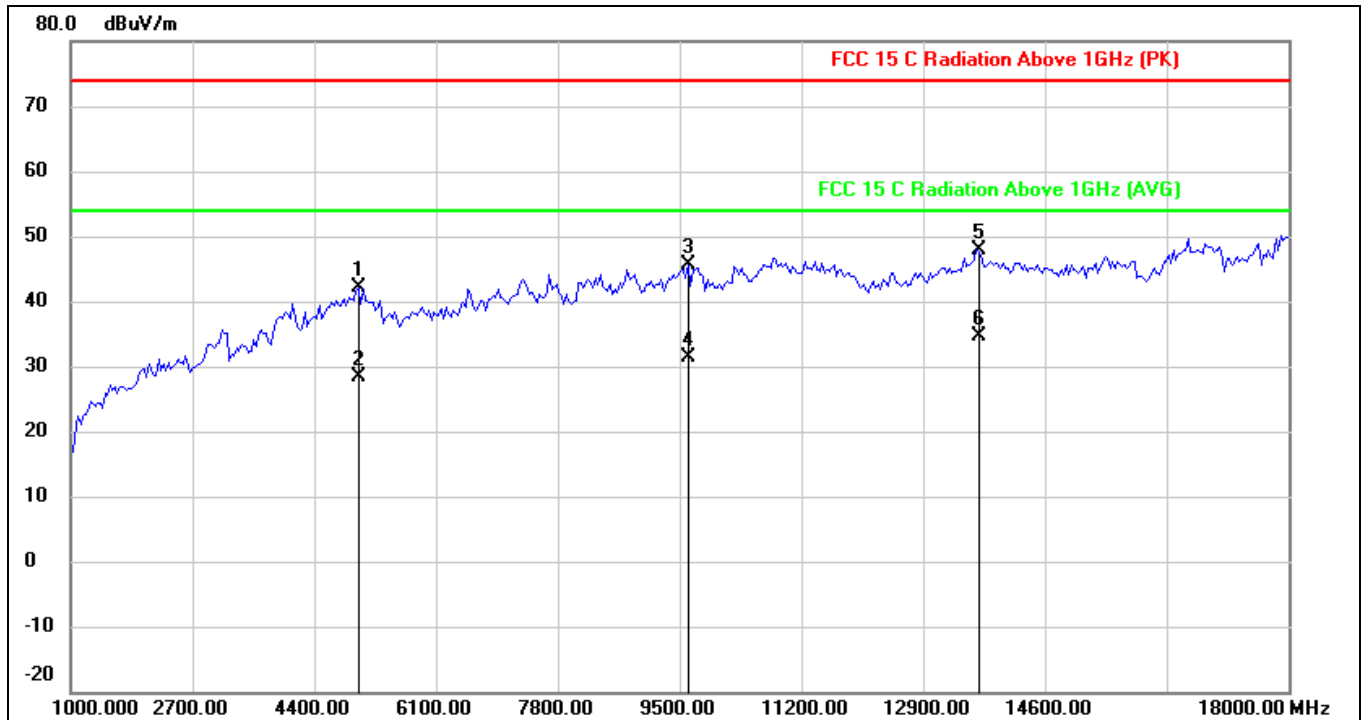


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		5633.266	51.38	-5.38	46.00	74.00	-28.00	peak
2		5633.266	36.28	-5.38	30.90	54.00	-23.10	AVG
3		10913.828	42.73	4.89	47.62	74.00	-26.38	peak
4	*	10913.828	28.61	4.89	33.50	54.00	-20.50	AVG
5		16501.002	45.55	4.58	50.13	74.00	-23.87	peak
6		16501.002	22.82	4.58	27.40	54.00	-26.60	AVG

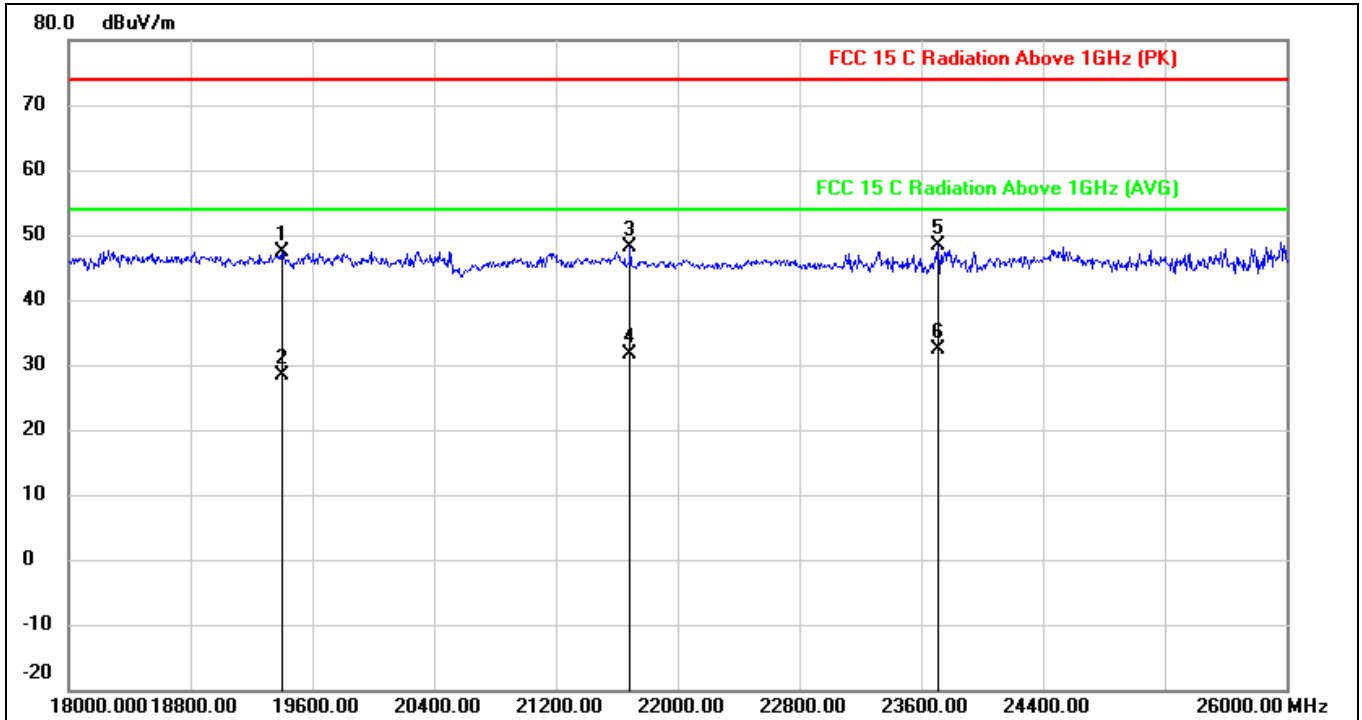


No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	
1		18992.000	28.77	19.12	47.89	74.00	-26.11	peak
2		18992.000	12.68	19.12	31.80	54.00	-22.20	AVG
3		21232.000	28.68	19.06	47.74	74.00	-26.26	peak
4		21232.000	12.94	19.06	32.00	54.00	-22.00	AVG
5		24744.000	30.88	19.79	50.67	74.00	-23.33	peak
6	*	24744.000	13.81	19.79	33.60	54.00	-20.40	AVG

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	H
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter AC 120V/60Hz
Test Mode :	TX-2462MHz		

