



# CTC Laboratories, Inc.

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## TEST REPORT

**Report No.** .....: **CTC20230838E04**

**FCC ID**.....: **2APN5NSPANELPRO**

**Applicant**.....: **Shenzhen Sonoff Technologies Co.,Ltd.**

Address.....: 3F & 6F, Bldg A, No. 663, Bulong Rd, Shenzhen, Guangdong, China

Manufacturer.....: Shenzhen Sonoff Technologies Co.,Ltd.

Address.....: 3F & 6F, Bldg A, No. 663, Bulong Rd, Shenzhen, Guangdong, China

**Product Name**.....: **SONOFF NSPanel Pro Smart Home Control Panel**

Trade Mark.....: Sonoff

Model/Type reference.....: NSPanel86PB

Listed Model(s) .....: NSPanel86PW, NSPanel86PG

**Standard**.....: **FCC CFR Title 47 Part 15 Subpart C Section 15.247**

Date of receipt of test sample...: Apr. 14, 2023

Date of testing.....: Apr. 14, 2023 to May 5, 2023

Date of issue.....: May 24, 2023

**Result**.....: **PASS**

Compiled by:		<i>Jim Jiang</i>
(Printed name+signature)	Jim Jiang	-----
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(Printed name+signature)	Eric Zhang	-----
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(Printed name+signature)	Totti Zhao	

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# 1. TEST SUMMARY

## 1.1. Test Standards

The tests were performed according to following standards:

[FCC Rules Part 15.247](#): Operation within the bands of 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.

[RSS-247 Issue 2](#): Standard Specifications for Frequency Hopping Systems (FHSs) and Digital Transmission Systems (DTSS) Operating in the Bands 902-928MHz, 2400-2483.5MHz and 5725-5850MHz.

[ANSI C63.10-2013](#): American National Standard for Testing Unlicensed Wireless Devices.

## 1.2. Report Version

Revised No.	Date of issue	Description
01	May 24, 2023	Original

## 1.3. Test Description

FCC Part 15 Subpart C (15.247) / RSS-247 Issue 2				
Test Item	Standard Section		Result	Test Engineer
	FCC	IC		
Antenna Requirement	15.203	/	Pass	Jim Jiang
Conducted Emission	15.207	RSS-Gen 8.8	Pass	Jim Jiang
Band Edge Emissions	15.247(d)	RSS-247 5.5	Pass	Jim Jiang
6dB Bandwidth	15.247(a)(2)	RSS-247 5.2 (a)	Pass	Jim Jiang
Conducted Max Output Power	15.247(b)(3)	RSS-247 5.4 (d)	Pass	Jim Jiang
Power Spectral Density	15.247(e)	RSS-247 5.2 (b)	Pass	Jim Jiang
Transmitter Radiated Spurious	15.209&15.247(d)	RSS-247 5.5& RSS-Gen 8.9	Pass	Jim Jiang

Note:

N/A: Not applicable.

The measurement uncertainty is not included in the test result.



## 1.4. Test Facility

### CTC Laboratories, Inc.

Add: 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China

### Laboratory accreditation

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

#### **A2LA-Lab Cert. No.: 4340.01**

CTC Laboratories, Inc. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

#### **Industry Canada (Registration No.: 9783A, CAB Identifier: CN0029)**

CTC Laboratories, Inc. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: 9783A on Jan, 2016.

#### **FCC (Registration No.: 951311, Designation Number CN1208)**

CTC Laboratories, Inc. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 951311, Aug 26, 2017.

## 1.5. 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 TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2" and is documented in the CTC Laboratories, Inc. 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.

Below is the best measurement capability for CTC Laboratories, Inc.



Test Items	Measurement Uncertainty	Notes
Transmitter power conducted	0.42 dB	(1)
Transmitter power Radiated	2.14 dB	(1)
Conducted spurious emissions 9kHz~40GHz	1.60 dB	(1)
Radiated spurious emissions 9kHz~40GHz	2.20 dB	(1)
Conducted Emissions 9kHz~30MHz	3.20 dB	(1)
Radiated Emissions 30~1000MHz	4.70 dB	(1)
Radiated Emissions 1~18GHz	5.00 dB	(1)
Radiated Emissions 18~40GHz	5.54 dB	(1)
Occupied Bandwidth	-----	(1)

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

## 1.6. Environmental Conditions

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

Temperature:	21°C~27°C
Relative Humidity:	40%~60%
Air Pressure:	101kPa



## 2. GENERAL INFORMATION

### 2.1. Client Information

Applicant:	Shenzhen Sonoff Technologies Co.,Ltd.
Address:	3F & 6F, Bldg A, No. 663, Bulong Rd, Shenzhen, Guangdong, China
Manufacturer:	Shenzhen Sonoff Technologies Co.,Ltd.
Address:	3F & 6F, Bldg A, No. 663, Bulong Rd, Shenzhen, Guangdong, China

### 2.2. General Description of EUT

Product Name:	SONOFF NSPanel Pro Smart Home Control Panel
Trade Mark:	Sonoff
Model/Type reference:	NSPanel86PB
Listed Model(s):	NSPanel86PW, NSPanel86PG
Model Difference:	All these models are identical in the same PCB, layout, electrical circuit and enclosure. The difference is the model name and appearance color.
Power supply:	Input: 100-240V~ 50/60Hz 150mA
Hardware version:	/
Software version:	/
<b>Zigbee 3.0</b>	
Modulation:	OQPSK
Operation frequency:	2405MHz~2480MHz
Channel number:	16
Channel separation:	5MHz
Antenna type:	FPC Antenna
Antenna gain:	2.0dBi



## 2.3. Accessory Equipment Information

Equipment Information			
Name	Model	S/N	Manufacturer
Notebook	ThinkPad X220	/	Lenovo
Cable Information			
Name	Shielded Type	Ferrite Core	Length
USB Cable	Unshielded	NO	120cm
Test Software Information			
Name	Version	/	/
RTLBTAPP	5.3.1.16	/	/

## 2.4. Operation State

The EUT has been tested under typical operating condition. The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing. Zigbee, 16 channels are provided to the EUT. Channels 11/18/26 were selected for testing.

Operation Frequency List:

Channel	Frequency (MHz)
<b>11</b>	<b>2405</b>
12	2410
:	:
18	2440
<b>19</b>	<b>2445</b>
20	2450
:	:
25	2475
<b>26</b>	<b>2480</b>

Note: The display in grey were the channel selected for testing.

Test Mode:

For RF test items:
The engineering test program was provided and enabled to make EUT continuous transmit.
For AC power line conducted emissions:
The EUT was set to connect with the Bluetooth instrument under large package sizes transmission.
For Radiated spurious emissions test item:
The engineering test program was provided and enabled to make EUT continuous transmit. The EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data recorded in the report.





