

Test Report

FCC ID: 2AKXB-W0202200

Date of issue: July 31, 2019

Report Number:	MTi190614E105
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

1. GENERAL INFORMATION	5
1.1. DESCRIPTION OF EUT	5
1.2. OPERATION CHANNEL LIST	5
1.3. TEST CHANNEL LIST	5
1.4. ANCILLARY EQUIPMENT LIST	6
1.5. DESCRIPTION OF SUPPORT UNITS	6
2. SUMMARY OF TEST RESULTS	7
3. TEST FACILITIES AND ACCREDITATIONS	8
3.1. TEST LABORATORY	8
3.2. ENVIRONMENTAL CONDITIONS	8
3.3. MEASUREMENT UNCERTAINTY	8
3.4. TEST SOFTWARE	8
4. EQUIPMENT LIST	9
5. TEST RESULT	10
5.1. ANTENNA REQUIREMENT	10
5.1.1 <i>Standard requirement</i>	10
5.1.2 <i>EUT Antenna</i>	10
5.2. PEAK OUTPUT POWER TEST	11
5.2.1 <i>Limit</i>	11
5.2.2 <i>Test setup</i>	11
5.2.3 <i>Test procedure</i>	11
5.2.4 <i>EUT operation condition</i>	11
5.2.5 <i>Test results</i>	11
5.3. CONDUCTED EMISSION	14
5.3.1 <i>Limits</i>	14
5.3.2 <i>Test setup</i>	14
5.3.3 <i>Test procedure</i>	15
5.3.4 <i>Test results</i>	15
5.4. RADIATED SPURIOUS EMISSION	20
5.4.1 <i>Limits</i>	20
5.4.2 <i>Test setup</i>	21
5.4.3 <i>Test procedure</i>	22
5.4.4 <i>Test results</i>	23
5.4.4.1 <i>Radiation emission</i>	23
5.4.4.2 <i>Bandedge-Radiated</i>	37
5.5. POWER SPECTRAL DENSITY TEST	41
5.5.1 <i>Limit</i>	41
5.5.2 <i>Test procedure</i>	41
5.5.3 <i>Test setup</i>	41
5.5.4 <i>EUT operation conditions</i>	41
5.5.5 <i>Test results</i>	42
5.6. 6DB BANDWIDTH	44
5.6.1 <i>Limit</i>	44
5.6.2 <i>TEST PROCEDURE</i>	44
5.6.3 <i>TEST SETUP</i>	44
5.6.4 <i>EUT operation conditions</i>	44
5.6.5 <i>Test Result</i>	44
5.7. DUTY CYCLE	47
5.7.1 <i>Conformance Limit</i>	47
5.7.2 <i>Measuring Instruments</i>	47
5.7.3 <i>Test Setup</i>	47

5.7.4	Test Procedure.....	47
5.7.5	Test Results.....	48
5.8	CONDUCTED BANDEDGE	49
5.8.1	Limits.....	49
5.8.2	Test setup	49
5.8.3	Test procedure.....	49
5.8.4	EUT operation conditions.....	49
5.8.5	Test Result	49
PHOTOGRAPHS OF THE TEST SETUP		51
PHOTOGRAPHS OF THE EUT.....		53

PRODUCT INFORMATION

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) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

Tested by:

Jone Lee

Jone Lee

July 31, 2019

Reviewed by:

Blue Zheng

Blue Zheng

July 31, 2019

Approved by:

Smith Chen

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
Difference in series models:	All the model are the same circuit and RF module, except the model No. and color.
Operation frequency:	2402-2480MHz
Modulation type:	GFSK
Bit Rate of transmitter:	1 Mbps
Antenna type:	PIFA Antenna
Antenna gain:	3.66dBi
Max. output power:	-5.573dBm
Hardware version:	V1.0
Software version:	V1.0
Power supply:	DC 5V from adapter
Adapter information:	N/A
Battery:	N/A

1.2. Operation channel list

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

1.3. Test channel list

Channel	Channel	Frequency (MHz)
---------	---------	-----------------

Low	00	2402
Middle	19	2440
High	39	2480

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	15.207	Conducted Emission	Pass	
4	15.247 (d) & 15.209	Radiated Spurious Emission	Pass	
5	15.247 (e)	Power Spectral Density	Pass	
6	15.247 (a)(2)	6dB Bandwidth	Pass	
7	558074 D01 15.247 Meas Guidance v05r02 Chapter 6	Duty Cycle	Pass	
8	15.247(d)	Band Edge Emission	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-E004	EMI Test Receiver	Rohde&schwarz	ESPI	1000314	2018/09/18	2019/09/17
MTI-E006	Broadband antenna	schwarzbeck	VULB9163	872	2018/09/18	2019/09/17
MTI-E007	Horn antenna	schwarzbeck	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	16I00054SN016	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	Schwarzbeck	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	Schwarzbeck	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 test

5.2.1 Limit

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

5.2.2 Test setup



5.2.3 Test procedure

- (1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- (2) Spectrum Setting:
 RBW=1MHz, VBW=3MHz, Detector=Peak (If 20dB BW ≤1 MHz)
 RBW=3MHz, VBW=8MHz, Detector=Peak (If 20dB BW > 1 MHz)
- (3) The EUT was set to continuously transmitting in the max power during the test.

5.2.4 EUT operation condition

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.

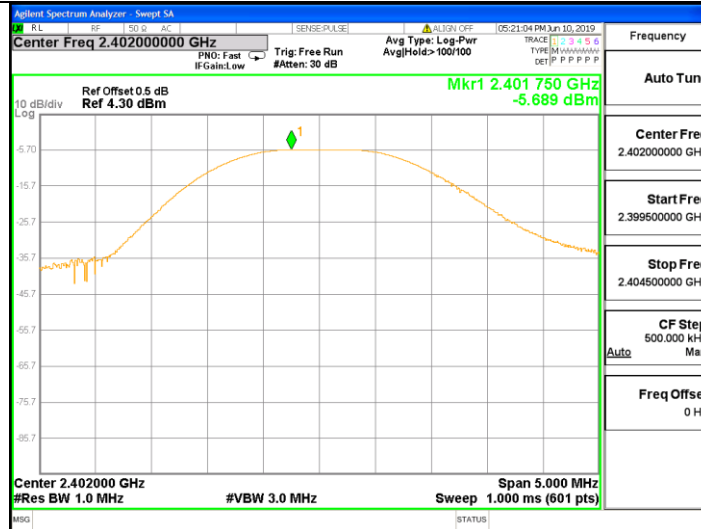
5.2.5 Test results

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Temperature :	25 °C	Relative Humidity :	60%
Pressure :	1012 hPa	Test Voltage :	DC 5V from USB port

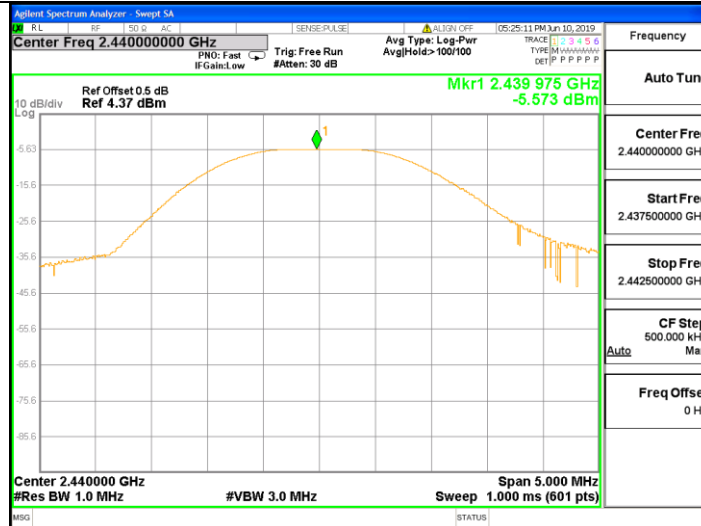
TX BLE mode

Test Channel	Frequency	Maximum Conducted Output Power(PK)	Limit
	(MHz)	(dBm)	dBm
CH00	2402	-5.689	30
CH19	2440	-5.573	30
CH39	2480	-6.113	30

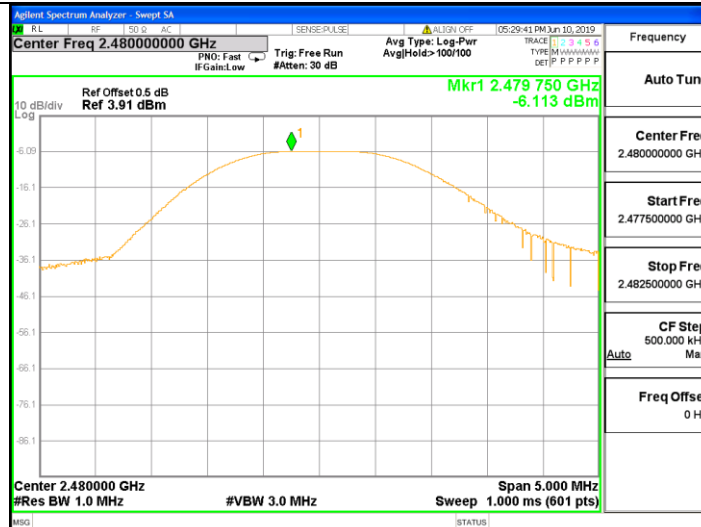
2402MHz



2440MHz



2480MHz



5.3. Conducted emission

5.3.1 Limits

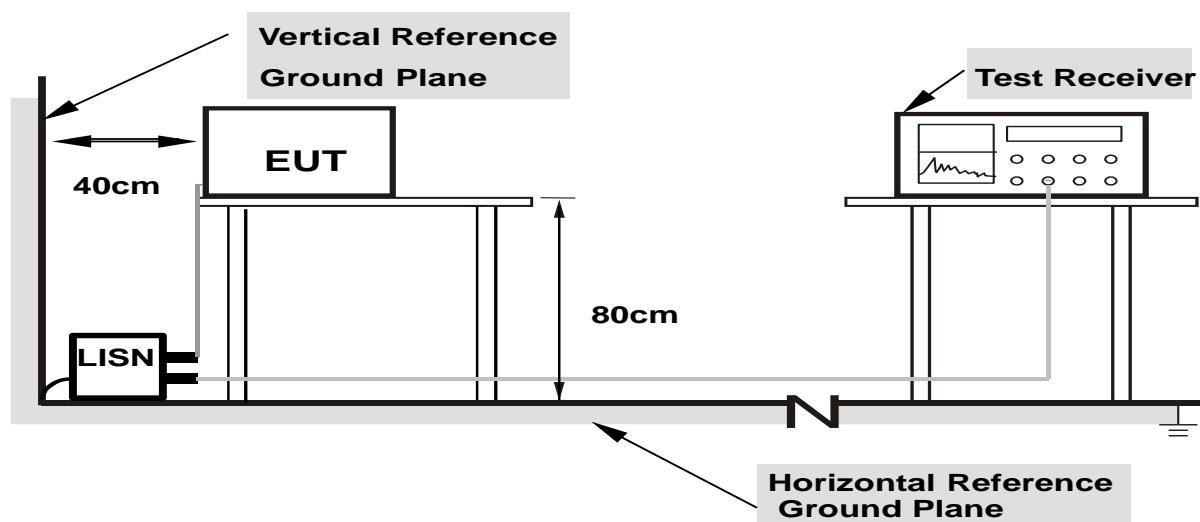
FREQUENCY (MHz)	Class B (dBuV)	
	Quasi-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

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.

5.3.2 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

5.3.3 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

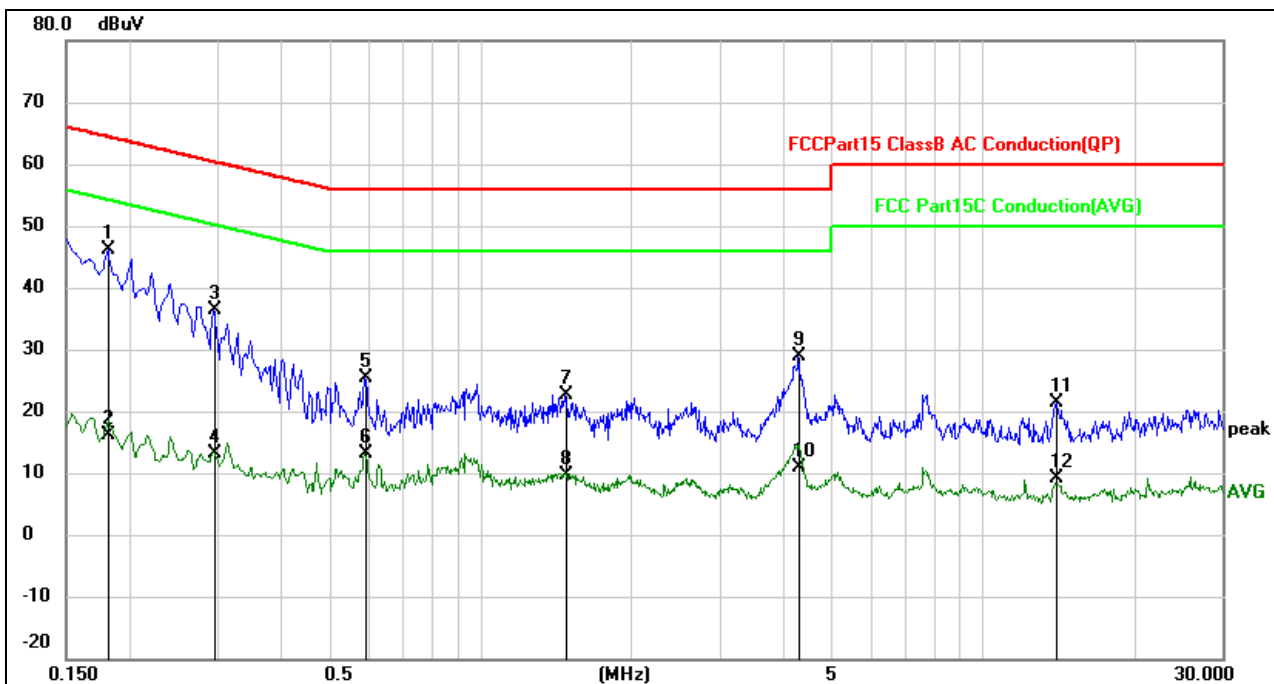
- c. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- 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.