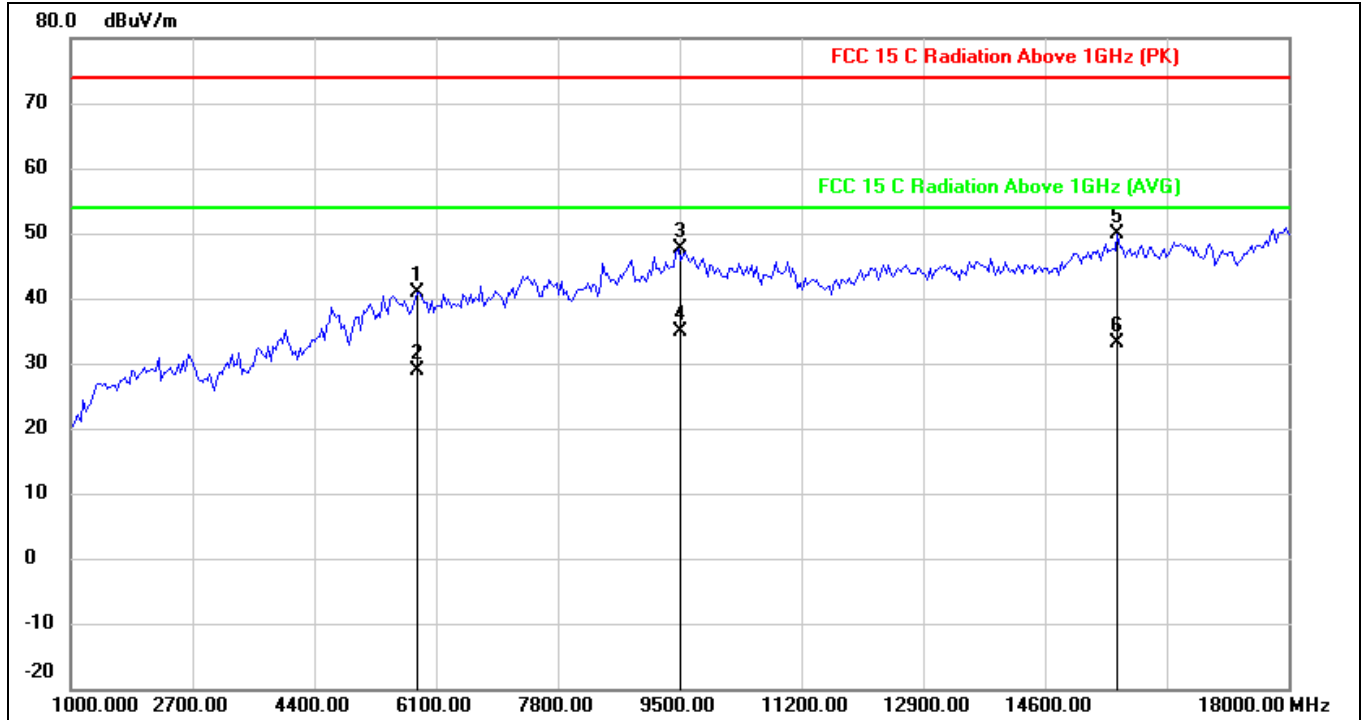


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		5020.040	48.99	-6.95	42.04	74.00	-31.96	peak
2		5020.040	35.45	-6.95	28.50	54.00	-25.50	AVG
3		9619.238	43.22	2.33	45.55	74.00	-28.45	peak
4		9619.238	29.07	2.33	31.40	54.00	-22.60	AVG
5		13639.279	42.51	5.33	47.84	74.00	-26.16	peak
6	*	13639.279	29.27	5.33	34.60	54.00	-19.40	AVG

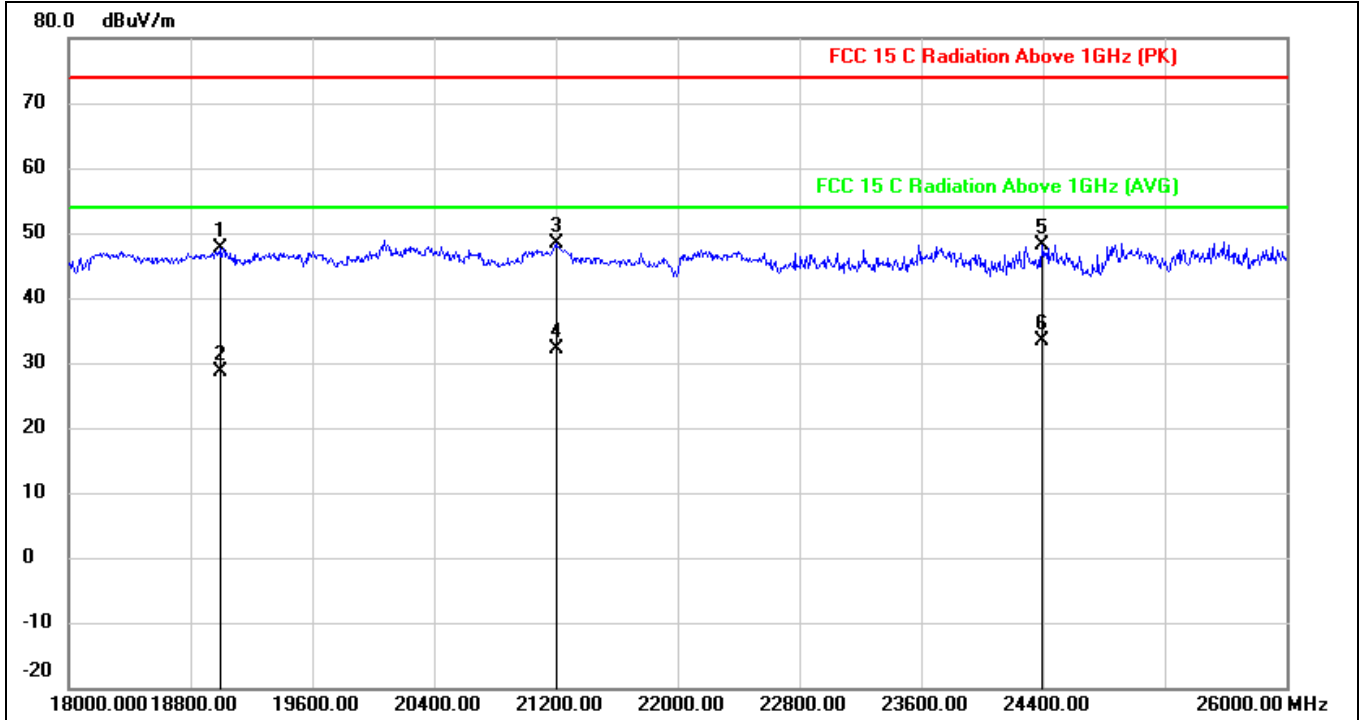


No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	
1		19400.000	28.38	19.01	47.39	74.00	-26.61	peak
2		19400.000	9.49	19.01	28.50	54.00	-25.50	AVG
3		21688.000	29.06	19.16	48.22	74.00	-25.78	peak
4		21688.000	12.54	19.16	31.70	54.00	-22.30	AVG
5		23712.000	28.93	19.57	48.50	74.00	-25.50	peak
6	*	23712.000	12.73	19.57	32.30	54.00	-21.70	AVG

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	V
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter AC 120V/60Hz
Test Mode :	TX-2462MHz		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		5837.675	46.05	-5.25	40.80	74.00	-33.20	peak
2		5837.675	34.15	-5.25	28.90	54.00	-25.10	AVG
3		9482.966	45.49	2.22	47.71	74.00	-26.29	peak
4	*	9482.966	32.68	2.22	34.90	54.00	-19.10	AVG
5		15615.230	45.72	4.05	49.77	74.00	-24.23	peak
6		15615.230	29.15	4.05	33.20	54.00	-20.80	AVG