## 2.5. Measurement Instruments List

Tonscend JS0806-2 Test system					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	MXA Signal Analyzer	Keysight	N9020A	MY46471737	Dec. 16, 2023
2	Spectrum Analyzer	R&S	FSU26	100105	Dec. 16, 2023
3	Spectrum Analyzer	R&S	FSV40-N	101331	Mar. 14, 2024
4	MXG Vector Signal Generator	Agilent	N5182A	MY47420864	Dec. 16, 2023
5	PSG Analog Signal Generator	Agilent	E8257D	MY46521908	Dec. 16, 2023
6	Power Sensor	Keysight	U2021XA	MY55130004	Mar. 14, 2024
7	Power Sensor	Keysight	U2021XA	MY55130006	Mar. 14, 2024
8	Wideband Radio Communication Tester	R&S	CMW500	102414	Dec. 16, 2023
9	High and low temperature box	ESPEC	MT3035	/	Mar. 24, 2024
10	JS1120 RF Test system	TONSCEND	v2.6	/	/

Radiated emission					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	Trilog-Broadband Antenna	Schwarzbeck	VULB 9163	01026	Dec. 18, 2024
2	Horn Antenna	Schwarzbeck	BBHA 9120D	9120D-647	Dec. 01, 2024
3	Test Receiver	Keysight	N9038A	MY56400071	Dec. 16, 2023
4	Broadband Prempplier	SCHWARZBECK	BBV9743B	259	Dec. 16, 2023
5	Mirowave Broadband Amplifier	SCHWARZBECK	BBV9718C	111	Dec. 16, 2023
6	3m chamber 3	YIHENG	EE106	/	Sep. 09, 2023



Conducted Emission					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	LISN	R&S	ENV216	101112	Dec. 16, 2023
2	LISN	R&S	ENV216	101113	Dec. 16, 2023
3	EMI Test Receiver	R&S	ESCS30	100353	Dec. 16, 2023
4	ISN CAT6	Schwarzbeck	NTFM 8158	CAT6-8158-0046	Dec. 16, 2023
5	ISN CAT5	Schwarzbeck	NTFM 8158	CAT5-8158-0046	Dec. 16, 2023

Note: The Cal. Interval was one year.

### 3. TEST ITEM AND RESULTS

#### 3.1. Conducted Emission

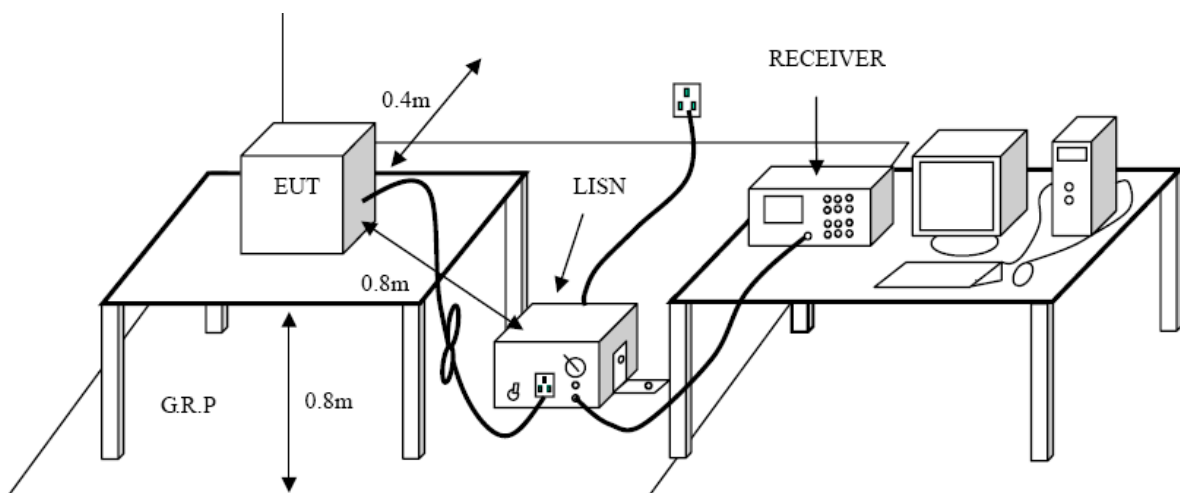
**Limit**

FCC CFR Title 47 Part 15 Subpart C Section 15.207/ RSS - Gen 8.8

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 Configuration**



**Test Procedure**

1. The EUT was setup according to ANSI C63.10:2013 requirements.
2. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface.
3. The EUT and simulators are connected to the main power through a line impedances stabilization network (LISN). The LISN provides a 50ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs)
4. Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.
5. The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.
6. Conducted Emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.
7. During the above scans, the emissions were maximized by cable manipulation.

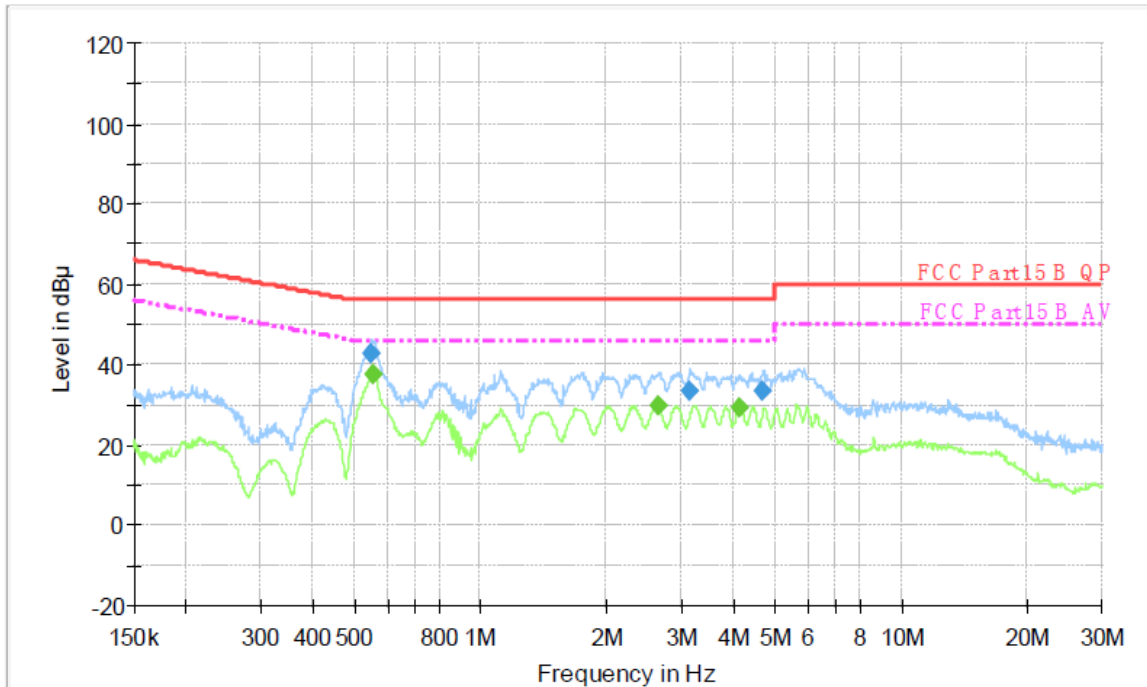


**Test Mode:**

Please refer to the clause 2.4.

**Test Results**

<b>Test Voltage:</b>	AC 120V/60 Hz
<b>Terminal:</b>	Line
<b>Remark:</b>	Only worse case is reported



**Final Measurement Detector 1**

Frequency (MHz)	QuasiPeak (dBµ V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµ V)	Comment
0.551170	42.6	1000.00	9.000	On	L1	9.7	13.4	56.0	
3.154380	33.5	1000.00	9.000	On	L1	9.7	22.5	56.0	
4.683300	33.3	1000.00	9.000	On	L1	9.7	22.7	56.0	