5.3.4 Test results

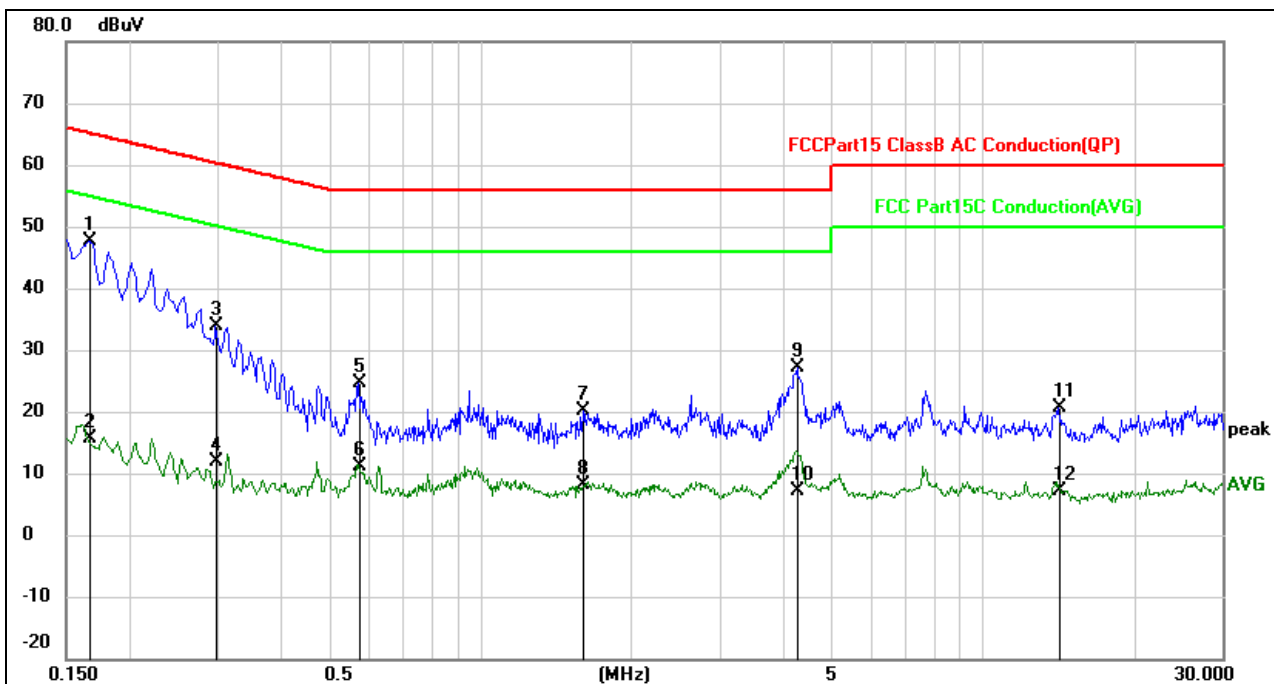
Test data

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



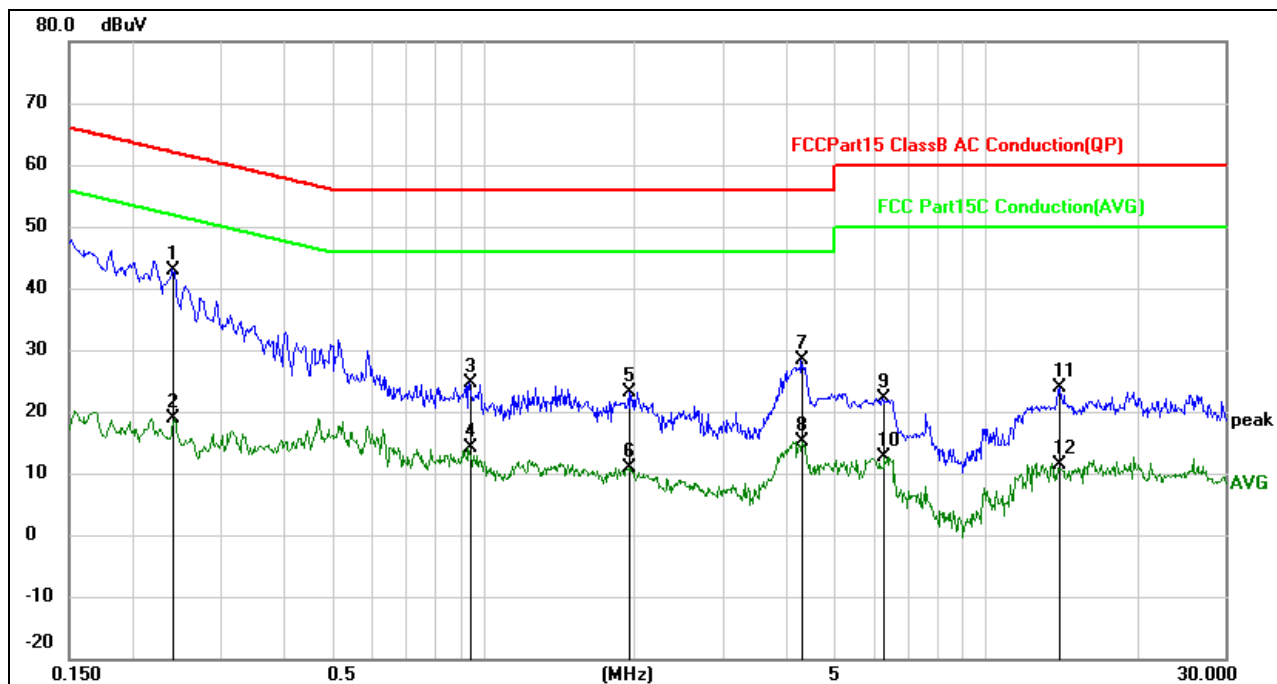
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1	*	0.1819	36.47	9.73	46.20	64.40	-18.20	QP	
2		0.1819	6.29	9.73	16.02	54.40	-38.38	AVG	
3		0.2940	26.62	9.75	36.37	60.41	-24.04	QP	
4		0.2940	3.31	9.75	13.06	50.41	-37.35	AVG	
5		0.5899	15.54	9.89	25.43	56.00	-30.57	QP	
6		0.5899	3.17	9.89	13.06	46.00	-32.94	AVG	
7		1.4740	12.67	9.96	22.63	56.00	-33.37	QP	
8		1.4740	-0.27	9.96	9.69	46.00	-36.31	AVG	
9		4.3100	18.86	10.03	28.89	56.00	-27.11	QP	
10		4.3100	0.86	10.03	10.89	46.00	-35.11	AVG	
11		14.0060	11.17	10.21	21.38	60.00	-38.62	QP	
12		14.0060	-1.15	10.21	9.06	50.00	-40.94	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



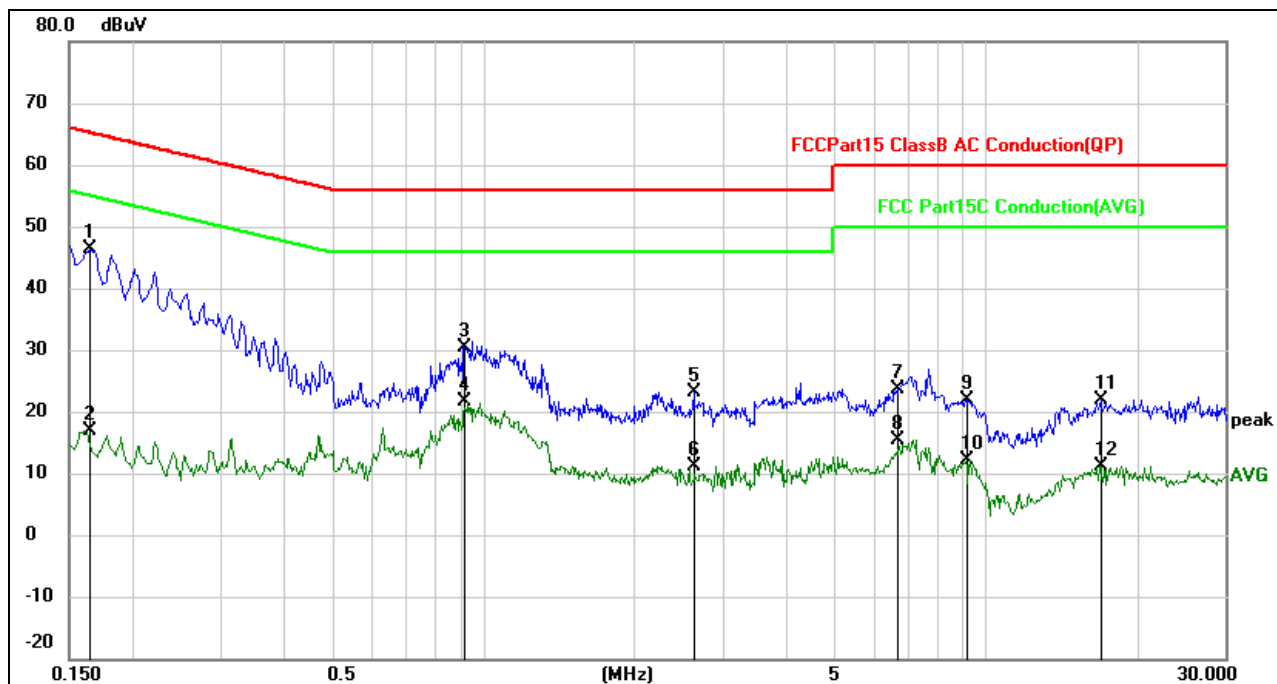
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1	*	0.1660	37.86	9.73	47.59	65.16	-17.57	QP	
2		0.1660	5.98	9.73	15.71	55.16	-39.45	AVG	
3		0.2980	24.23	9.76	33.99	60.30	-26.31	QP	
4		0.2980	2.18	9.76	11.94	50.30	-38.36	AVG	
5		0.5740	14.79	9.89	24.68	56.00	-31.32	QP	
6		0.5740	1.21	9.89	11.10	46.00	-34.90	AVG	
7		1.6019	10.10	9.96	20.06	56.00	-35.94	QP	
8		1.6019	-1.84	9.96	8.12	46.00	-37.88	AVG	
9		4.2900	17.08	10.03	27.11	56.00	-28.89	QP	
10		4.2900	-3.00	10.03	7.03	46.00	-38.97	AVG	
11		14.1500	10.39	10.21	20.60	60.00	-39.40	QP	
12		14.1500	-3.02	10.21	7.19	50.00	-42.81	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.	Reading Level	Correct Factor	Measurement	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.2404	33.27	9.73	43.00	62.08	-19.08	QP	
2		0.2404	9.20	9.73	18.93	52.08	-33.15	AVG	
3		0.9418	14.71	9.94	24.65	56.00	-31.35	QP	
4		0.9418	4.12	9.94	14.06	46.00	-31.94	AVG	
5		1.9538	13.27	9.97	23.24	56.00	-32.76	QP	
6		1.9538	0.90	9.97	10.87	46.00	-35.13	AVG	
7		4.3100	18.36	10.03	28.39	56.00	-27.61	QP	
8		4.3100	5.11	10.03	15.14	46.00	-30.86	AVG	
9		6.2419	12.06	10.11	22.17	60.00	-37.83	QP	
10		6.2419	2.57	10.11	12.68	50.00	-37.32	AVG	
11		14.0059	13.67	10.21	23.88	60.00	-36.12	QP	
12		14.0059	1.29	10.21	11.50	50.00	-38.50	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	*	0.1650	36.65	9.73	46.38	65.21	-18.83	QP	
2		0.1650	7.04	9.73	16.77	55.21	-38.44	AVG	
3		0.9140	20.56	9.94	30.50	56.00	-25.50	QP	
4		0.9140	11.66	9.94	21.60	46.00	-24.40	AVG	
5		2.6300	13.16	9.99	23.15	56.00	-32.85	QP	
6		2.6300	1.03	9.99	11.02	46.00	-34.98	AVG	
7		6.6977	13.62	10.13	23.75	60.00	-36.25	QP	
8		6.6977	5.36	10.13	15.49	50.00	-34.51	AVG	
9		9.1659	11.56	10.25	21.81	60.00	-38.19	QP	
10		9.1659	1.79	10.25	12.04	50.00	-37.96	AVG	
11		16.9459	11.85	10.15	22.00	60.00	-38.00	QP	
12		16.9459	1.05	10.15	11.20	50.00	-38.80	AVG	

5.4 Radiated spurious emission

5.4.1 Limits

Frequency (MHz)	Field Strength (micorvolts/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

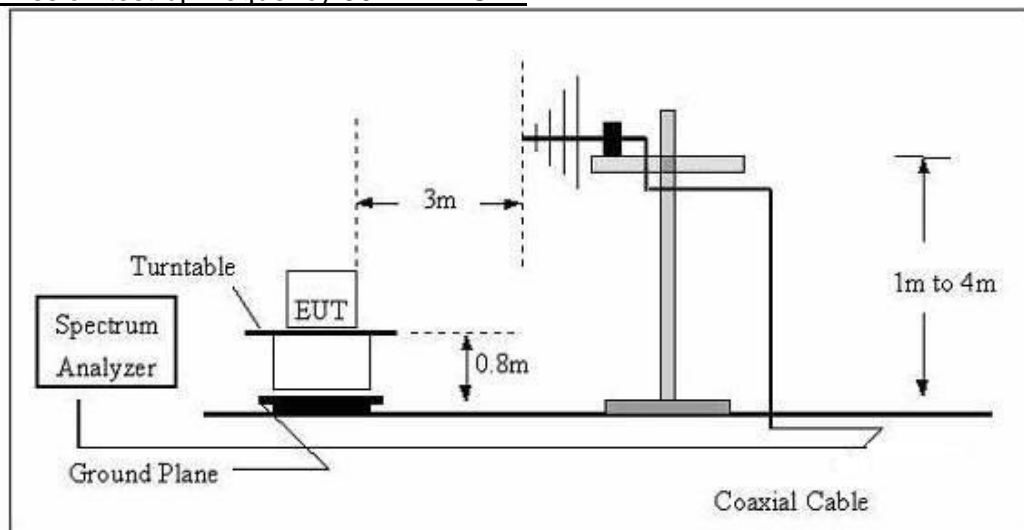
Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic

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

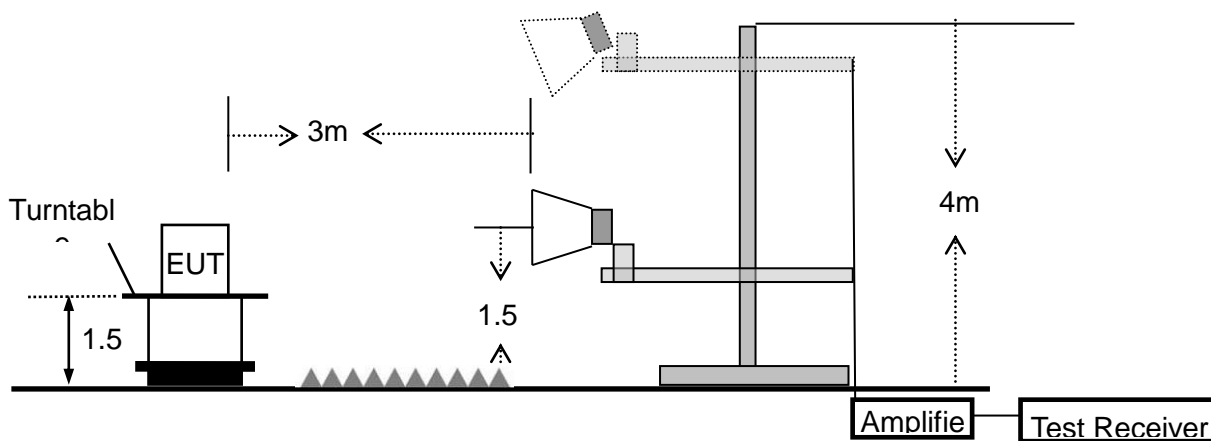
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

5.4.2 Test setup

Radiated emission test-up frequency 30MHz~1GHz



Radiated emission test-up frequency above 1GHz



5.4.3 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 shield 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 1 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. 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.

5.4.4 Test results

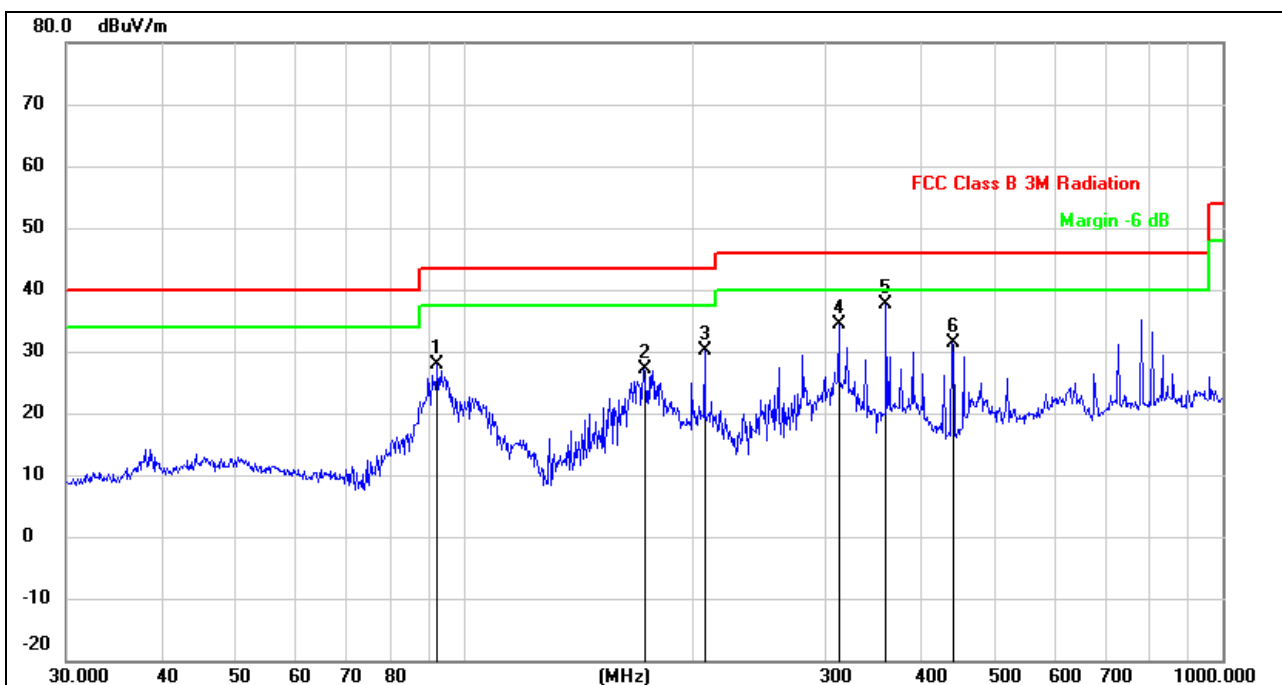
5.4.4.1 Radiation emission

Between 30MHz – 1GHz:

Note: The high, medium and low channels have been tested. The report only shows the worst mode. The worst mode is CH39.