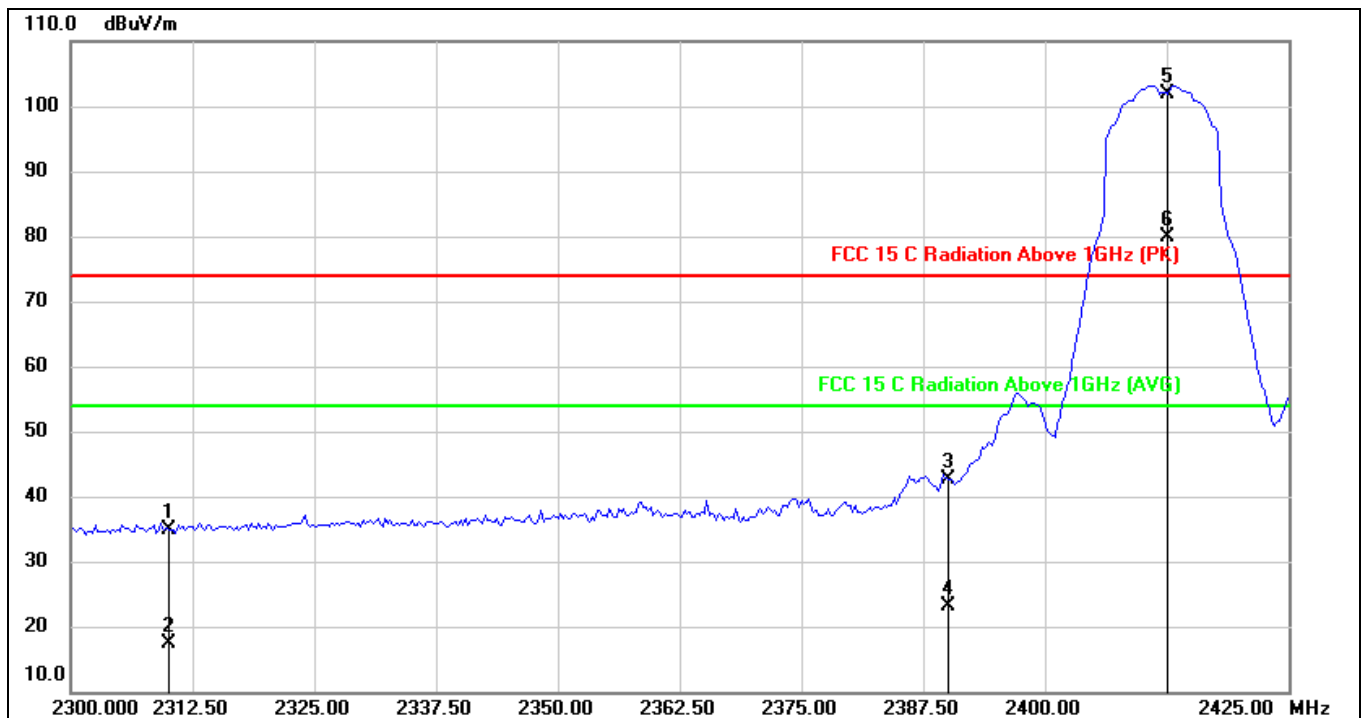
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		19000.000	28.46	19.14	47.60	74.00	-26.40	peak
2		19000.000	9.46	19.14	28.60	54.00	-25.40	AVG
3		21200.000	29.30	19.06	48.36	74.00	-25.64	peak
4		21200.000	13.04	19.06	32.10	54.00	-21.90	AVG
5		24392.000	28.53	19.71	48.24	74.00	-25.76	peak
6	*	24392.000	13.59	19.71	33.30	54.00	-20.70	AVG



5.5.4.2 Band edge - radiated

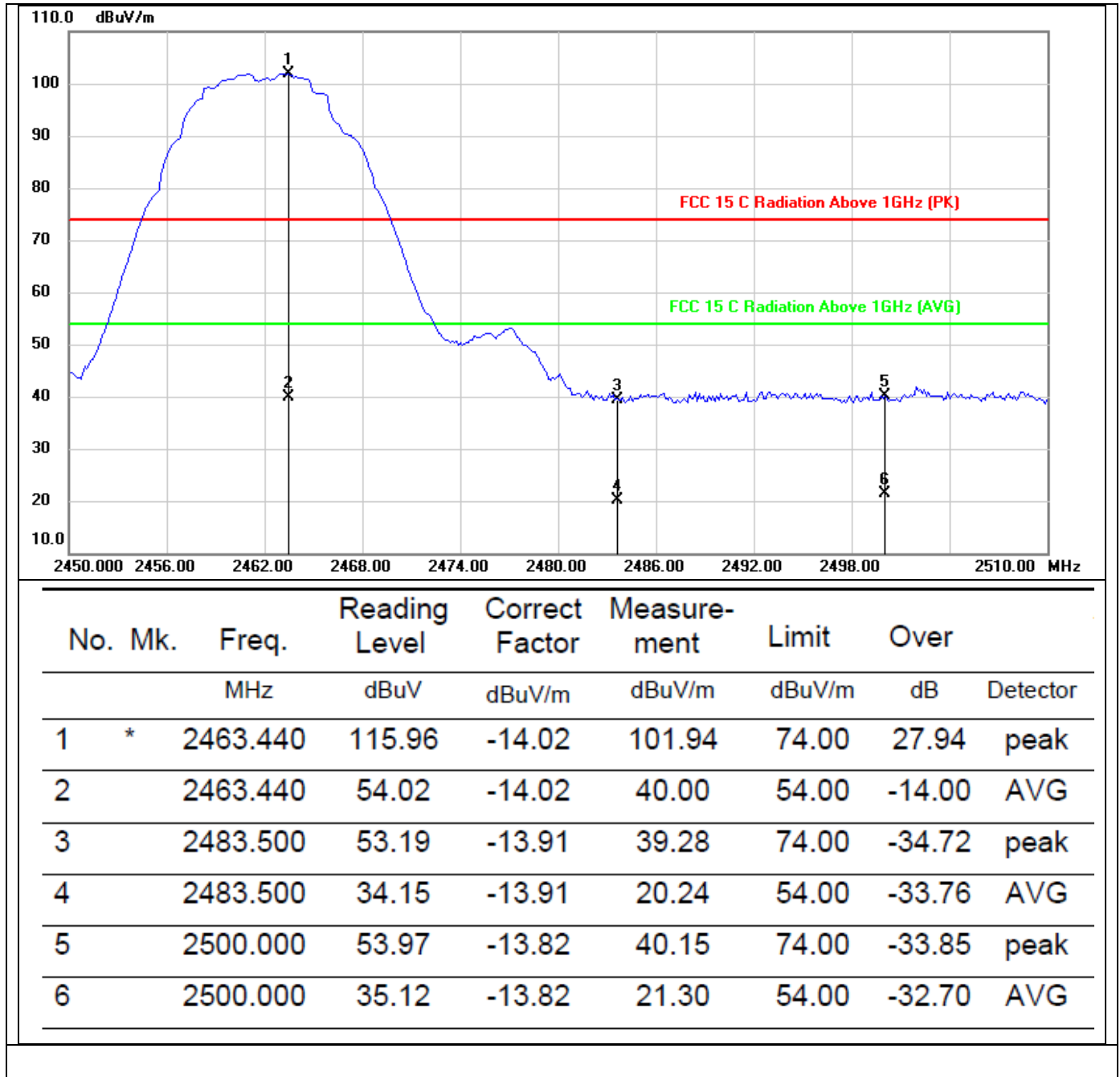
- Note: (1) Emission Level= Antenna Factor + Cable Loss + Read Level - Preamp Factor  
 (2) All other emissions more than 20dB below the limit.  
 (3) The three modulated high, medium and low channels have been tested. The report only shows the worst mode. The worst mode is 802.11b.  
 (4) Only shows the worst case, H and V.