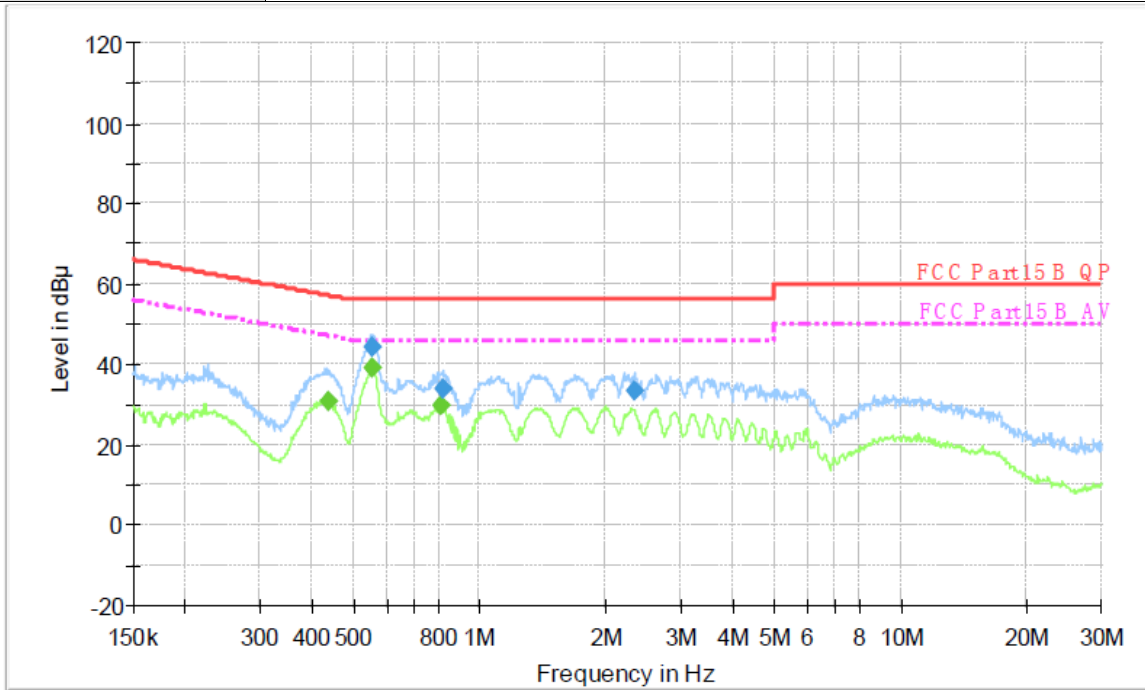
**Final Measurement Detector 2**

Frequency (MHz)	Average (dBµ V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµ V)	Comment
0.555580	37.4	1000.00	9.000	On	L1	9.7	8.6	46.0	
2.635710	29.7	1000.00	9.000	On	L1	9.7	16.3	46.0	
4.121670	29.3	1000.00	9.000	On	L1	9.7	16.7	46.0	

Emission Level= Read Level+ Correct Factor



<b>Test Voltage:</b>	AC 120V/60 Hz
<b>Terminal:</b>	Neutral
<b>Remark:</b>	Only worse case is reported



**Final Measurement Detector 1**

Frequency (MHz)	QuasiPeak (dBu V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBu V)	Comment
0.557810	44.2	1000.00	9.000	On	N	10.0	11.8	56.0	
0.815050	34.1	1000.00	9.000	On	N	10.0	21.9	56.0	
2.328910	33.6	1000.00	9.000	On	N	10.0	22.4	56.0	

**Final Measurement Detector 2**

Frequency (MHz)	Average (dBu V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBu V)	Comment
0.435500	30.6	1000.00	9.000	On	N	10.0	16.5	47.1	
0.555580	39.2	1000.00	9.000	On	N	10.0	6.8	46.0	
0.811810	29.9	1000.00	9.000	On	N	10.0	16.1	46.0	

Emission Level= Read Level+ Correct Factor



## 3.2. Radiated Emission

### Limit

#### FCC CFR Title 47 Part 15 Subpart C Section 15.209/ RSS – Gen 8.9

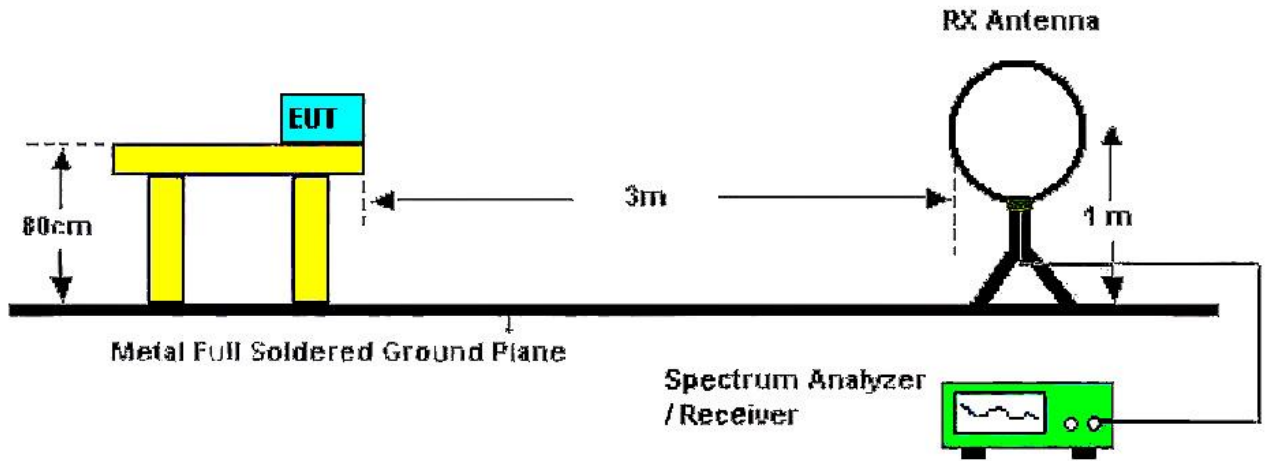
Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
960~1000	500	3

Frequency (MHz)	dB(uV/m) (at 3 meters)	
	Peak	Average
Above 1000	74	54

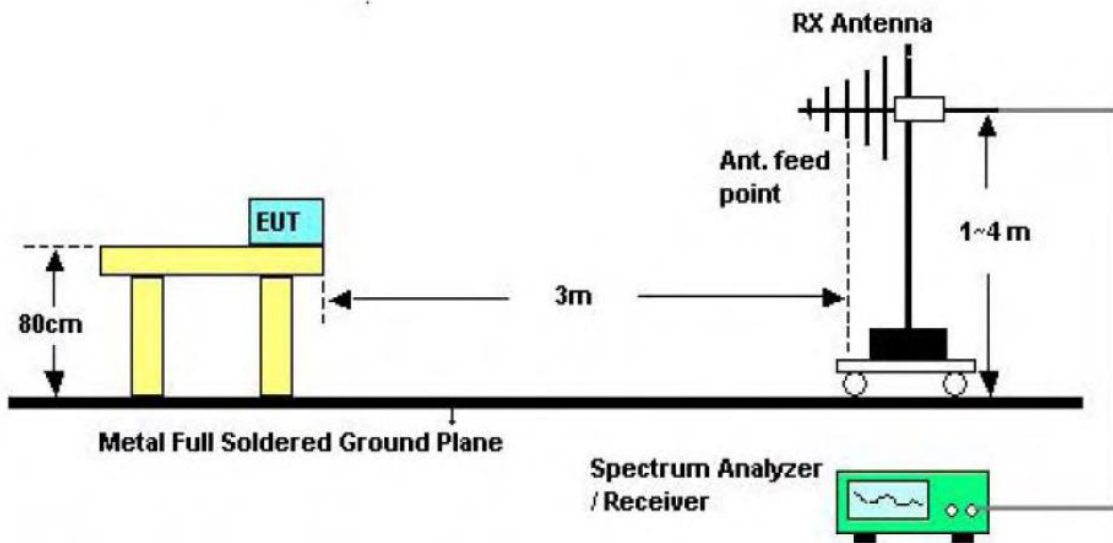
#### **Note:**

- (1) The tighter limit applies at the band edges.
- (2) Emission Level (dBuV/m)=20log Emission Level (uV/m).