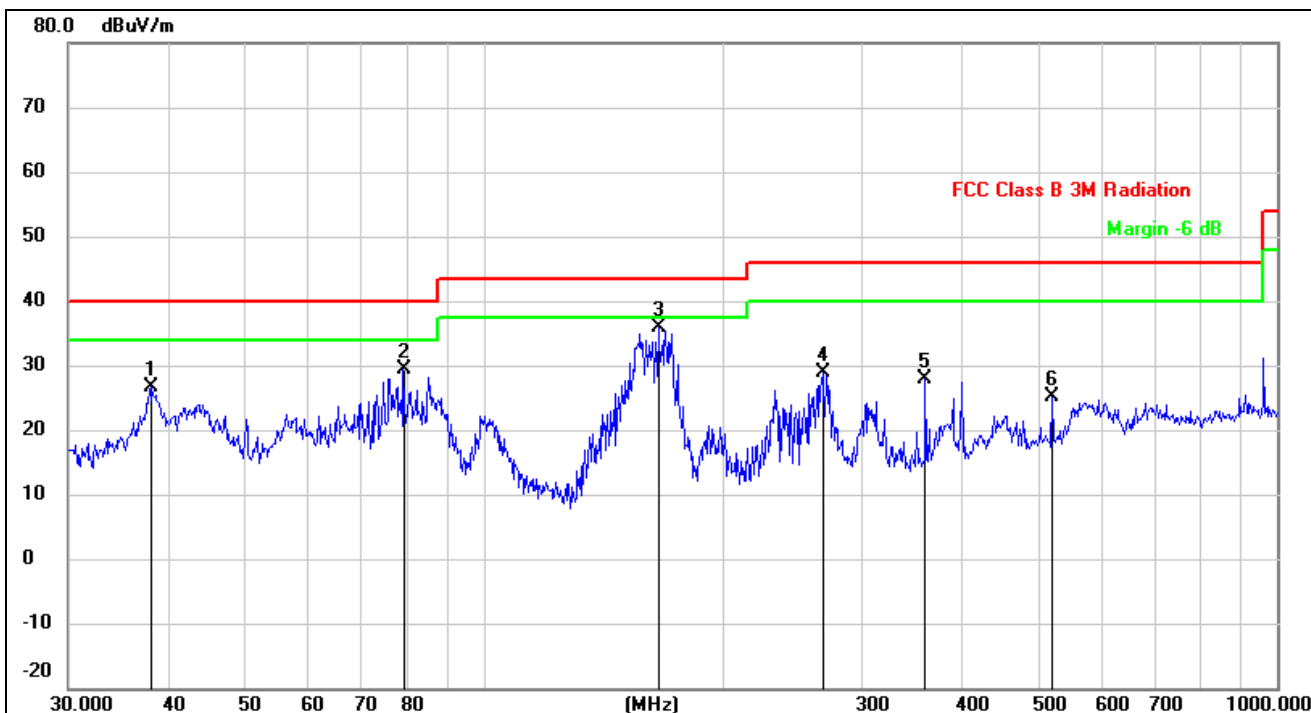
EUT has two different voltage supports, reporting only the worst voltage mode

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



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		92.4624	43.13	-15.31	27.82	43.50	-15.68	QP
2		172.5988	42.55	-15.40	27.15	43.50	-16.35	QP
3		207.8501	43.05	-12.99	30.06	43.50	-13.44	QP
4		312.1794	45.24	-10.79	34.45	46.00	-11.55	QP
5	*	360.4476	47.52	-9.80	37.72	46.00	-8.28	QP
6		440.1963	40.45	-8.98	31.47	46.00	-14.53	QP

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



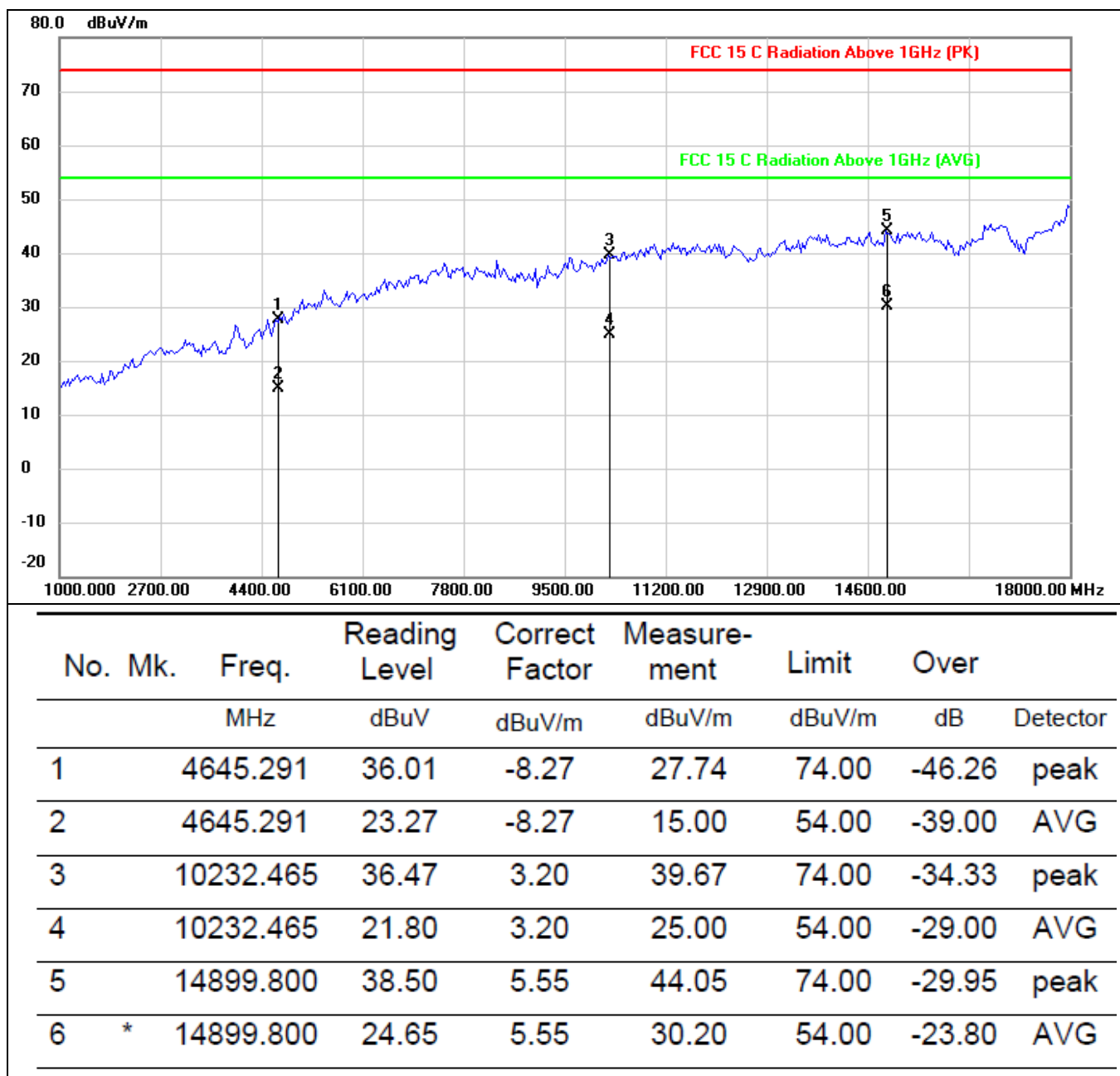
No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	Detector
1		38.2120	40.39	-13.87	26.52	40.00	-13.48	QP
2		79.2426	46.95	-17.68	29.27	40.00	-10.73	QP
3	*	166.0680	51.60	-15.80	35.80	43.50	-7.70	QP
4		267.5455	40.61	-11.80	28.81	46.00	-17.19	QP
5		360.4476	37.77	-9.80	27.97	46.00	-18.03	QP
6		520.8882	33.39	-8.27	25.12	46.00	-20.88	QP

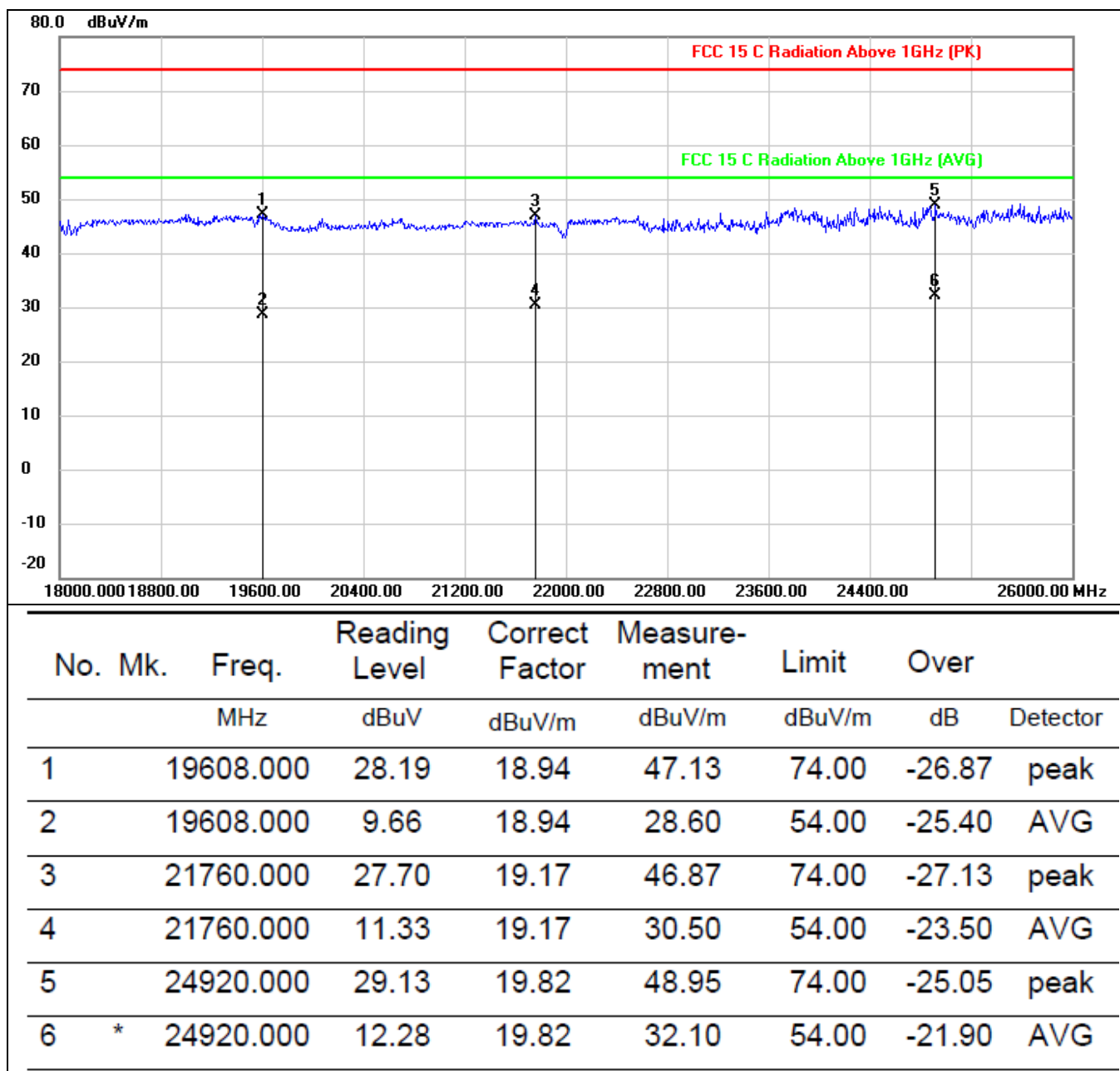
1G-25GHz

Note: (1) Emission Level= Antenna Factor + Cable Loss + Read Level - Preamp Factor

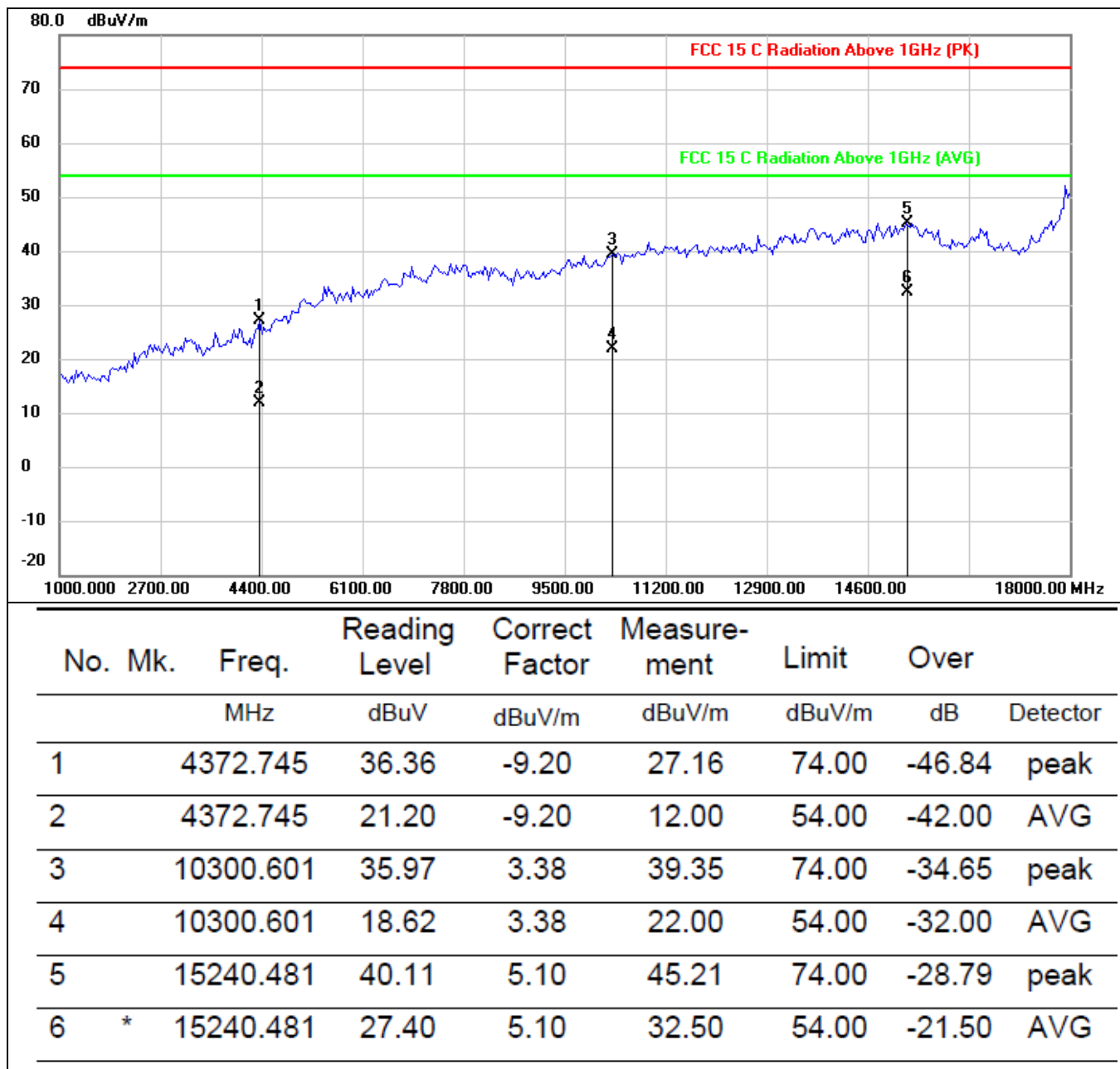
(2) All other emissions more than 20dB below the limit.