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	H(worst case)
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter AC 120V/60Hz
Test Mode :	TX-802.11b-2412MHz		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		2310.000	49.83	-14.83	35.00	74.00	-39.00	peak
2		2310.000	32.15	-14.83	17.32	54.00	-36.68	AVG
3		2390.000	57.09	-14.41	42.68	74.00	-31.32	peak
4		2390.000	37.45	-14.41	23.04	74.00	-50.96	peak
5	*	2412.500	116.22	-14.29	101.93	74.00	27.93	peak
6	X	2412.500	94.29	-14.29	80.00	54.00	26.00	AVG

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	V(worst case)
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter AC 120V/60Hz
Test Mode :	TX-802.11b-2412MHz		



## 5.6 Band edge - Conducted

### 5.6.1 Limits

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)).

### 5.6.2 Test setup



### 5.6.3 Test procedure

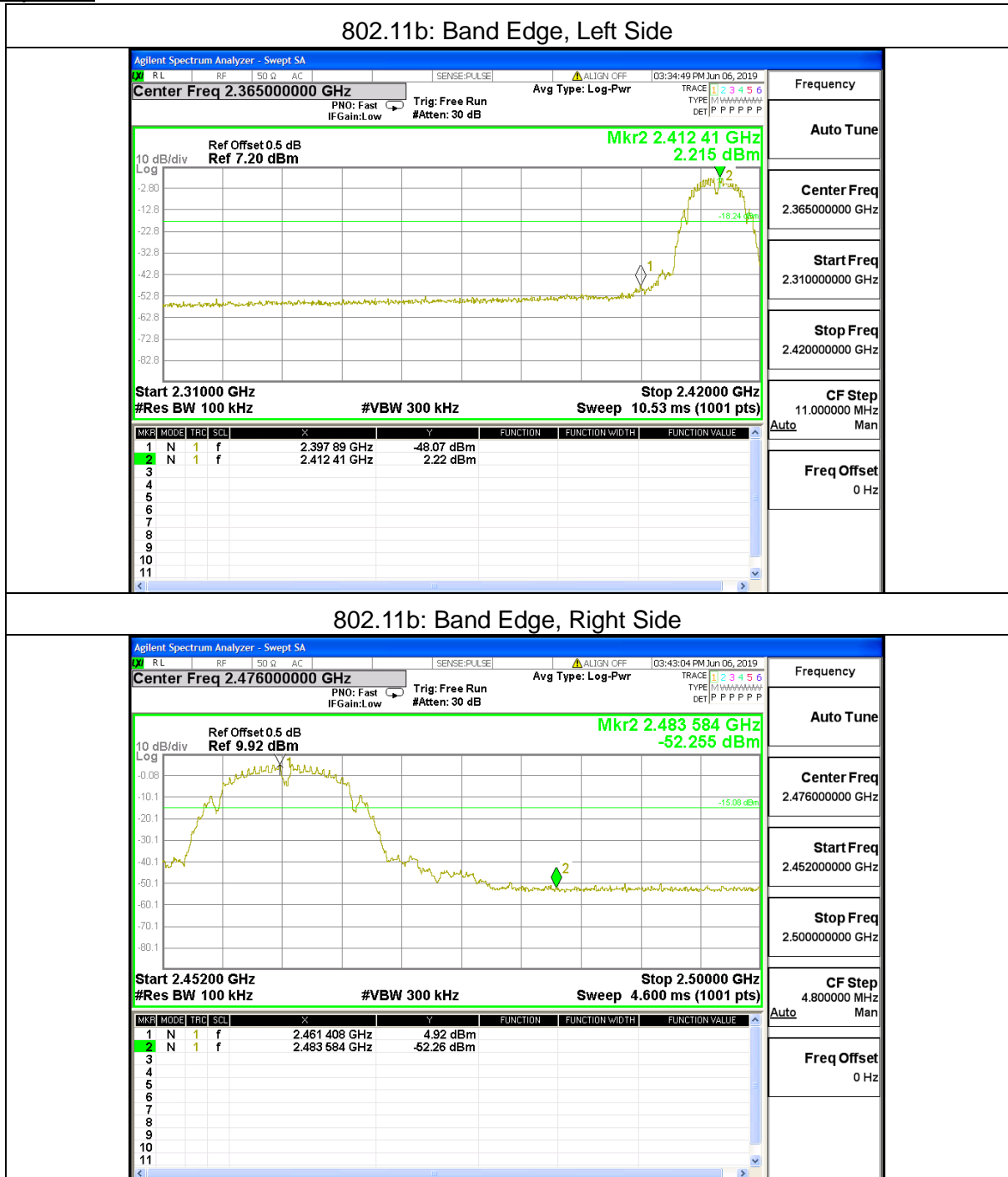
- a) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b) Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- c) Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- d) 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.
- e) Repeat above procedures until all measured frequencies were complete.

#### EUT OPERATION CONDITIONS

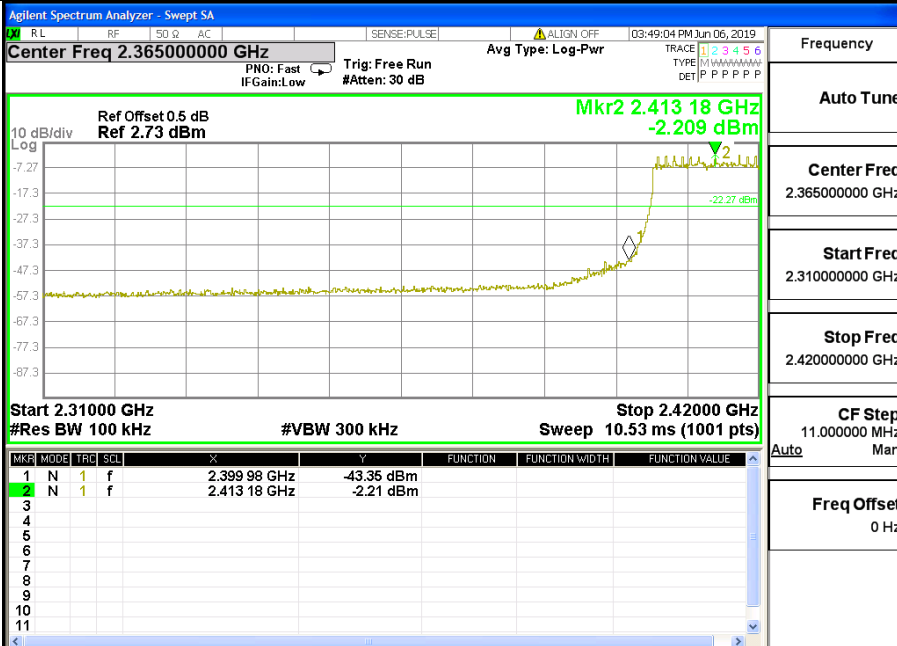
The EUT tested system was configured as the statements of 2.4 unless otherwise a special operating condition is specified in the follows during the testing.