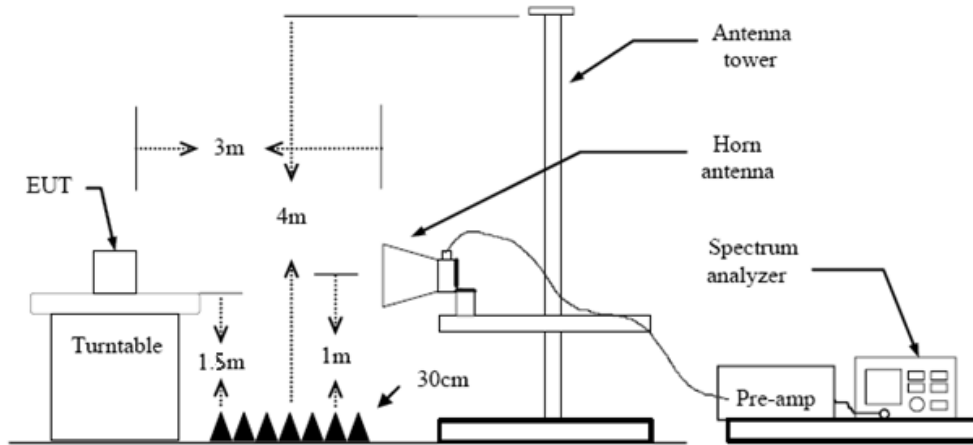
### Test Configuration



Below 30MHz Test Setup



30-1000MHz Test Setup



Above 1GHz Test Setup

### Test Procedure

1. The EUT was setup and tested according to ANSI C63.10:2013
2. The EUT is placed on a turn table which is 0.8 meter above ground for below 1 GHz, and 1.5 m for above 1 GHz. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was set 3 meters from the receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Use the following spectrum analyzer settings

(1) Span shall wide enough to fully capture the emission being measured;

(2) Below 1 GHz:

RBW=120 kHz, VBW=300 kHz, Sweep=auto, Detector function=peak, Trace=max hold;

If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

(3) From 1 GHz to 10<sup>th</sup> harmonic:

RBW=1MHz, VBW=3MHz Peak detector for Peak value.

RBW=1MHz, VBW see note 1 with Peak Detector for Average Value.

Note 1: For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements. For the Duty Cycle please refer to clause 3.8 Duty Cycle.

### Test Mode

Please refer to the clause 2.4.

### Test Result

#### **9 KHz~30 MHz**

From 9 KHz to 30 MHz: Conclusion: PASS

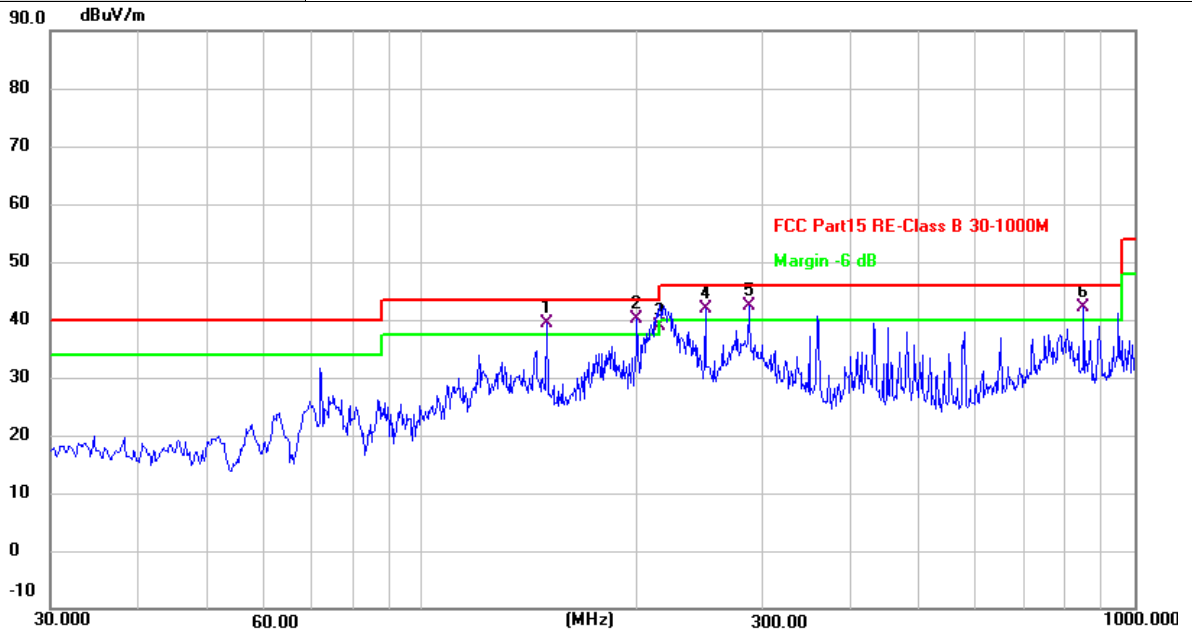
Note: The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.





30MHz-1GHz

Ant. Pol.	Horizontal
Test Mode:	TX Zigbee Mode 2405MHz
Remark:	Only worse case is reported.



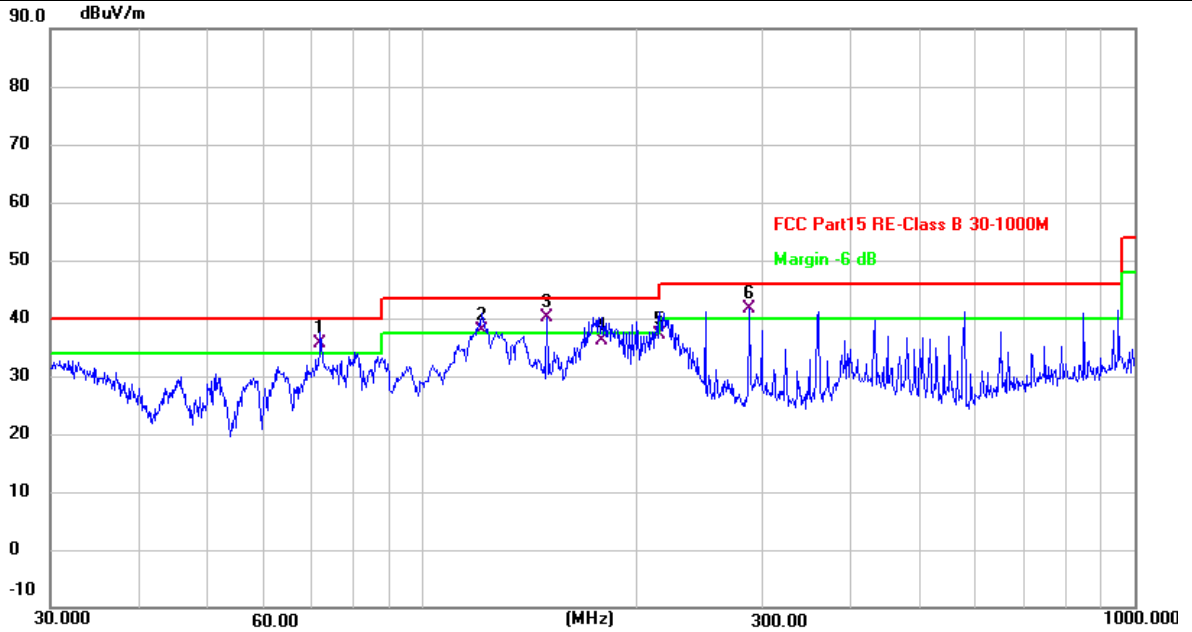
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1 !	149.9566	58.98	-19.60	39.38	43.50	-4.12	QP
2 *	200.0732	56.30	-16.07	40.23	43.50	-3.27	QP
3 !	215.5929	54.39	-15.62	38.77	43.50	-4.73	QP
4 !	249.8666	56.48	-14.64	41.84	46.00	-4.16	QP
5 !	287.6965	56.25	-13.82	42.43	46.00	-3.57	QP
6 !	849.9732	45.43	-3.34	42.09	46.00	-3.91	QP

Remarks:

- 1. Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 2. Margin value = Level -Limit value



<b>Ant. Pol.</b>	Vertical
<b>Test Mode:</b>	TX Zigbee Mode 2405MHz
<b>Remark:</b>	Only worse case is reported.