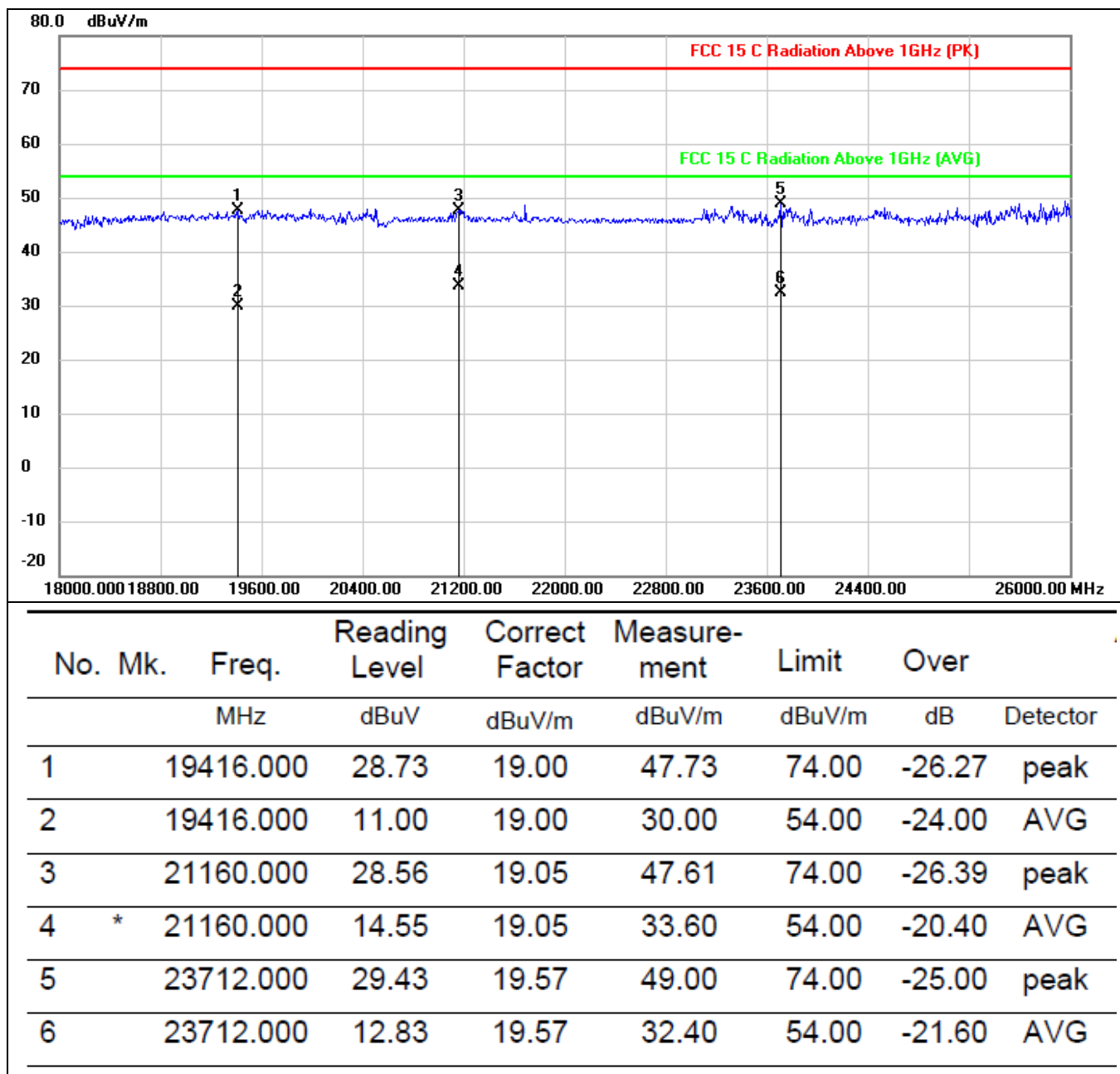
EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	H
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter 120V/60Hz
Test Mode :	TX-2402MHz		



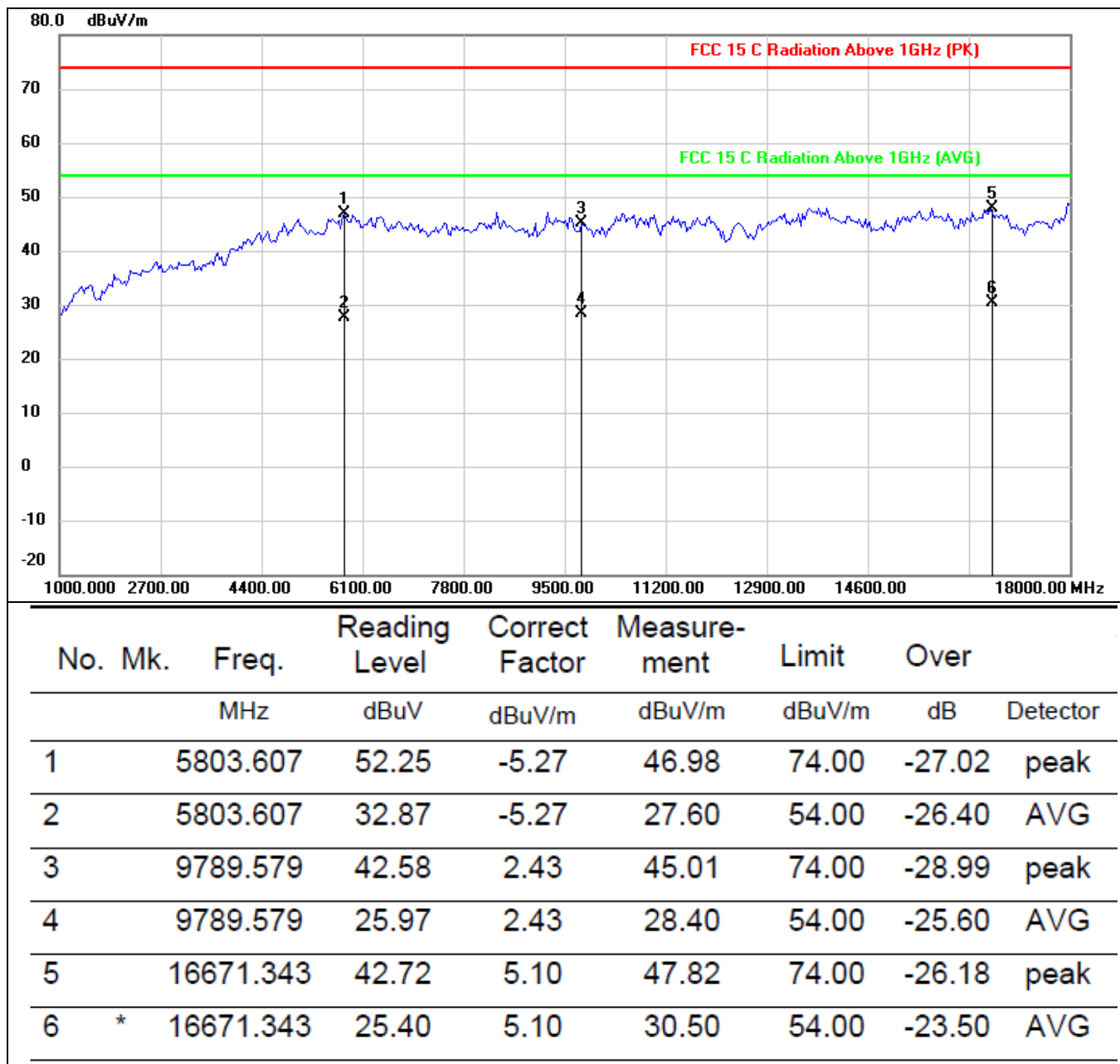


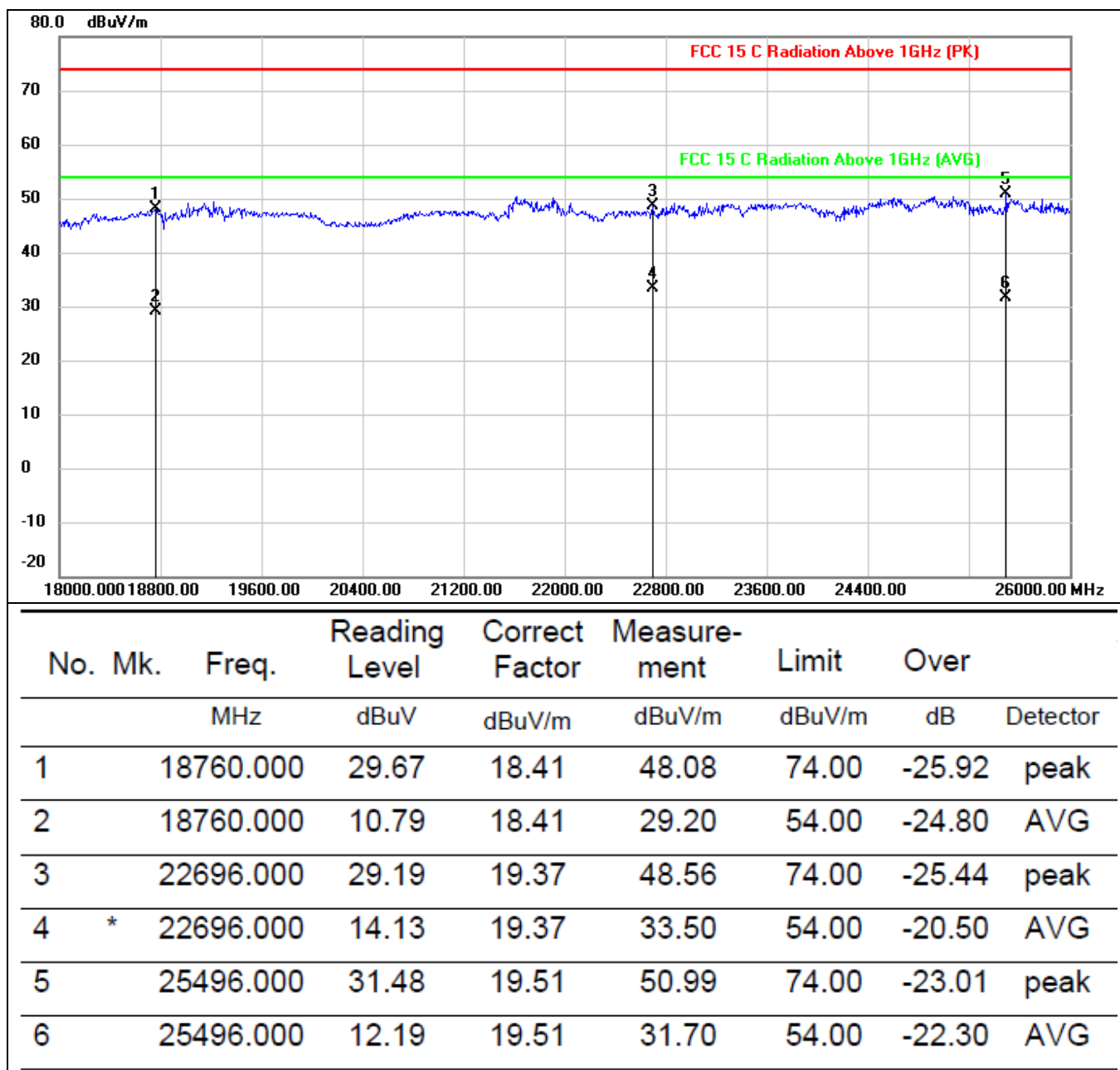
EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	V
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter 120V/60Hz
Test Mode :	TX-2402MHz		



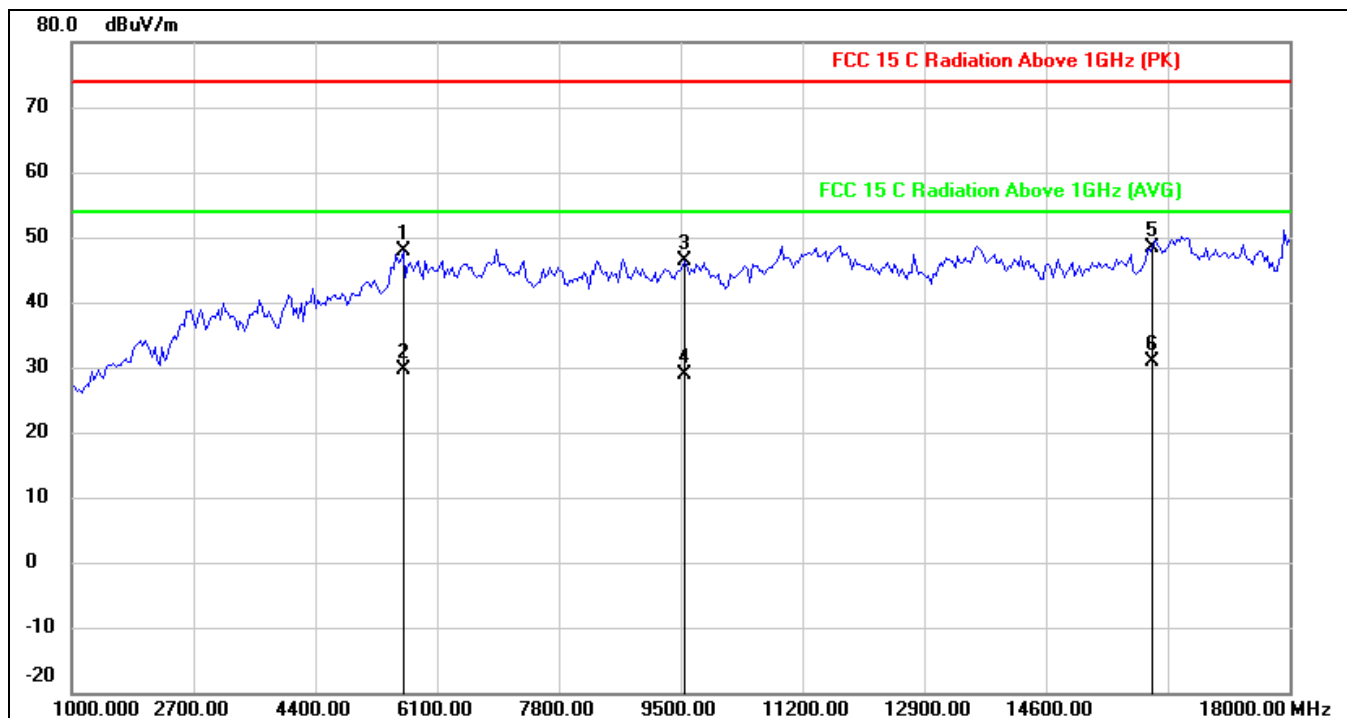


EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	H
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter 120V/60Hz
Test Mode :	TX-2440MHz		