5.6.4 Test results

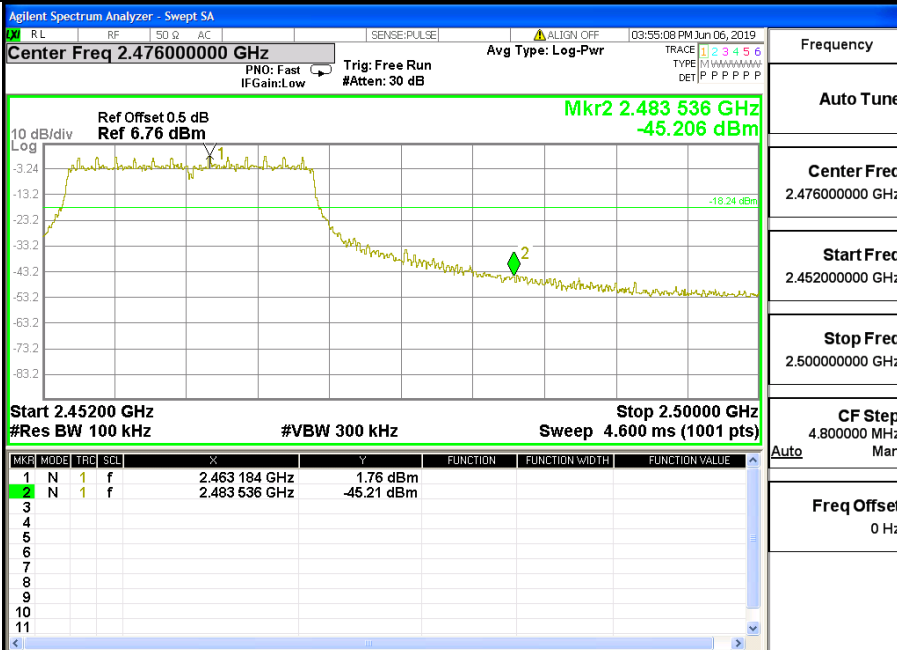
Test plots:



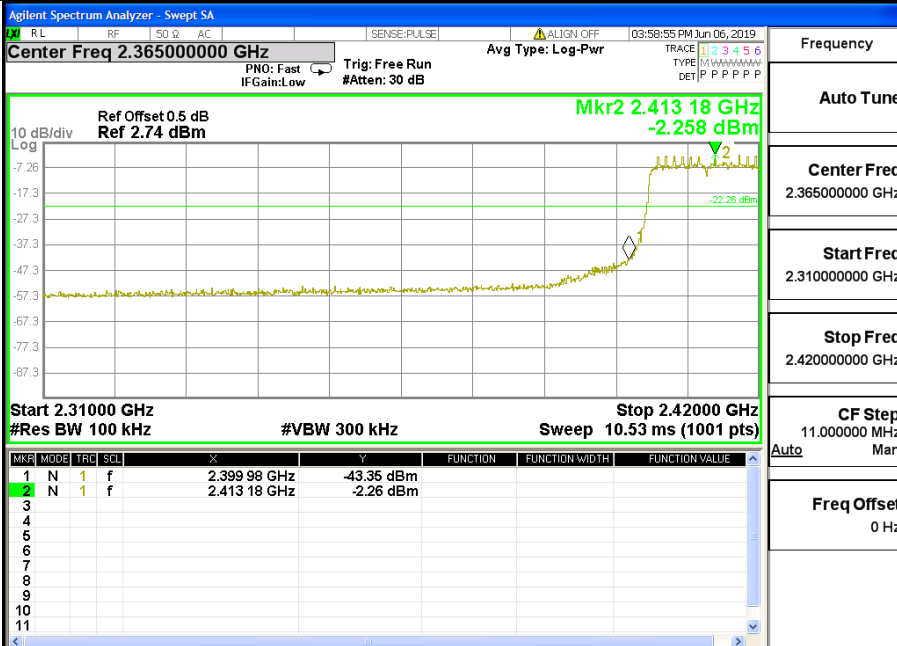
802.11g: Band Edge, Left Side



802.11g: Band Edge, Right Side

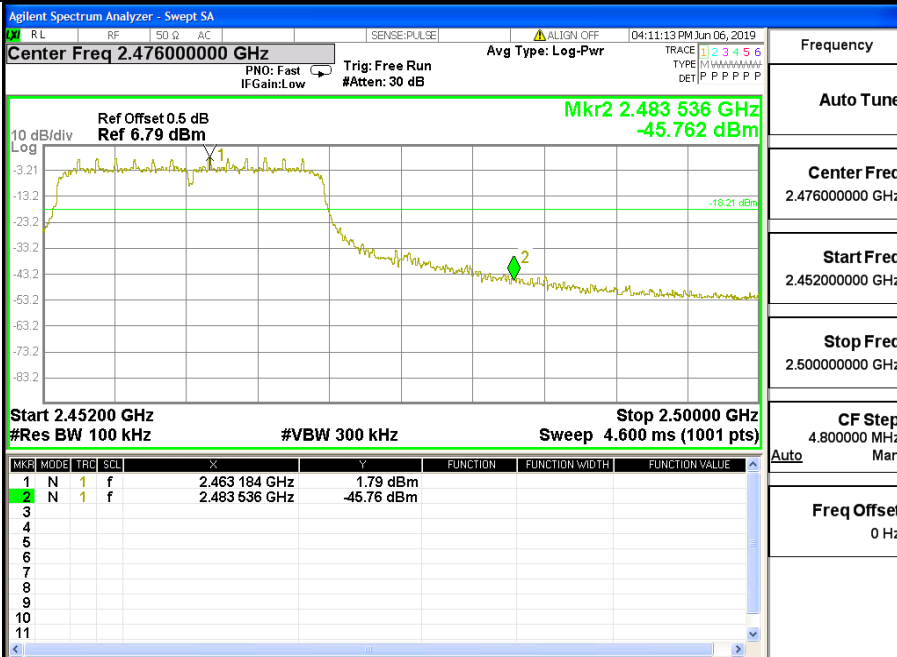


802.11n20: Band Edge, Left Side



Frequency	
Auto Tune	
Center Freq	2.365000000 GHz
Start Freq	2.310000000 GHz
Stop Freq	2.420000000 GHz
CF Step	11.000000 MHz
Auto	Man
Freq Offset	0 Hz

802.11n20: Band Edge, Right Side



Frequency	
Auto Tune	
Center Freq	2.476000000 GHz
Start Freq	2.452000000 GHz
Stop Freq	2.500000000 GHz
CF Step	4.800000 MHz
Auto	Man
Freq Offset	0 Hz

5.7 6dB bandwidth

5.7.1 Limit

FCC Part15 Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2)	Bandwidth	$\geq 500\text{KHz}$ (6dB bandwidth)	2400-2483.5	Pass

5.7.2 Test setup



5.7.3 Test procedure

- a. Set RBW= 100 kHz.
- b. Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.
- c. Detector = Peak.
- d. Trace mode = max hold.
- e. Sweep = auto couple.
- f. Allow the trace to stabilize.
- g. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