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1 !	71.8319	54.40	-18.83	35.57	40.00	-4.43	QP
2 !	121.1230	56.15	-18.25	37.90	43.50	-5.60	QP
3 *	149.4857	59.68	-19.62	40.06	43.50	-3.44	QP
4	178.7581	54.32	-18.12	36.20	43.50	-7.30	QP
5	215.2675	52.88	-15.63	37.25	43.50	-6.25	QP
6 !	287.9904	55.49	-13.81	41.68	46.00	-4.32	QP

Remarks:

- Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- Margin value = Level -Limit value



## Above 1GHz

<b>Ant. Pol.</b>	Horizontal
<b>Test Mode:</b>	TX Zigbee Mode 2405MHz
<b>Remark:</b>	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBUV)	Factor (dB/m)	Level (dBUV/m)	Limit (dBUV/m)	Margin (dB)	Detector
1	3859.667	40.34	0.05	40.39	74.00	-33.61	peak
2	4952.167	38.67	2.45	41.12	74.00	-32.88	peak
3	6389.667	38.87	6.87	45.74	74.00	-28.26	peak
4	7969.000	38.58	10.82	49.40	74.00	-24.60	peak
5	9322.167	39.14	11.80	50.94	74.00	-23.06	peak
6 *	11637.500	37.98	15.13	53.11	74.00	-20.89	peak

## Remarks:

- 1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 2.Margin value = Level -Limit value

<b>Ant. Pol.</b>	Vertical
<b>Test Mode:</b>	TX Zigbee Mode 2405MHz
<b>Remark:</b>	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBUV)	Factor (dB/m)	Level (dBUV/m)	Limit (dBUV/m)	Margin (dB)	Detector
1	3836.667	40.89	-0.03	40.86	74.00	-33.14	peak
2	4733.667	41.85	2.01	43.86	74.00	-30.14	peak
3	6408.833	38.84	6.93	45.77	74.00	-28.23	peak
4	8333.167	39.39	10.81	50.20	74.00	-23.80	peak
5	9916.333	38.41	12.83	51.24	74.00	-22.76	peak
6 *	11660.500	37.92	15.15	53.07	74.00	-20.93	peak

## Remarks:

- 1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 2.Margin value = Level -Limit value



<b>Ant. Pol.</b>	Horizontal
<b>Test Mode:</b>	TX Zigbee Mode 2445MHz
<b>Remark:</b>	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBUV)	Factor (dB/m)	Level (dBUV/m)	Limit (dBUV/m)	Margin (dB)	Detector
1	3438.000	41.81	-1.35	40.46	74.00	-33.54	peak
2	4718.333	40.14	1.98	42.12	74.00	-31.88	peak
3	6006.333	38.72	5.47	44.19	74.00	-29.81	peak
4	7183.167	38.49	9.47	47.96	74.00	-26.04	peak
5	8781.667	39.75	11.01	50.76	74.00	-23.24	peak
6 *	11534.000	37.82	15.03	52.85	74.00	-21.15	peak

Remarks:

- 1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 2.Margin value = Level -Limit value

<b>Ant. Pol.</b>	Vertical
<b>Test Mode:</b>	TX Zigbee Mode 2445MHz
<b>Remark:</b>	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBUV)	Factor (dB/m)	Level (dBUV/m)	Limit (dBUV/m)	Margin (dB)	Detector
1	2790.167	42.20	-2.63	39.57	74.00	-34.43	peak
2	4998.167	39.01	2.56	41.57	74.00	-32.43	peak
3	6995.333	37.86	9.13	46.99	74.00	-27.01	peak
4	8781.667	40.42	11.01	51.43	74.00	-22.57	peak
5	10257.500	38.73	13.42	52.15	74.00	-21.85	peak
6 *	11710.333	37.71	15.19	52.90	74.00	-21.10	peak

Remarks:

- 1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 2.Margin value = Level -Limit value



<b>Ant. Pol.</b>	Horizontal
<b>Test Mode:</b>	TX Zigbee Mode 2480MHz
<b>Remark:</b>	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBUV)	Factor (dB/m)	Level (dBUV/m)	Limit (dBUV/m)	Margin (dB)	Detector
1	3231.000	40.80	-1.74	39.06	74.00	-34.94	peak
2	3905.667	40.33	0.20	40.53	74.00	-33.47	peak
3	4764.333	40.49	2.07	42.56	74.00	-31.44	peak
4	8229.667	38.35	10.83	49.18	74.00	-24.82	peak
5 *	10384.000	39.32	13.64	52.96	74.00	-21.04	peak
6	11468.833	37.68	15.00	52.68	74.00	-21.32	peak

Remarks:

- 1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 2.Margin value = Level -Limit value

<b>Ant. Pol.</b>	Vertical
<b>Test Mode:</b>	TX Zigbee Mode 2480MHz
<b>Remark:</b>	No report for the emission which more than 20 dB below the prescribed limit.

No.	Frequency (MHz)	Reading (dBUV)	Factor (dB/m)	Level (dBUV/m)	Limit (dBUV/m)	Margin (dB)	Detector
1	3675.667	41.12	-0.60	40.52	74.00	-33.48	peak
2	4864.000	40.14	2.28	42.42	74.00	-31.58	peak
3	6527.667	39.07	7.37	46.44	74.00	-27.56	peak
4	8041.833	39.94	10.87	50.81	74.00	-23.19	peak
5	9862.667	38.73	12.74	51.47	74.00	-22.53	peak
6 *	10855.500	38.09	14.65	52.74	74.00	-21.26	peak

Remarks:

- 1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 2.Margin value = Level -Limit value

### 3.3. Band Edge Emissions (Radiated)

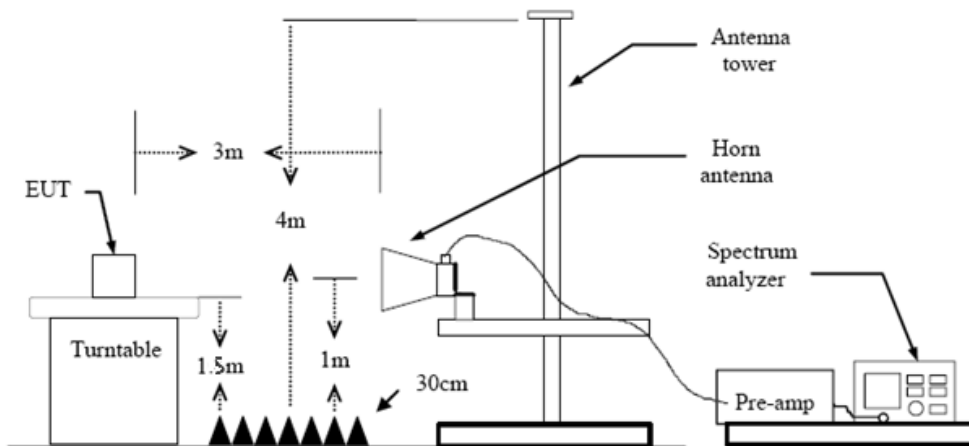
**Limit**

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d)/ RSS-247 5.5:

Restricted Frequency Band (MHz)	(dBuV/m)(at 3m)	
	Peak	Average
2310 ~ 2390	74	54
2483.5 ~ 2500	74	54

**Conducted band edge limit: The highest point of the operating frequency waveform down 20dB**

**Test Configuration**



**Test Procedure**

1. The EUT was setup and tested according to ANSI C63.10:2013 requirements.
2. The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.
5. The receiver set as follow:  
 RBW=1MHz, VBW=3MHz Peak detector for Peak value.  
 RBW=1MHz, VBW see note 1 with Peak Detector for Average Value.  
 Note 1: For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements. For the Duty Cycle please refer to clause 3.8 Duty Cycle.