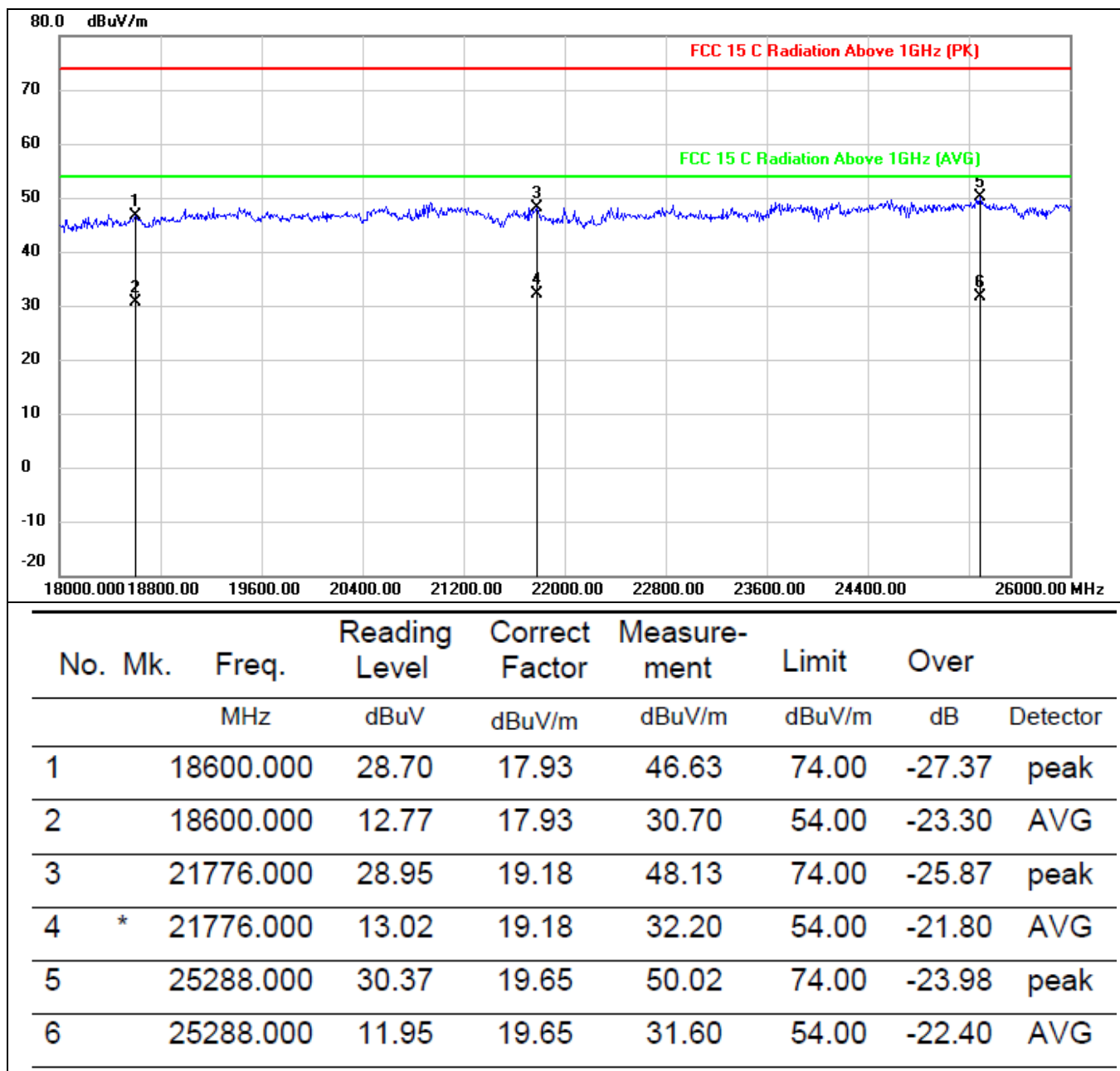




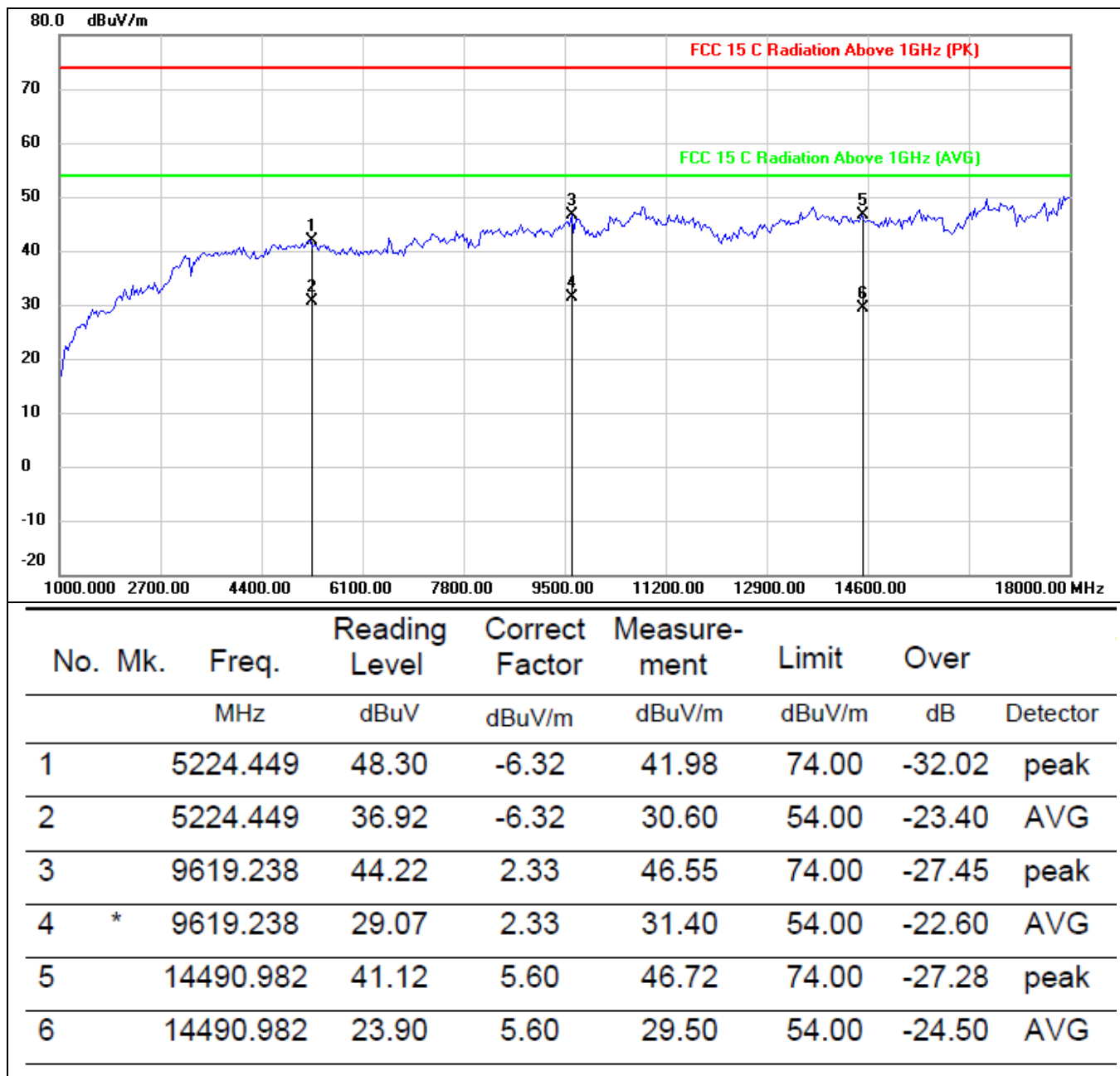
EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	V
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter 120V/60Hz
Test Mode :	TX-2440MHz		

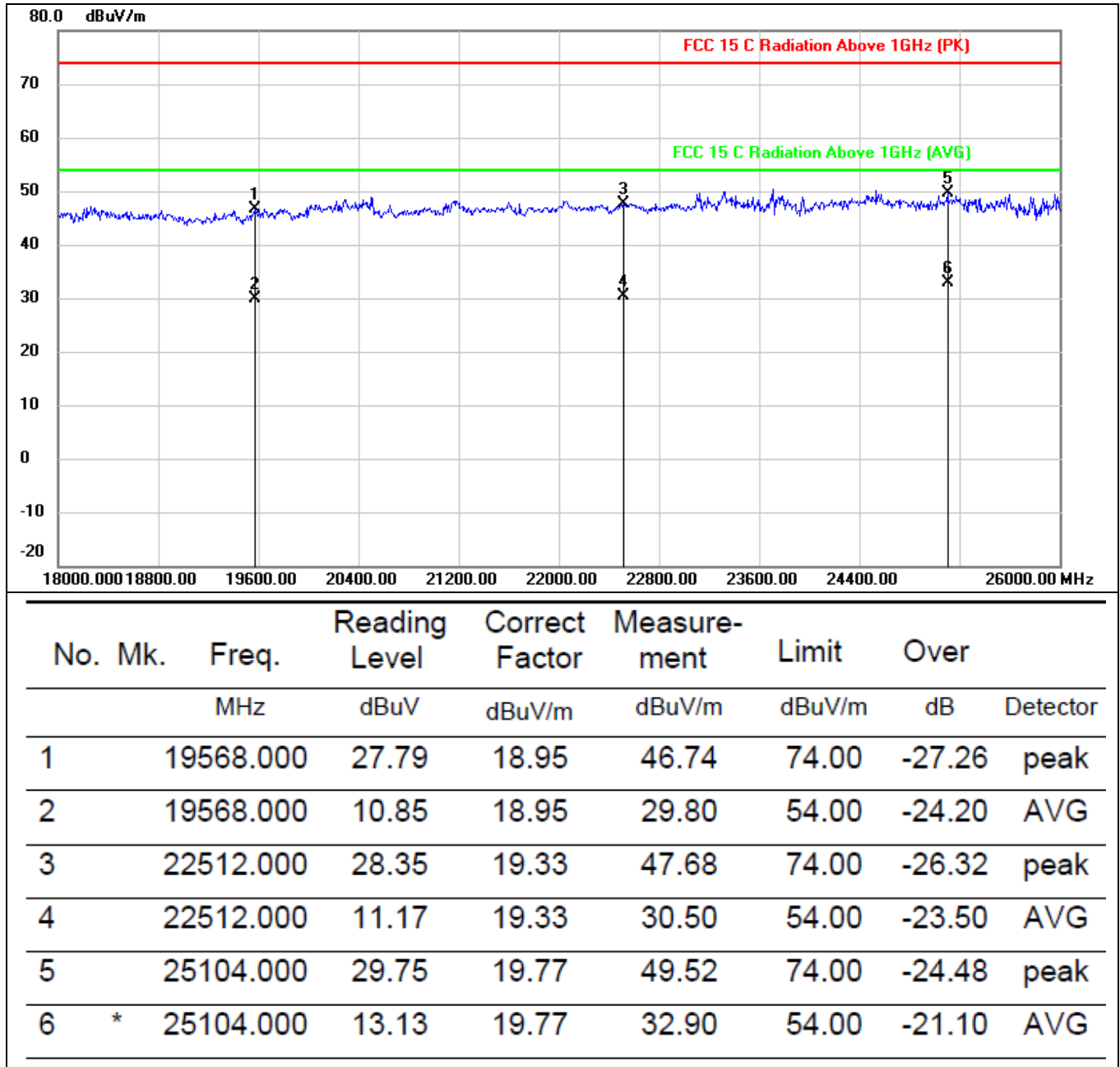


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		5633.266	53.38	-5.38	48.00	74.00	-26.00	peak
2		5633.266	35.08	-5.38	29.70	54.00	-24.30	AVG
3		9551.102	44.11	2.29	46.40	74.00	-27.60	peak
4		9551.102	26.61	2.29	28.90	54.00	-25.10	AVG
5		16092.184	45.84	2.62	48.46	74.00	-25.54	peak
6	*	16092.184	28.38	2.62	31.00	54.00	-23.00	AVG

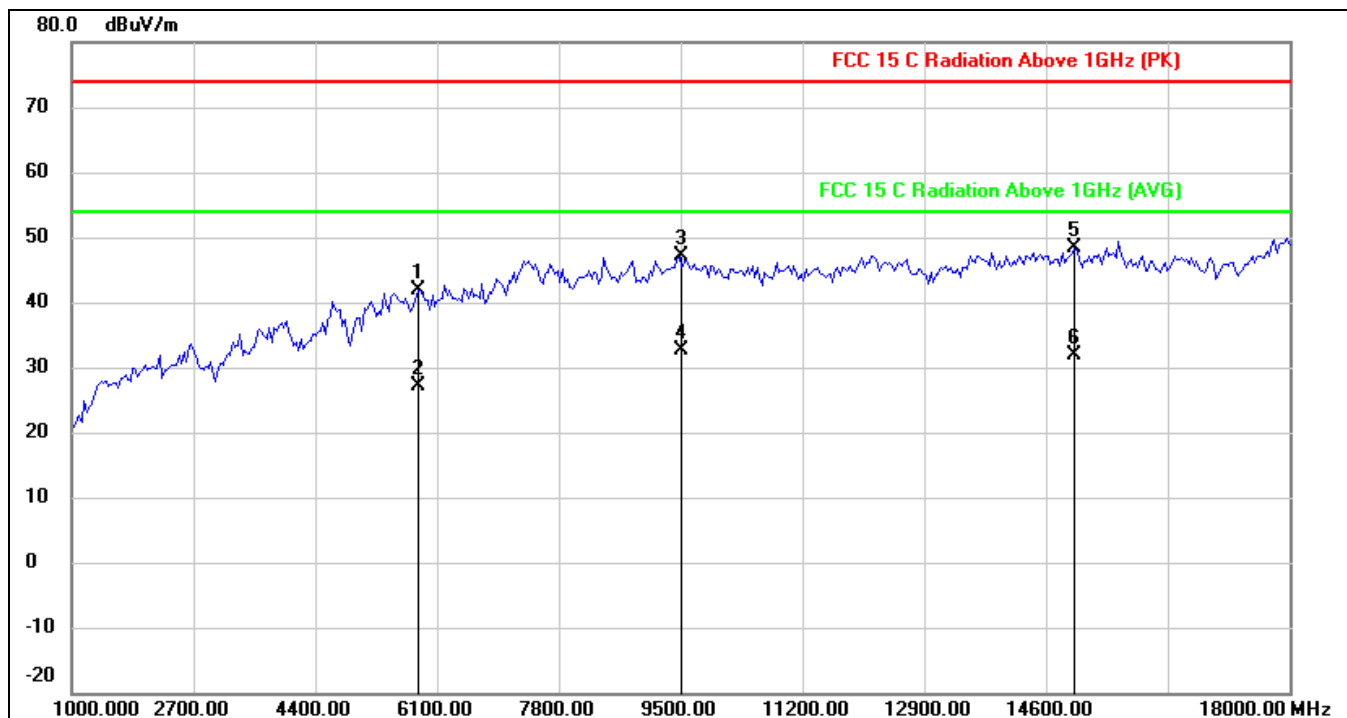


EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	H
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter 120V/60Hz
Test Mode :	TX-2480MHz		

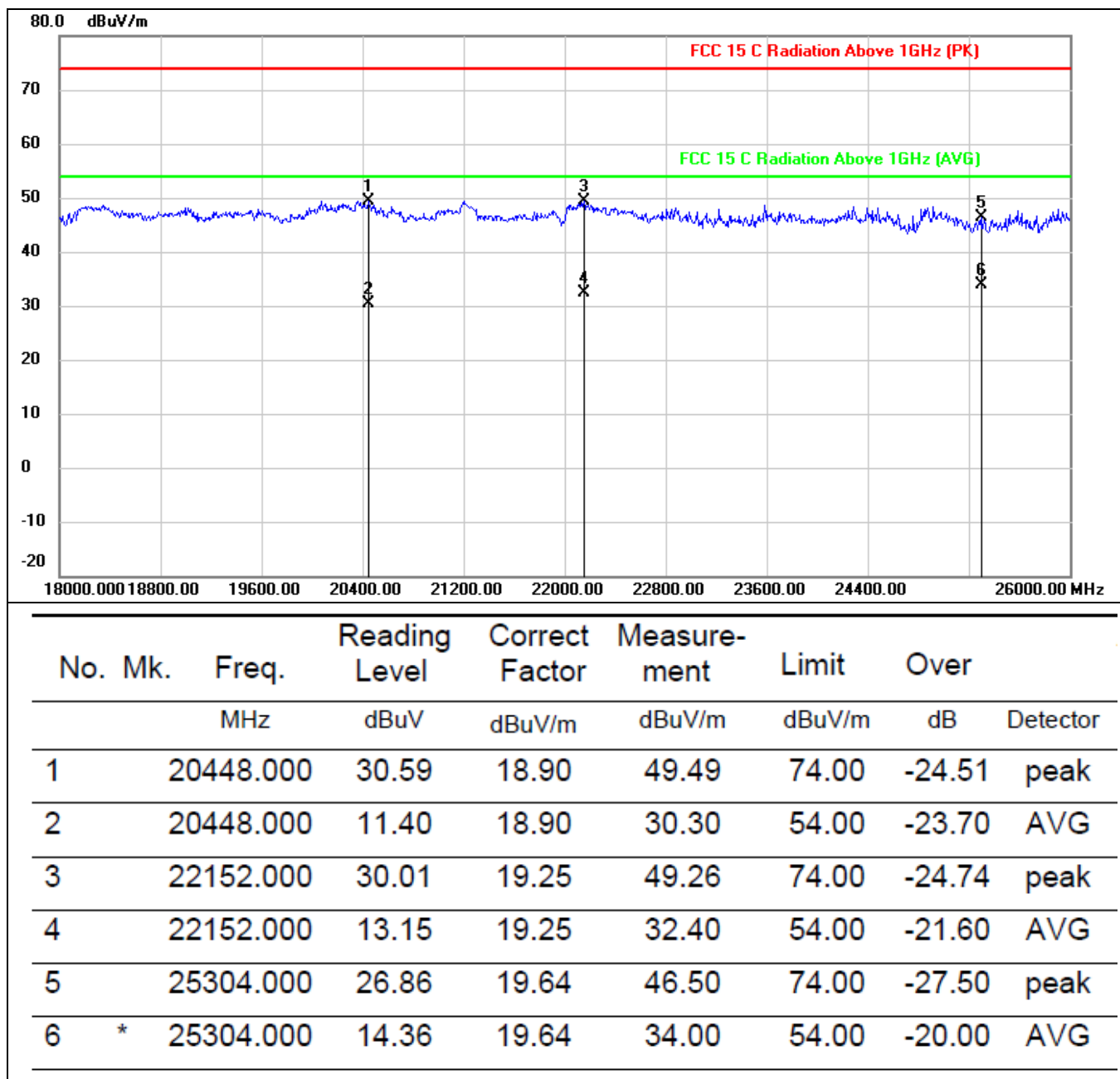




EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	V
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter 120V/60Hz
Test Mode :	TX-2480MHz		