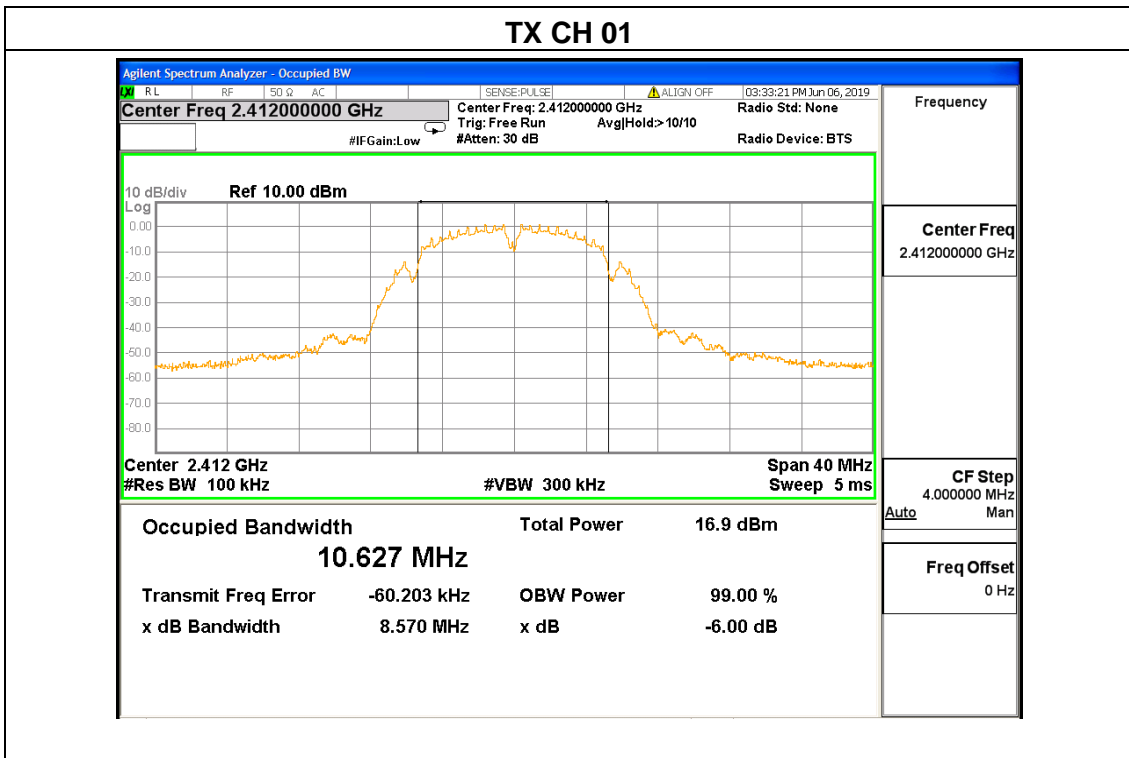
EUT Operation Conditions

The EUT tested system was configured as the statements of 2.4 unless otherwise a special operating condition is specified in the follows during the testing.

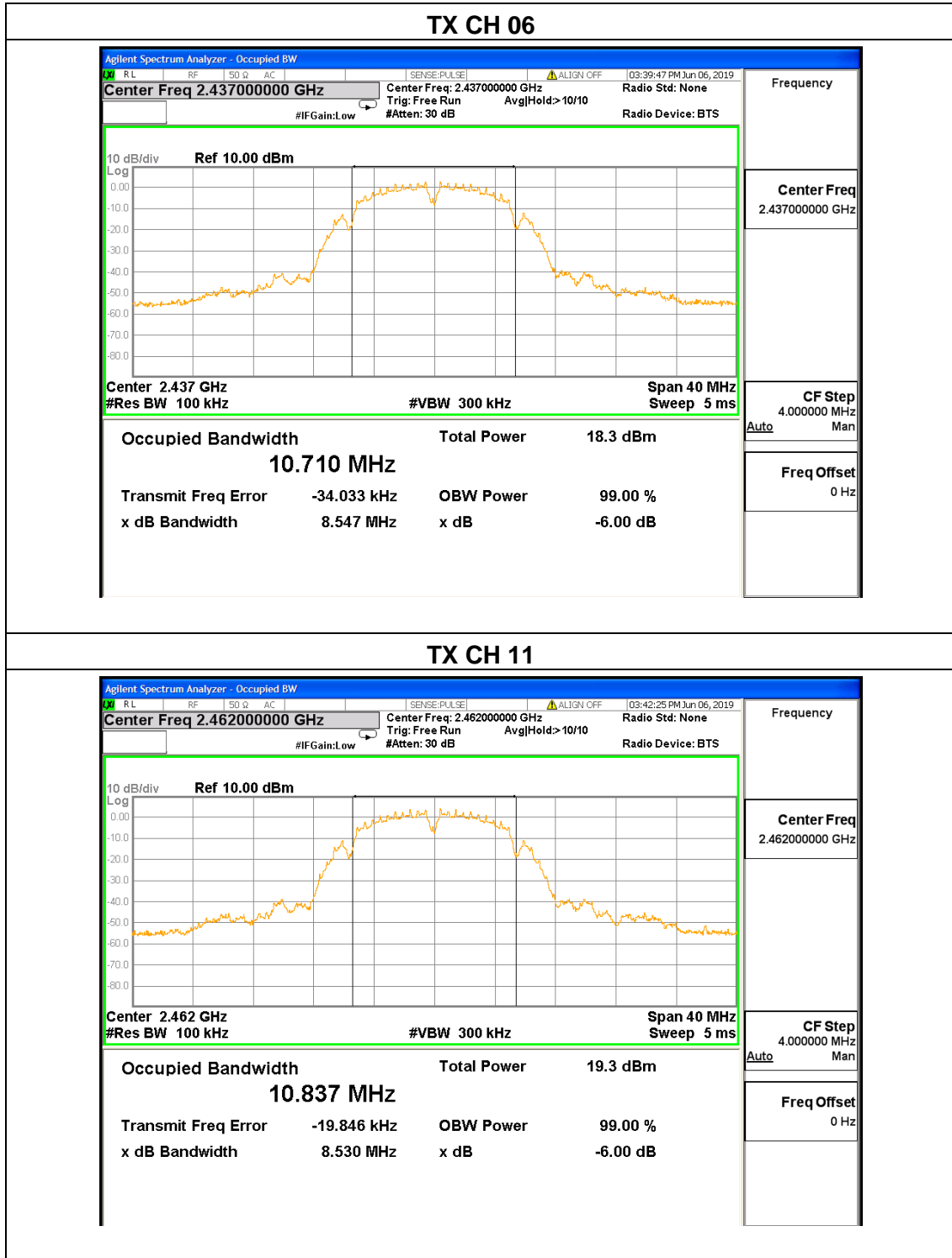
5.7.4 Test results

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Temperature :	25 °C	Relative Humidity :	60%
Pressure :	1012 hPa	Test Voltage :	DC 5V from USB port
Test Mode :	TX b Mode /CH01, CH06, CH11		

Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
Low	2412	8.570	500	Pass
Middle	2437	8.547	500	Pass
High	2462	8.530	500	Pass