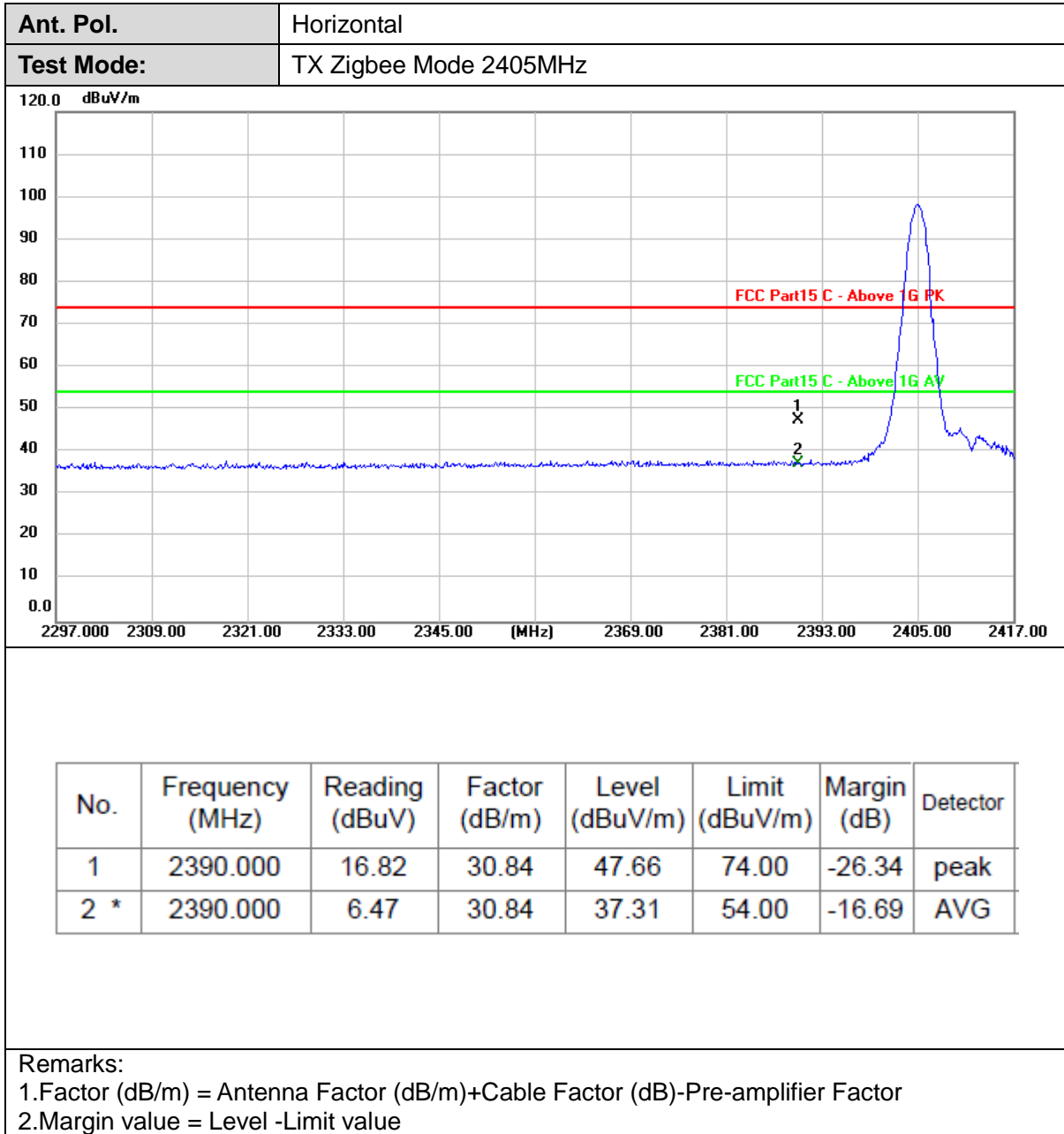
**Test Mode**

Please refer to the clause 2.4.

**Test Results**



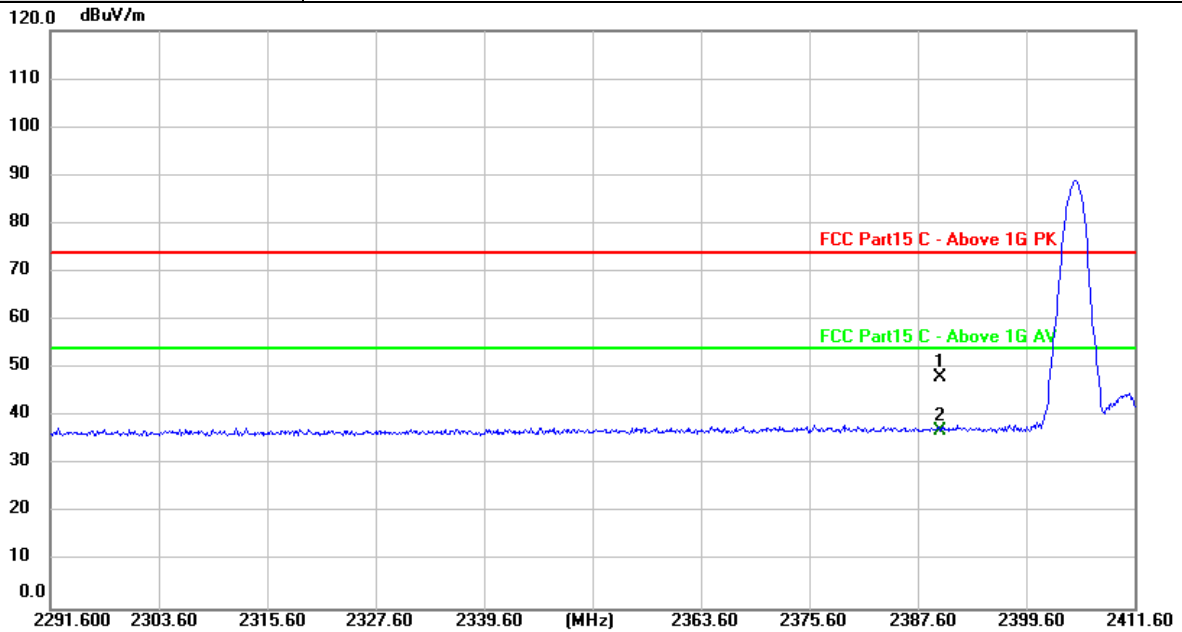
(1) Radiation Test







<b>Ant. Pol.</b>	Vertical
<b>Test Mode:</b>	TX Zigbee Mode 2405MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2390.000	17.40	30.84	48.24	74.00	-25.76	peak
2 *	2390.000	6.21	30.84	37.05	54.00	-16.95	AVG