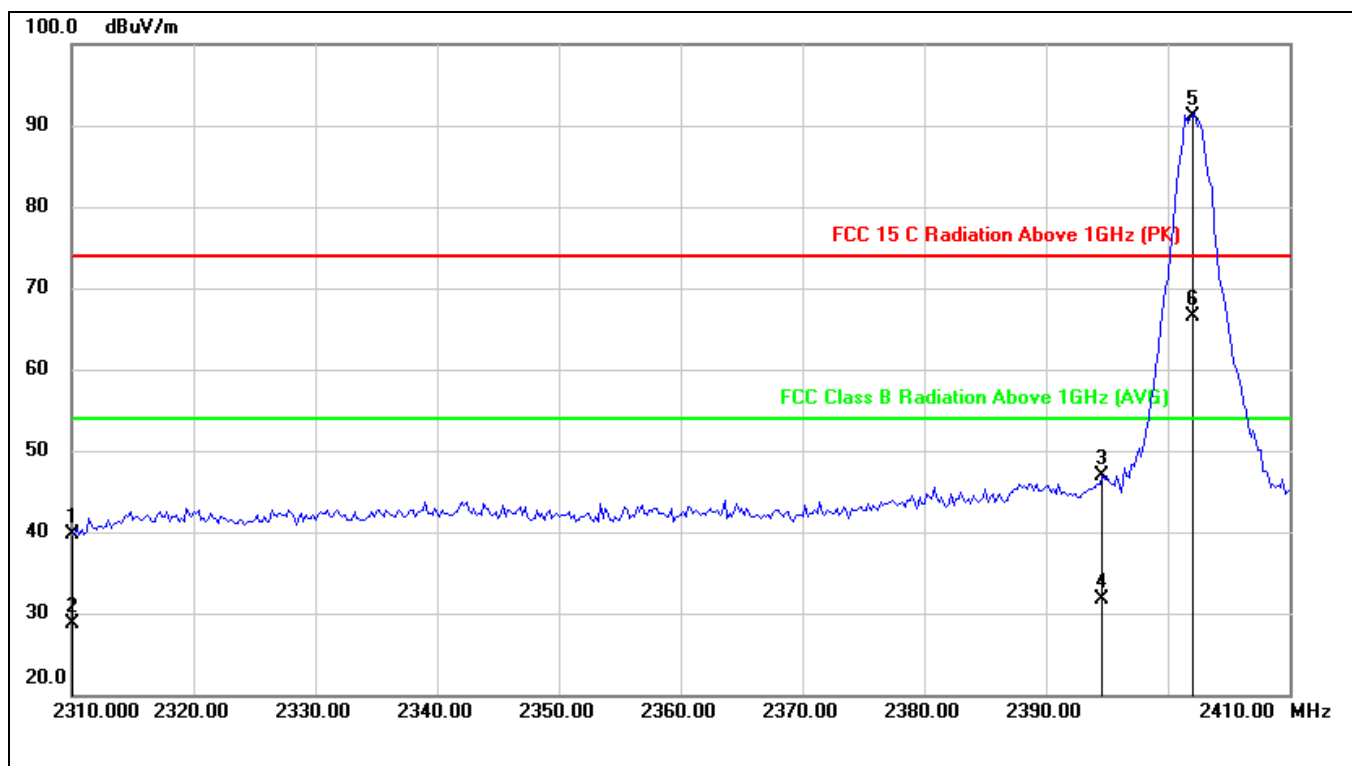
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		5837.675	47.05	-5.25	41.80	74.00	-32.20	peak
2		5837.675	32.35	-5.25	27.10	54.00	-26.90	AVG
3		9482.966	44.99	2.22	47.21	74.00	-26.79	peak
4	*	9482.966	30.38	2.22	32.60	54.00	-21.40	AVG
5		15002.004	42.92	5.53	48.45	74.00	-25.55	peak
6		15002.004	26.27	5.53	31.80	54.00	-22.20	AVG



5.4.4.2 Bandedge-Radiated

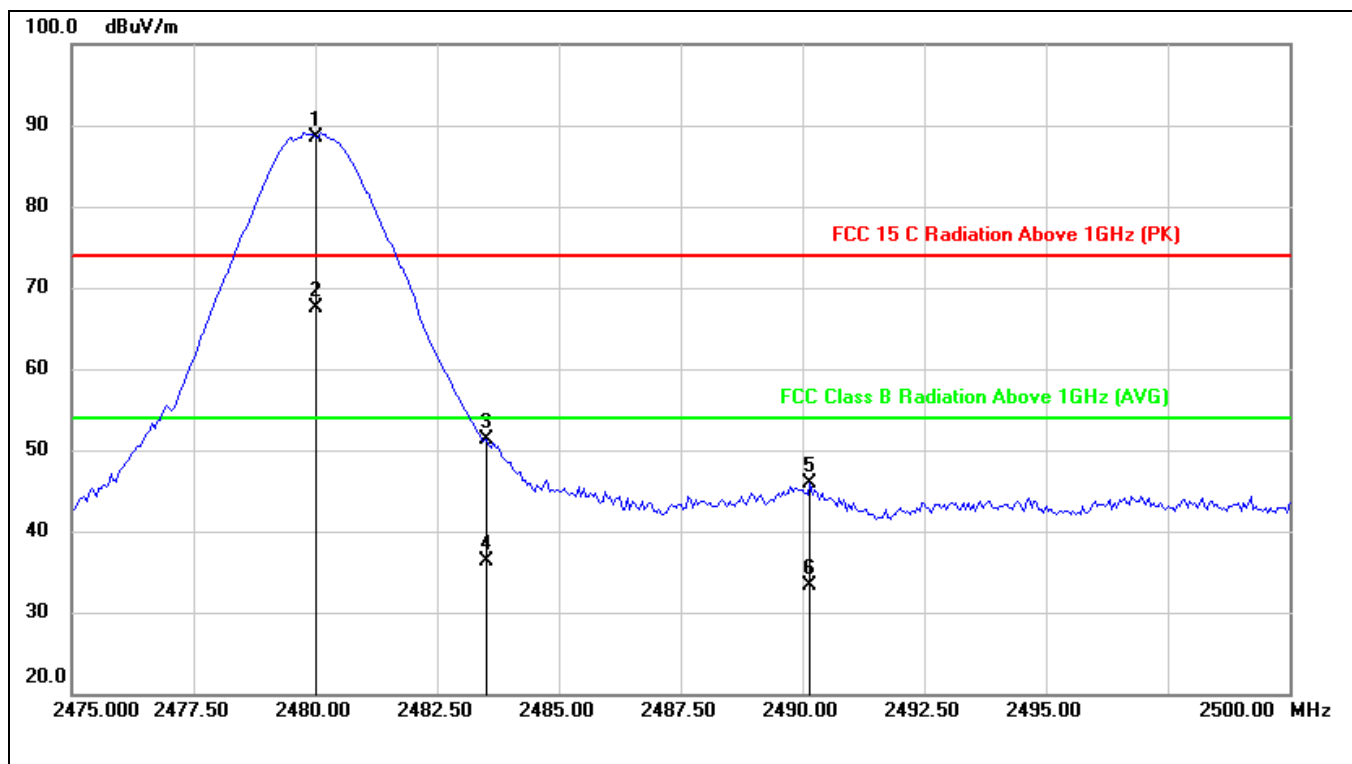
Note: (1) Emission Level= Antenna Factor + Cable Loss + Read Level - Preamp Factor
(2) All other emissions more than 20dB below the limit.

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	H
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter 120V/60Hz
Test Mode :	TX-2402MHz		



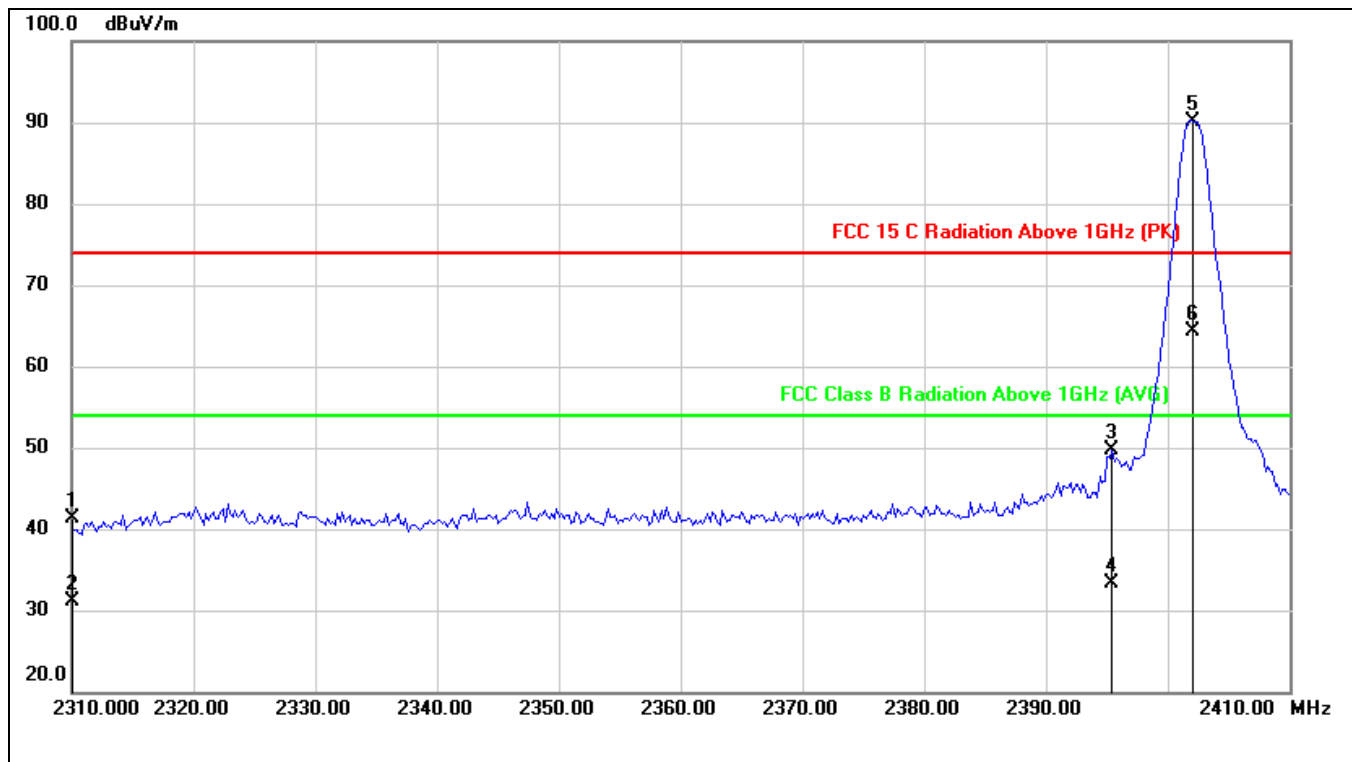
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		2310.000	50.03	-10.26	39.77	74.00	-34.23	peak
2		2310.000	39.06	-10.26	28.80	54.00	-25.20	AVG
3		2394.600	56.46	-9.48	46.98	74.00	-27.02	peak
4		2394.600	41.08	-9.48	31.60	54.00	-22.40	AVG
5	*	2402.000	100.43	-9.41	91.02	74.00	17.02	peak
6	X	2402.000	75.91	-9.41	66.50	54.00	12.50	AVG

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	H
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter 120V/60Hz
Test Mode :	TX-2480MHz		



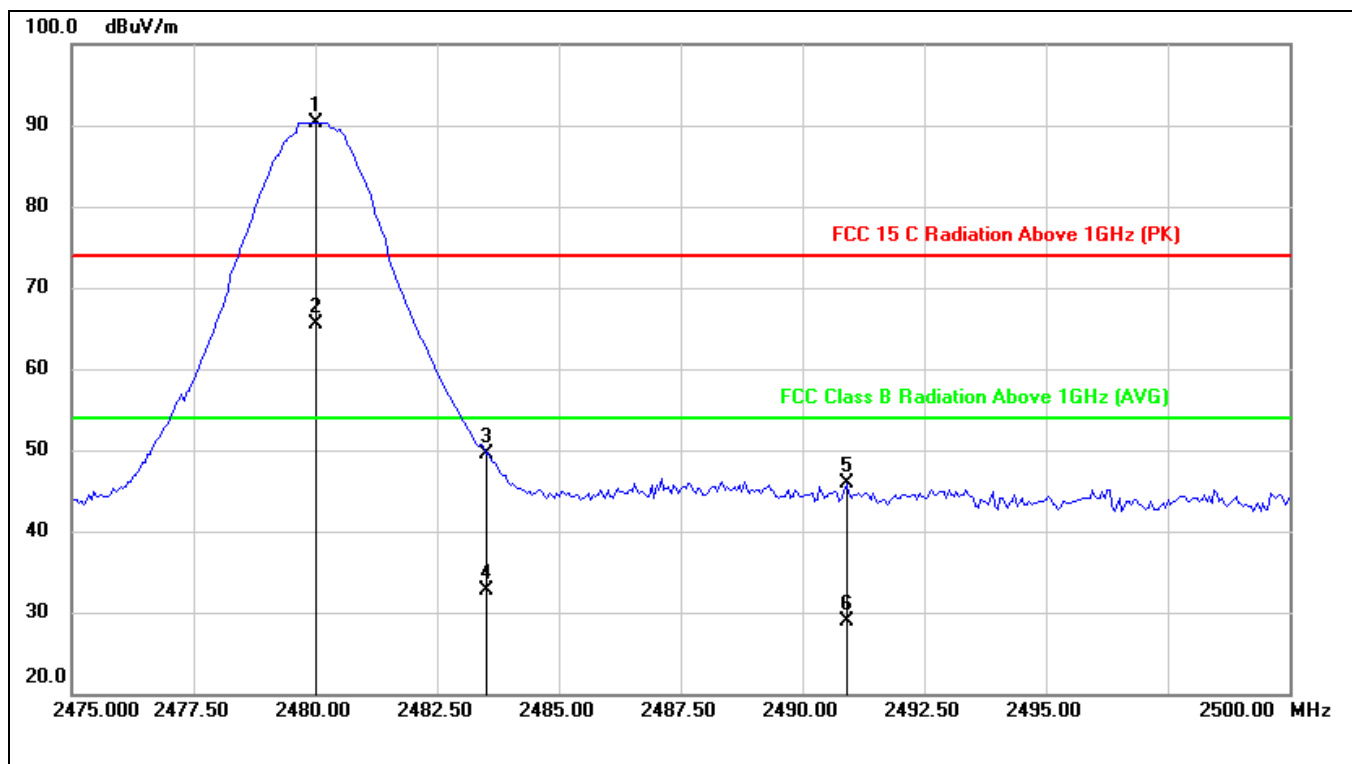
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1	*	2480.000	97.20	-8.69	88.51	74.00	14.51	peak
2	X	2480.000	76.09	-8.69	67.40	54.00	13.40	AVG
3		2483.500	59.87	-8.66	51.21	74.00	-22.79	peak
4		2483.500	44.96	-8.66	36.30	54.00	-17.70	AVG
5		2490.150	54.46	-8.60	45.86	74.00	-28.14	peak
6		2490.150	41.80	-8.60	33.20	54.00	-20.80	AVG