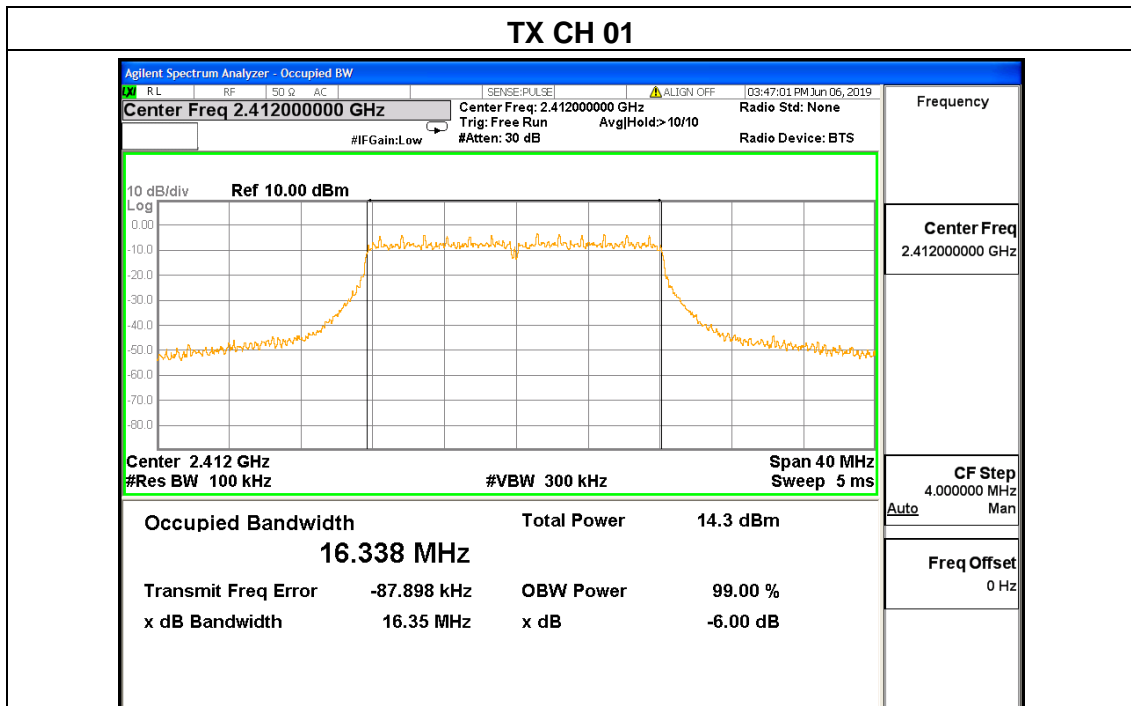


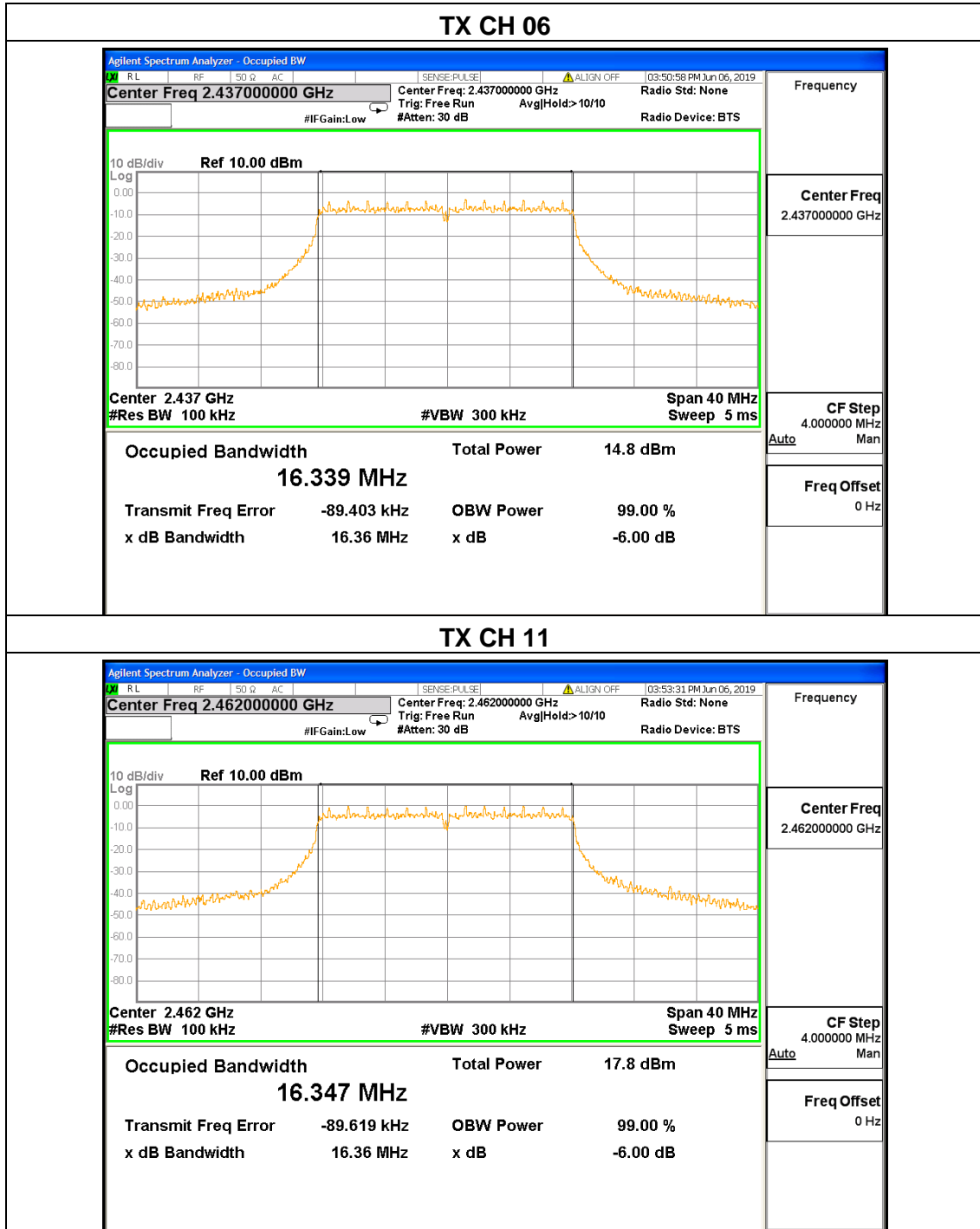




EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Temperature :	25 °C	Relative Humidity :	60%
Pressure :	1012 hPa	Test Voltage :	DC 5V from USB port
Test Mode :	TX g Mode /CH01, CH06, CH11		

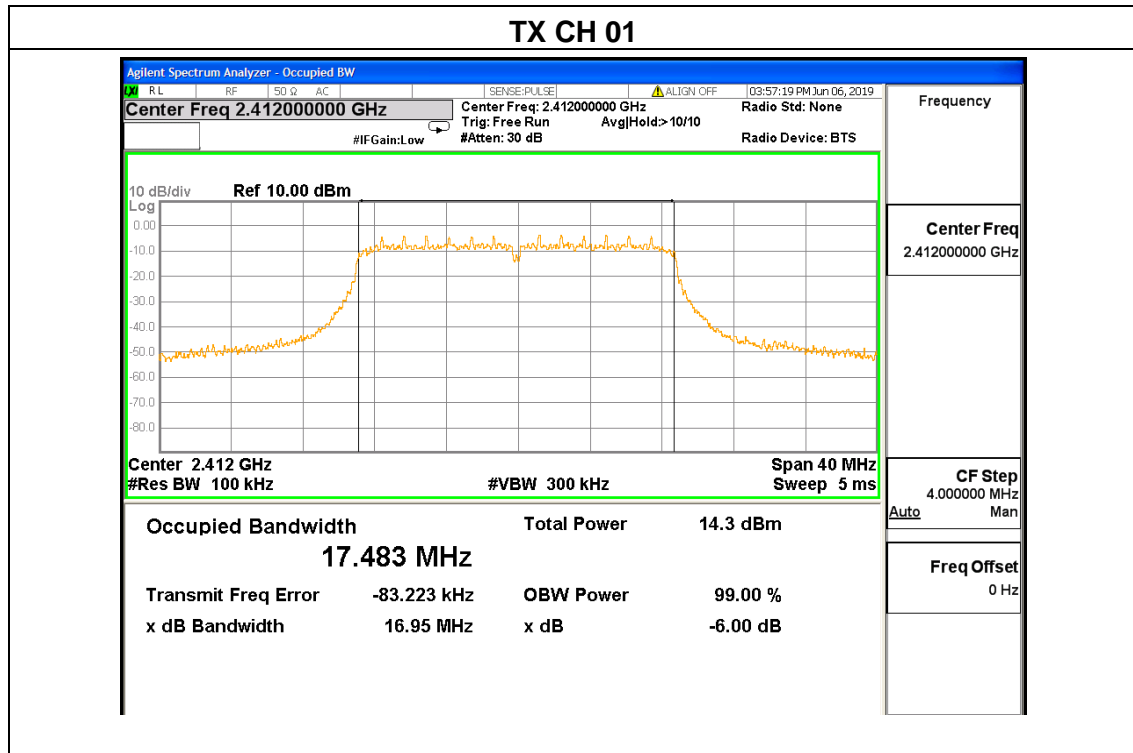
Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
Low	2412	16.35	500	Pass
Middle	2437	16.36	500	Pass
High	2462	16.36	500	Pass