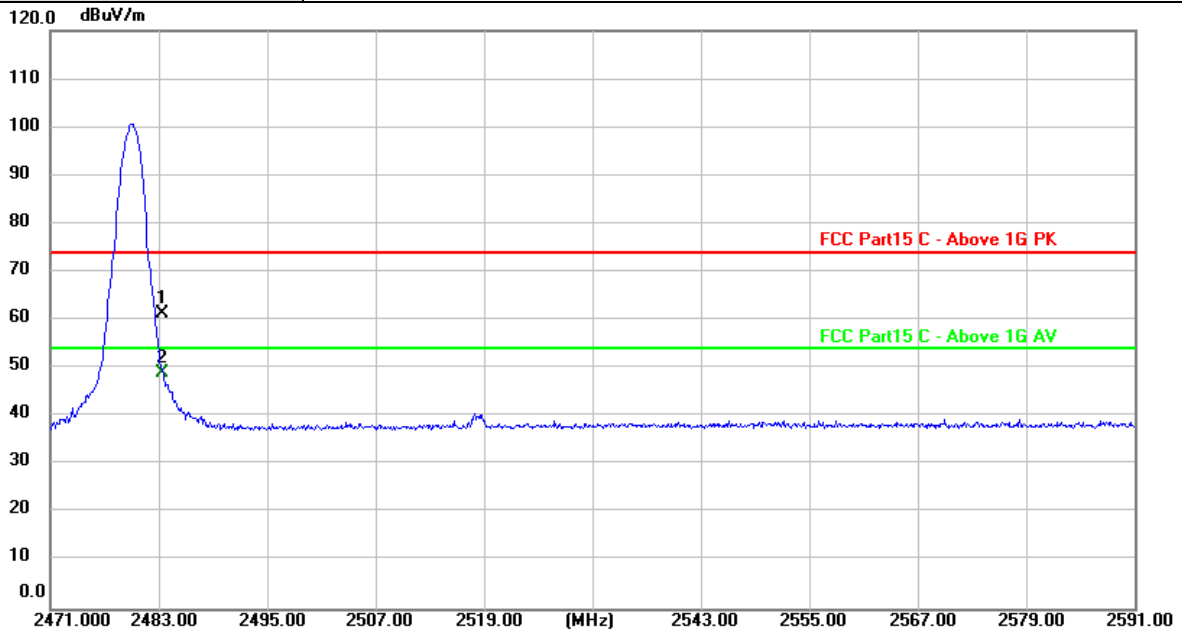
Remarks:

- 1. Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 2. Margin value = Level -Limit value





Ant. Pol.	Horizontal
Test Mode:	TX Zigbee Mode 2480MHz



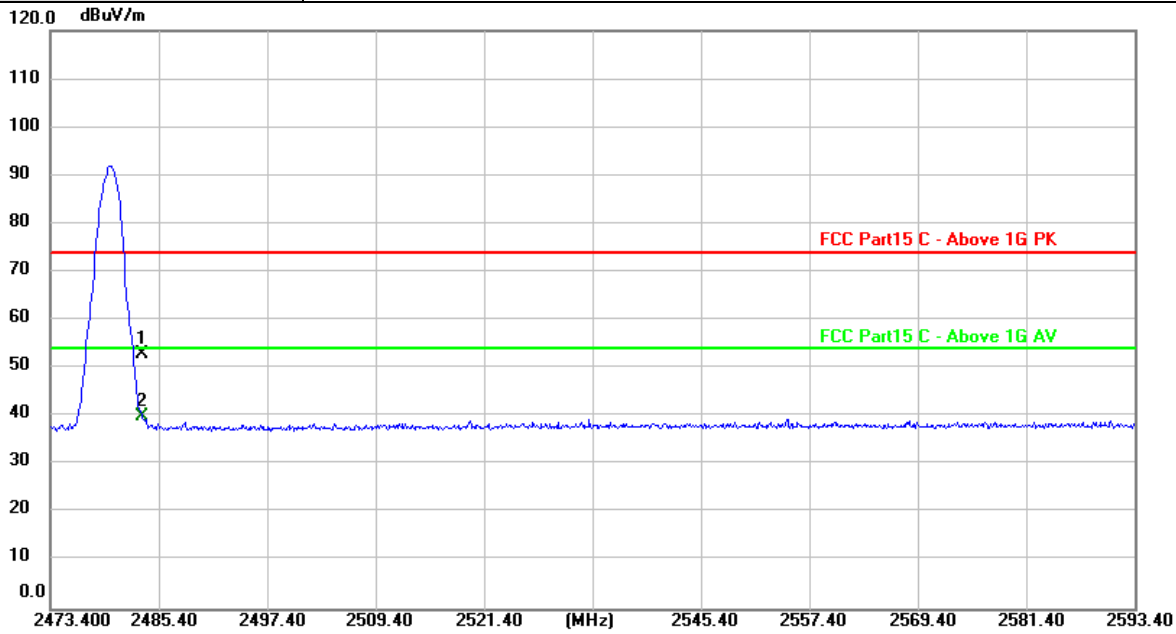
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2483.500	30.19	31.24	61.43	74.00	-12.57	peak
2 *	2483.500	17.81	31.24	49.05	54.00	-4.95	AVG

Remarks:

- 1. Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 2. Margin value = Level -Limit value



<b>Ant. Pol.</b>	Vertical
<b>Test Mode:</b>	TX Zigbee Mode 2480MHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2483.500	21.78	31.24	53.02	74.00	-20.98	peak
2 *	2483.500	8.87	31.24	40.11	54.00	-13.89	AVG

Remarks:

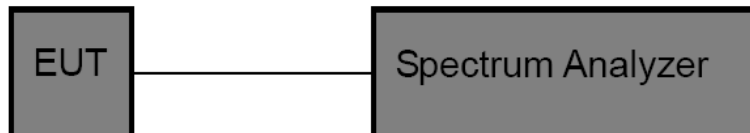
- 1. Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 2. Margin value = Level -Limit value

### 3.4. Band edge and Spurious Emissions (Conducted)

#### Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

#### Test Configuration



#### Test Procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:  
RBW = 100 kHz, VBW  $\geq$  RBW, scan up through 10<sup>th</sup> harmonic.  
Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

#### Test Mode

Please refer to the clause 2.4.