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	V
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter 120V/60Hz
Test Mode :	TX-2402MHz		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		2310.000	52.20	-10.95	41.25	74.00	-32.75	peak
2		2310.000	42.15	-10.95	31.20	54.00	-22.80	AVG
3		2395.400	59.96	-10.34	49.62	74.00	-24.38	peak
4		2395.400	43.74	-10.34	33.40	54.00	-20.60	AVG
5	*	2402.000	100.48	-10.29	90.19	74.00	16.19	peak
6	X	2402.000	74.59	-10.29	64.30	54.00	10.30	AVG

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Relative Humidity:	52%	Phase:	V
Pressure:	1010 hPa	Test Voltage :	DC 5V from adapter 120V/60Hz
Test Mode :	TX-2480MHz		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1	*	2480.000	100.07	-9.75	90.32	74.00	16.32	peak
2	X	2480.000	75.35	-9.75	65.60	54.00	11.60	AVG
3		2483.500	59.29	-9.73	49.56	74.00	-24.44	peak
4		2483.500	42.53	-9.73	32.80	54.00	-21.20	AVG
5		2490.900	55.49	-9.67	45.82	74.00	-28.18	peak
6		2490.900	38.57	-9.67	28.90	54.00	-25.10	AVG

5.5 Power spectral density test

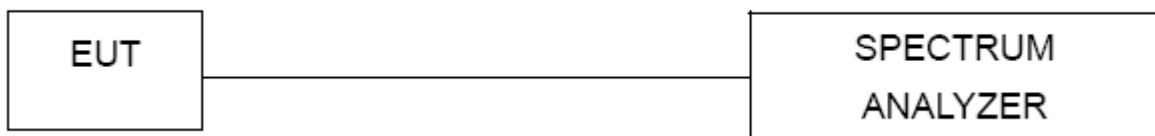
5.5.1 Limit

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

5.5.2 Test procedure

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW ≥ 3 kHz.
4. Set the VBW $\geq 3 \times$ 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.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.5.3 Test setup



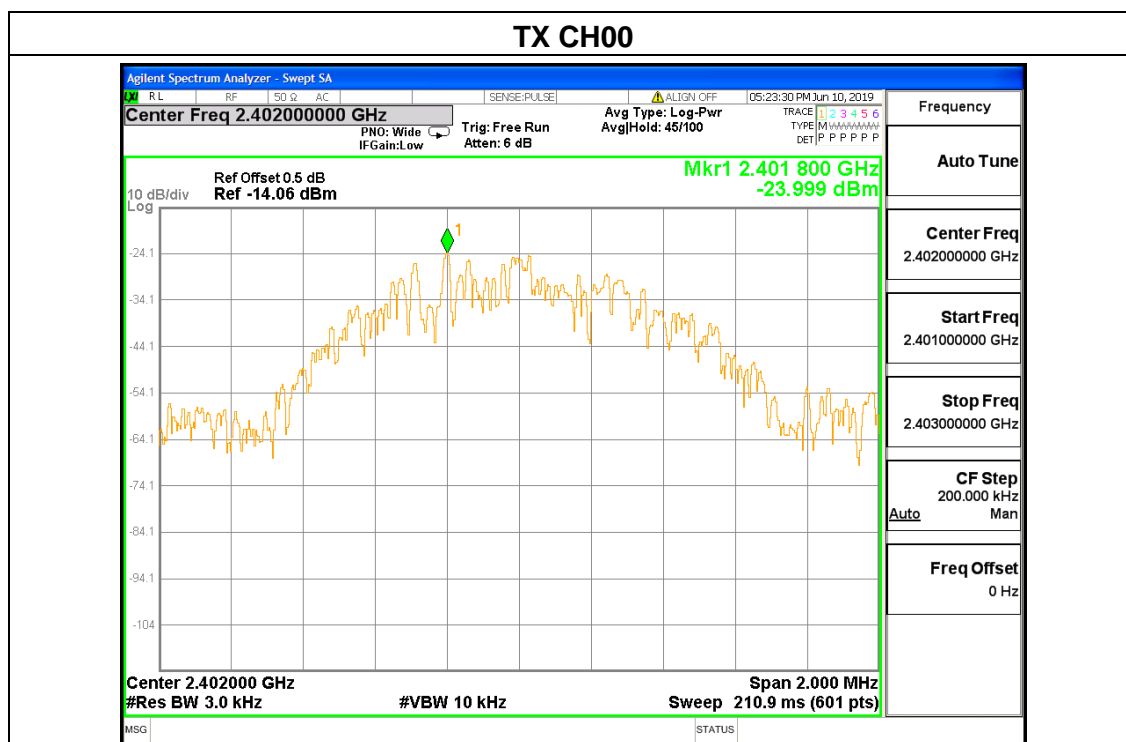
5.5.4 EUT operation conditions

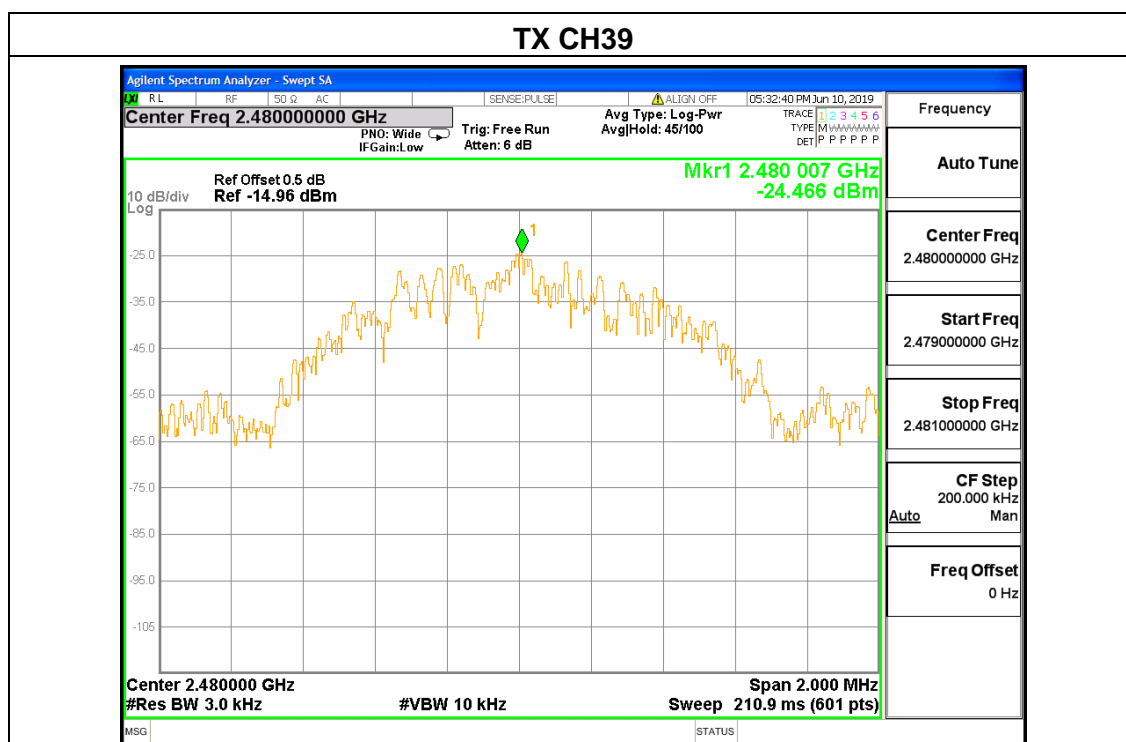
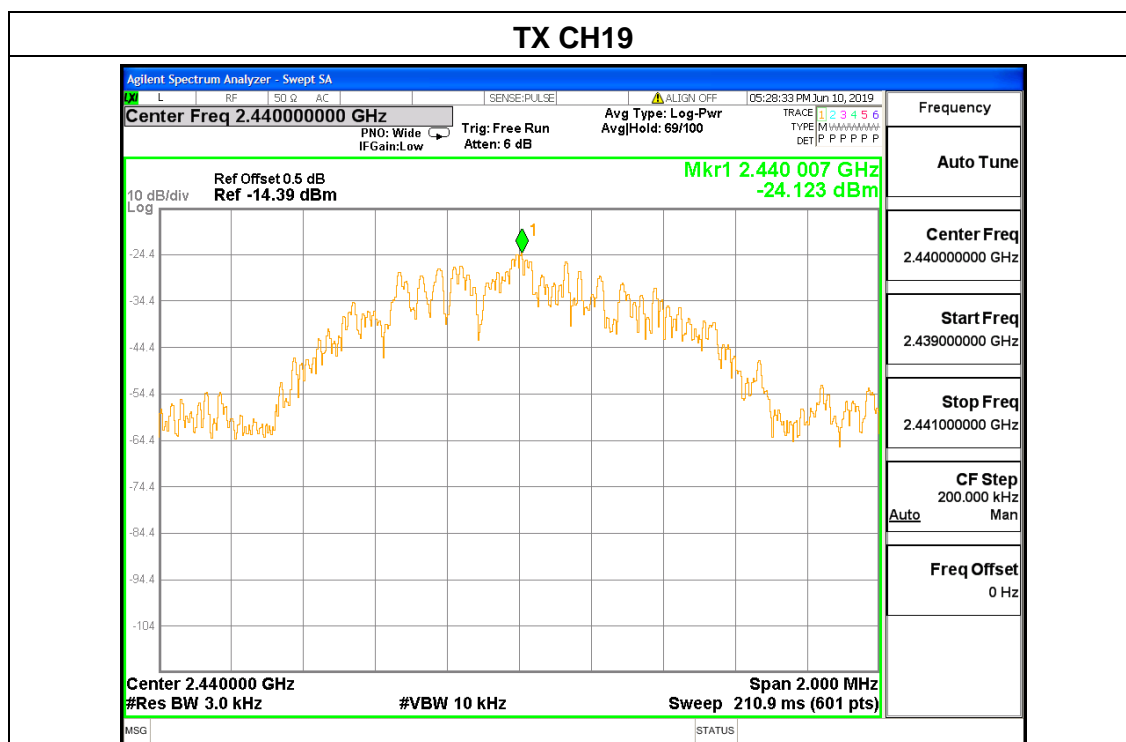
The EUT tested system was configured as the statements of 2.1 Unless otherwise a special operating condition is specified in the follows during the testing

5.5.5 Test results

EUT :	SwitchBot Hub Mini	Model Name :	W0202200
Temperature :	25 °C	Relative Humidity :	60%
Pressure :	1015 hPa	Test Voltage :	DC 5V from USB port
Test Mode :	TX Mode /CH00, CH19, CH39		

Frequency	Power Density (dBm/3KHz)	Limit (dBm/3KHz)	Result
2402 MHz	-23.999	8	PASS
2440 MHz	-24.123	8	PASS
2480 MHz	-24.466	8	PASS





5.6 6dB bandwidth

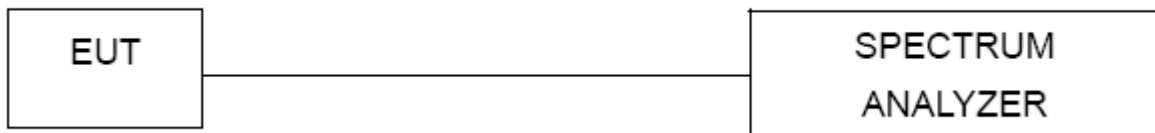
5.6.1 Limit

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

5.6.2 TEST PROCEDURE

1. Set RBW= 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times \text{RBW}$.
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) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.6.3 TEST SETUP



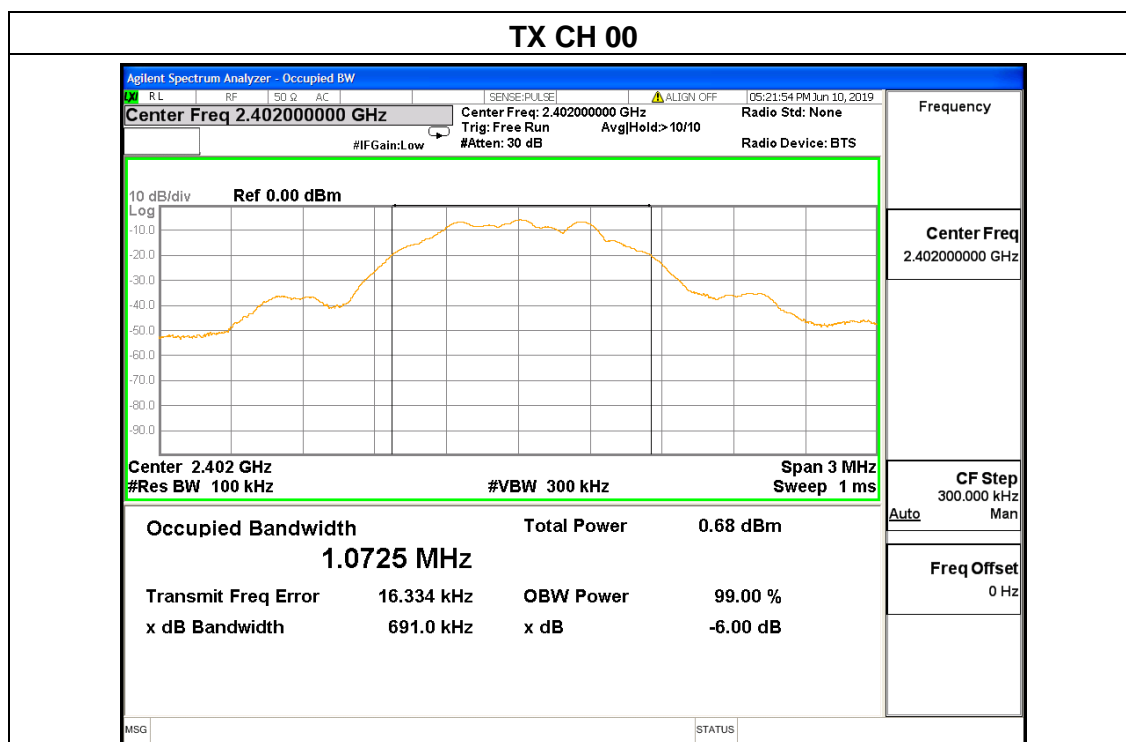
5.6.4 EUT operation conditions

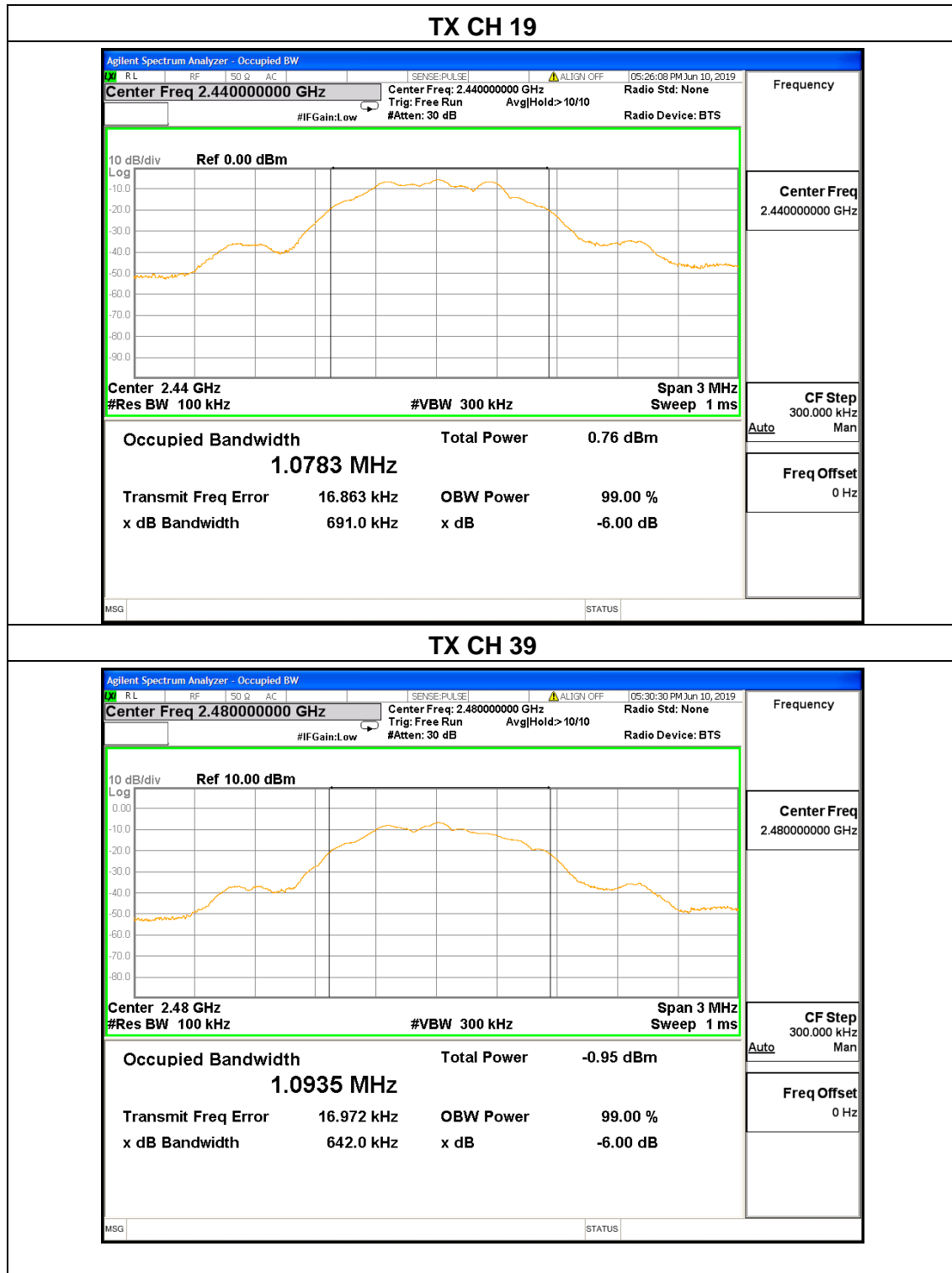
The EUT tested system was configured as the statements of 2.1 Unless otherwise a special operating condition is specified in the follows during the testing