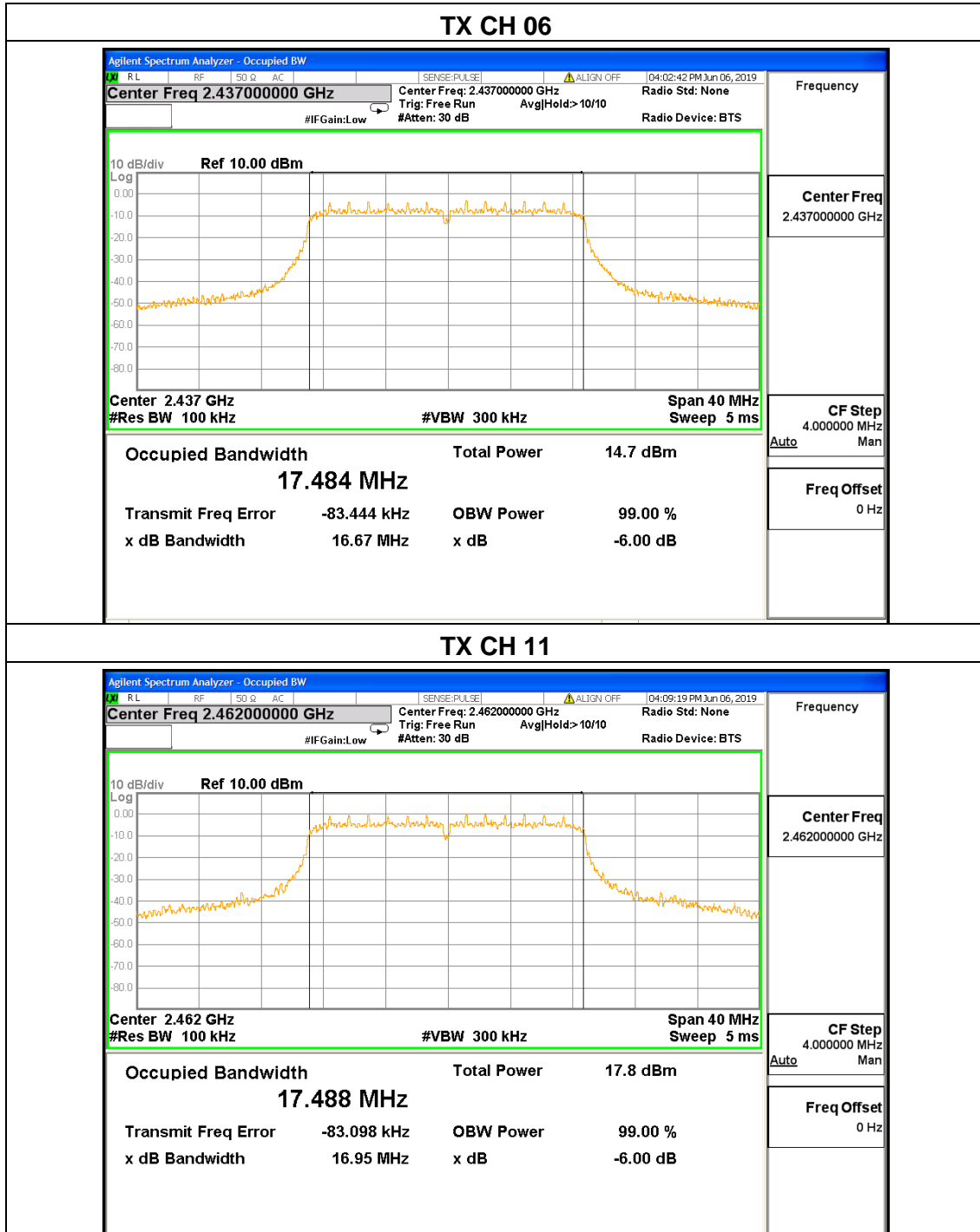




EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Temperature :	25 °C	Relative Humidity :	60%
Pressure :	1012 hPa	Test Voltage :	DC 5V from USB port
Test Mode :	TX n20 Mode /CH01, CH06, CH11		

Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
Low	2412	16.95	500	Pass
Middle	2437	16.67	500	Pass
High	2462	16.95	500	Pass





## 5.8 Duty Cycle

### 5.8.1 Conformance Limit

No limit requirement.

### 5.8.2 Measuring Instruments

The Measuring equipment is listed in the section 4 of this test report.

### 5.8.3 Test Setup



### 5.8.4 Test Procedure

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

The transmitter output is connected to the Spectrum Analyzer. We tested according to the zero-span measurement method, 6.0(b) in KDB 558074

The largest available value of RBW is 8 MHz and VBW is 50 MHz. The zero-span method of measuring duty cycle shall not be used if  $T \leq 6.25$  microseconds. ( $50/6.25 = 8$ )

The zero-span method was used because all measured T data are  $> 6.25$  microseconds and both RBW and VBW are  $> 50/T$ .

The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.

The path loss was compensated to the results for each measurement.

Set to the maximum power setting and enable the EUT transmit continuously.

The EUT was operating in controlled its channel.

Use the following spectrum analyzer settings:

Span = Zero Span

RBW = 8MHz (the largest available value)

VBW = 8MHz ( $\geq$  RBW)

Number of points in Sweep  $> 100$

Detector function = peak

Trace = Clear write

Measure Ttotal and Ton

Calculate Duty Cycle =  $Ton / Ttotal$

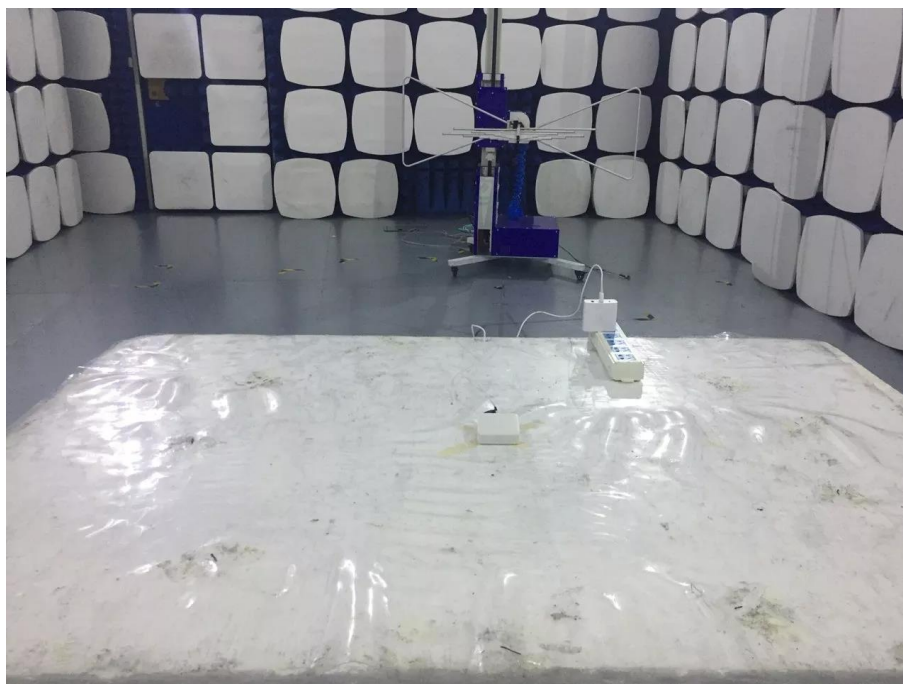
5.8.5 Test Results

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Pressure:	1012 hPa	Test Voltage:	DC 5V from USB port
Test Mode:	TX b/g/n(20) Mode / CH06		

Mode	Data rate	Channel	Ton	Ttotal	Duty Cycle	Duty Cycle Factor (dB)	VBW Setting
802.11b	1Mbps	6	-	-	100%	0	10Hz
802.11g	6Mbps	6	-	-	100%	0	10Hz
802.11n HT20	MCS0	6	-	-	100%	0	10Hz

**Photographs of the Test Setup**

Radiated emission





Conducted emission



**Photographs of the EUT**

See the APPENDIX 1: EUT PHOTO in the report No.: MTi190614E105-1.

**----END OF REPORT----**