5.6.5 Test Result

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 Mode /CH00, CH19, CH39		

Channel	Frequency (MHz)	6dB bandwidth (kHz)	Limit (kHz)	Result
Low	2402	691.0	500	Pass
Middle	2440	691.0	500	Pass
High	2480	642.0	500	Pass




TX CH 39

Agilent Spectrum Analyzer - Occupied BW
 Center Freq **2.480000000 GHz**
 #IFGain:Low

SENSE:PULSE
 Center Freq: 2.480000000 GHz
 Trig: Free Run
 #Atten: 30 dB

ALIGN OFF
 AvgHold>10/10
 Radio Std: None
 Radio Device: BTS

05:30:30 PM Jun 10, 2019

10 dB/div
 Log


Ref 10.00 dBm

Center 2.48 GHz
 #Res BW 100 kHz

#VBW 300 kHz

Span 3 MHz
 Sweep 1 ms

Occupied Bandwidth
1.0935 MHz

Total Power
-0.95 dBm

Transmit Freq Error
 16.972 kHz

OBW Power
 99.00 %

x dB Bandwidth
 642.0 kHz

x dB
 -6.00 dB

MSG

STATUS

Frequency

Center Freq
2.480000000 GHz

CF Step
300.000 kHz
Auto Man

Freq Offset
0 Hz

5.7 Duty Cycle

5.7.1 Conformance Limit

No limit requirement.

5.7.2 Measuring Instruments

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

5.7.3 Test Setup



5.7.4 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

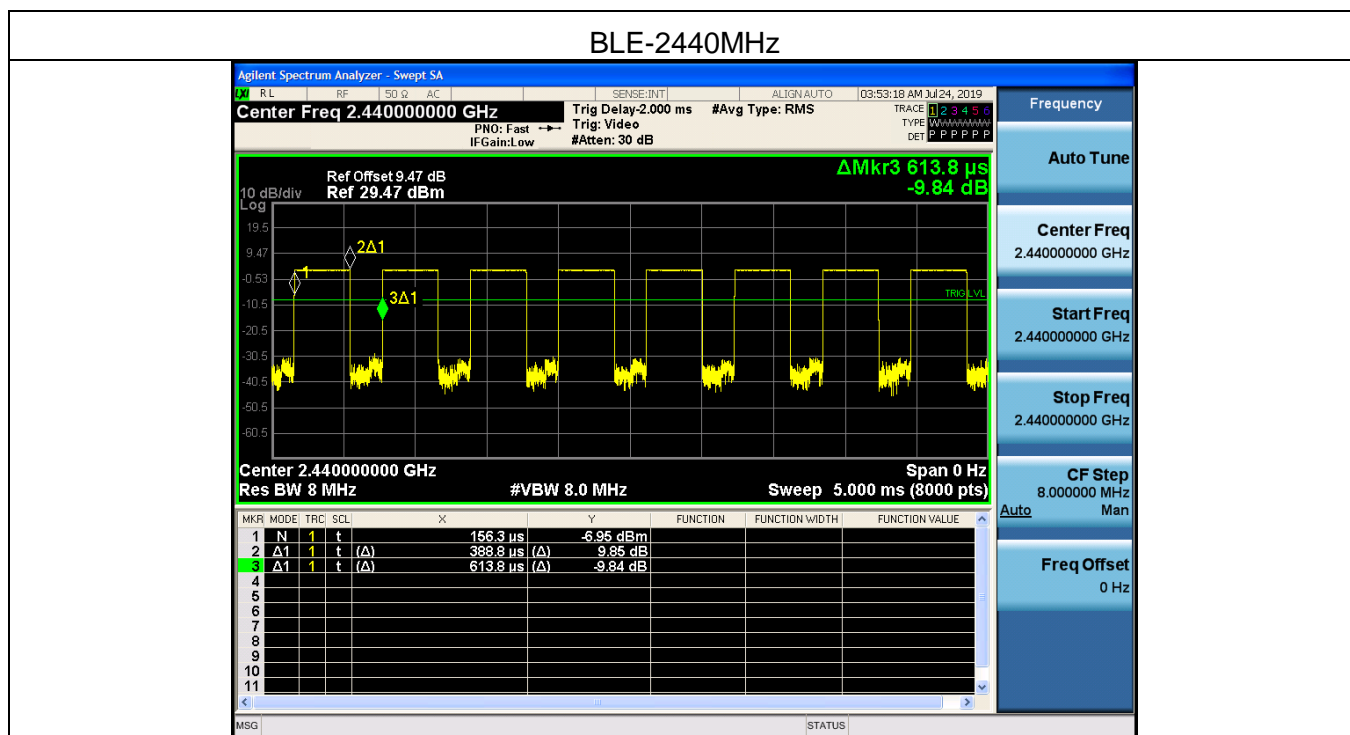
Trace = Clear write

Measure Ttotal and Ton

Calculate Duty Cycle = $Ton / Ttotal$

5.7.5 Test Results

EUT:	SwitchBot Hub Mini	Model Name :	W0202200
Pressure:	1012 hPa	Test Voltage:	DC 5V from USB port
Test Mode:	TX Mode -2440MHz		



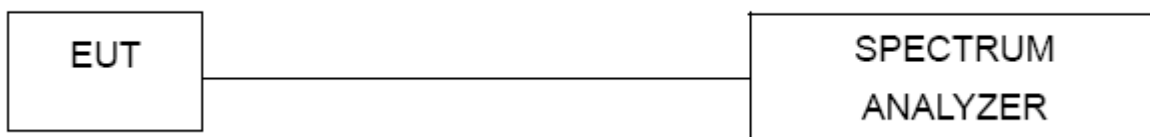
Mode	Duty Cycle (100%)	T (us)	1/T (kHz)	VBW Setting	10log(1/ Duty Cycle)
BLE	63.34	388.8	2.572	3kHz	1.98

5.8 Conducted bandedge

5.8.1 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)).

5.8.2 Test setup



5.8.3 Test procedure

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 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.
- 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.
- 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.
- Repeat above procedures until all measured frequencies were complete.

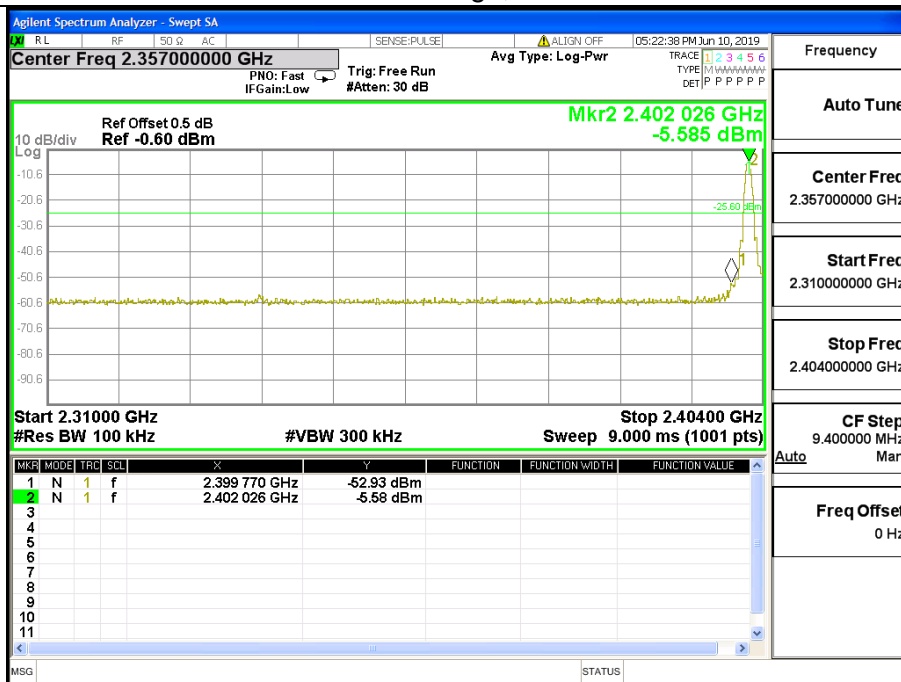
5.8.4 EUT operation conditions

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

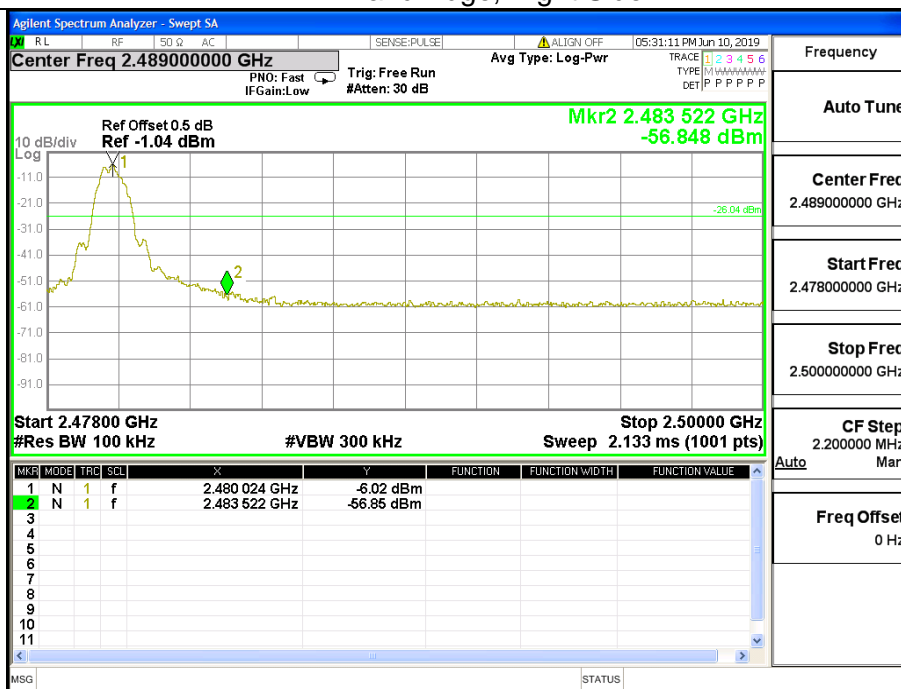
5.8.5 Test Result

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 Mode /CH00, CH39		

BLE: Band Edge, Left Side

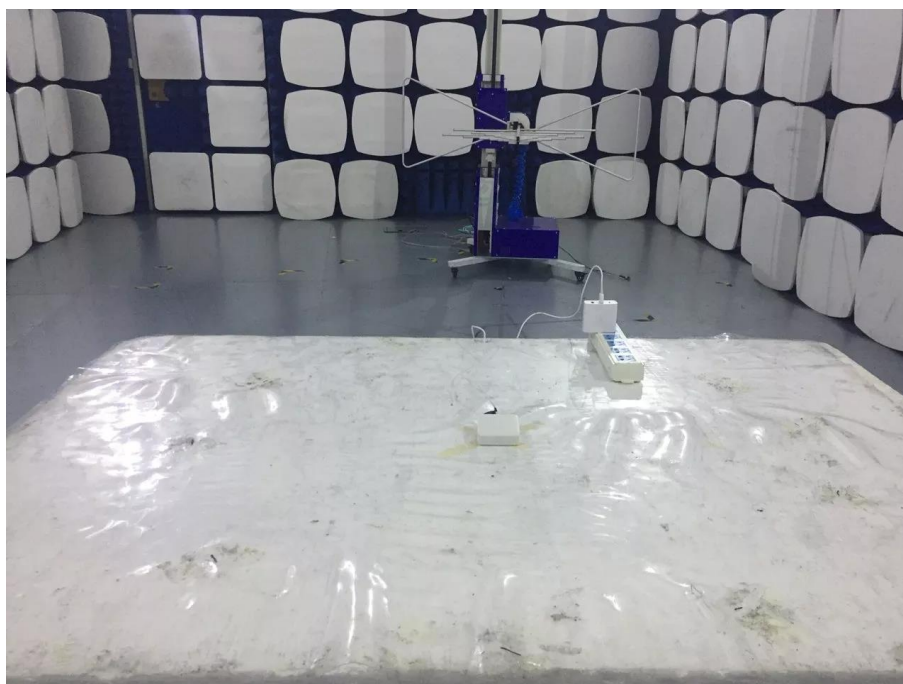


BLE: Band Edge, Right Side

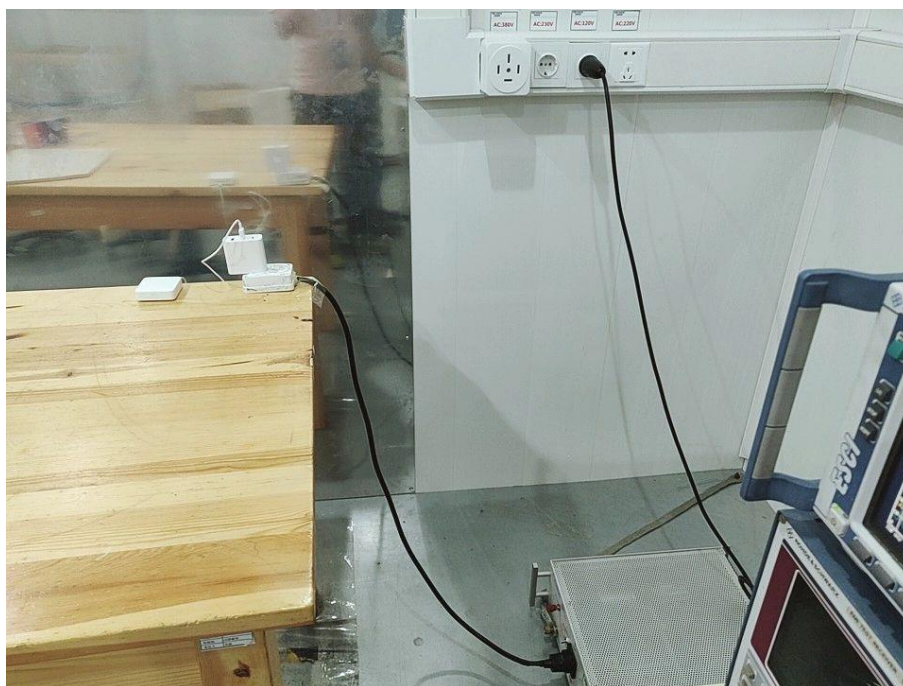


Photographs of the Test Setup

Radiated emission



Conducted emission



Photographs of the EUT

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

----END OF REPORT----