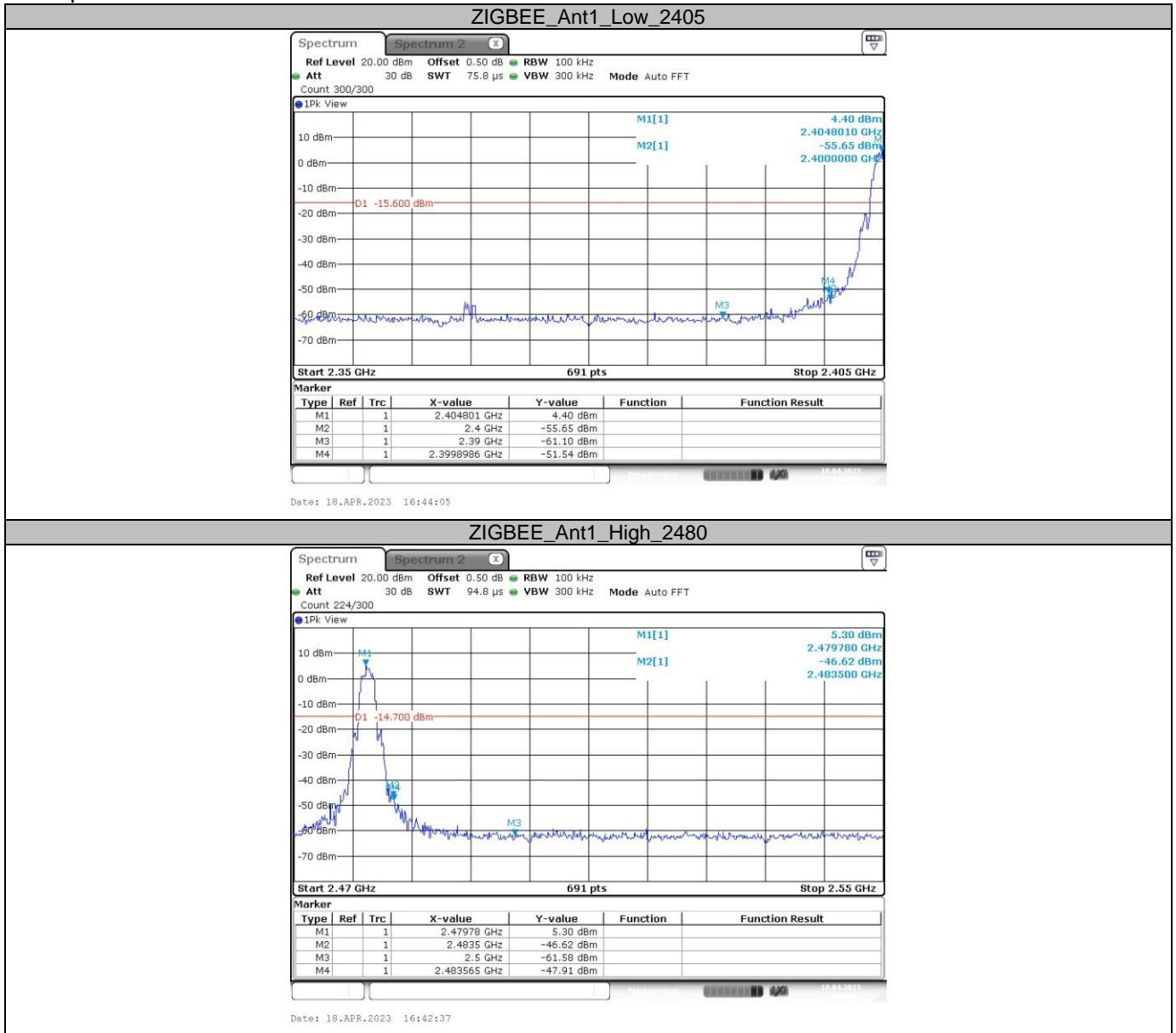
#### Test Results

##### (1) Band edge Conducted Test

Test Mode	ChName	Channel	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
Zigbee	Low	2405	4.40	-51.54	$\leq -15.60$	PASS
	High	2480	5.30	-47.91	$\leq -14.70$	PASS



Test plot as follows:



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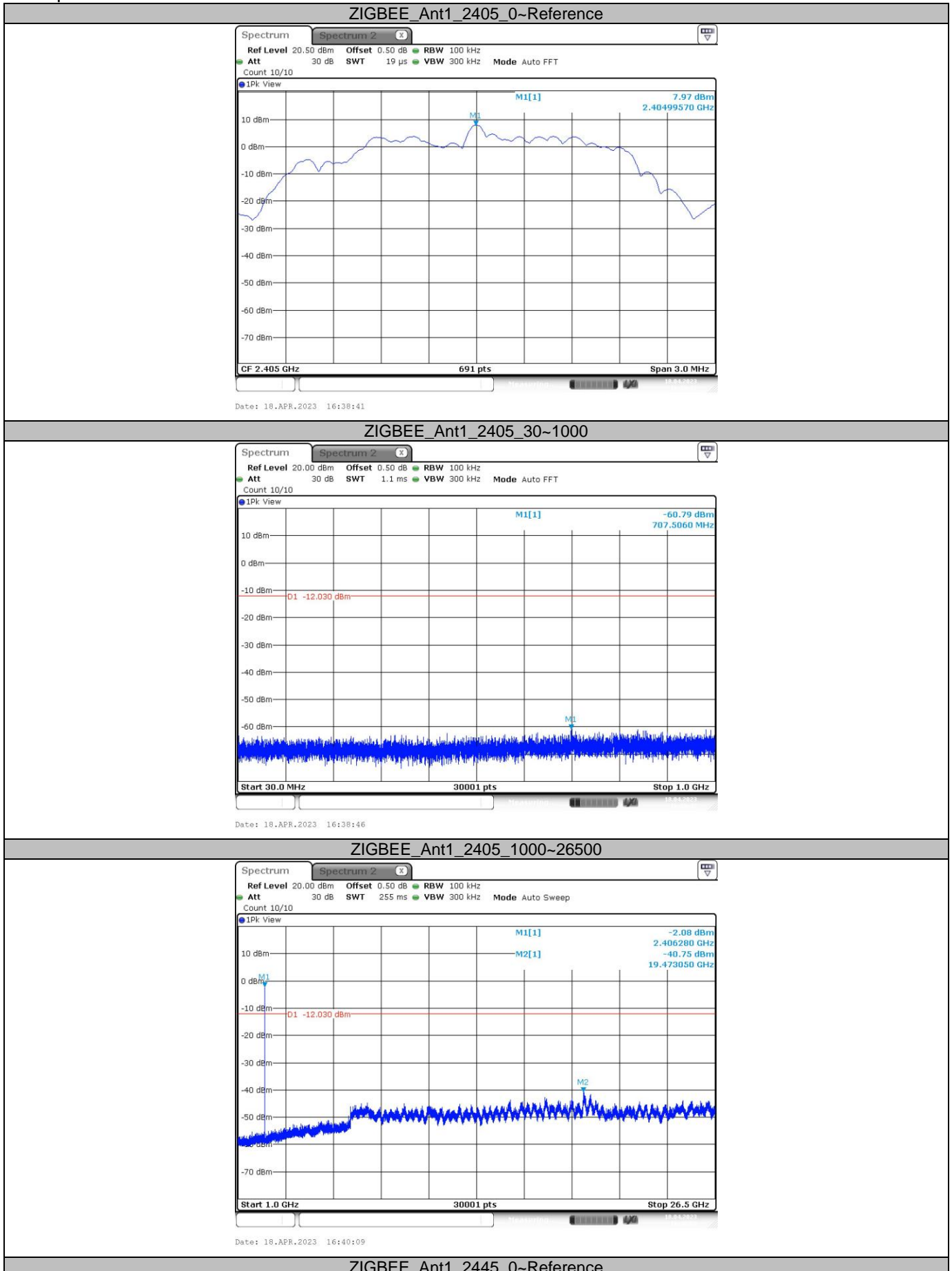
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**(2) Conducted Spurious Emissions Test**

Test Mode	Channel	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
Zigbee	2405	Reference	7.97	7.97	---	PASS
		30~1000	7.97	-60.79	$\leq -12.03$	PASS
		1000~26500	7.97	-40.75	$\leq -12.03$	PASS
	2445	Reference	10.10	10.10	---	PASS
		30~1000	10.10	-59.56	$\leq -9.90$	PASS
		1000~26500	10.10	-41.06	$\leq -9.90$	PASS
	2480	Reference	10.57	10.57	---	PASS
		30~1000	10.57	-61.00	$\leq -9.43$	PASS
		1000~26500	10.57	-42.28	$\leq -9.43$	PASS



Test plot as follows:



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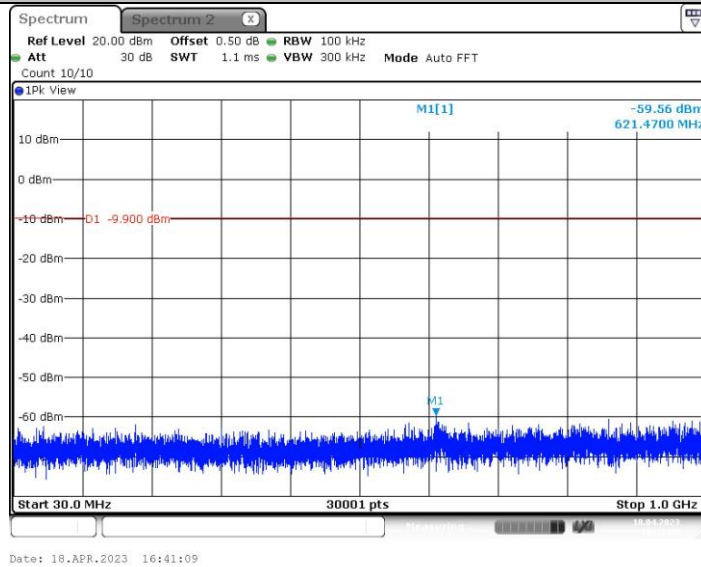
1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China  
 Tel.: (86)755-27521059 Fax: (86)755-27521011 Http://www.sz-ctc.org.cn



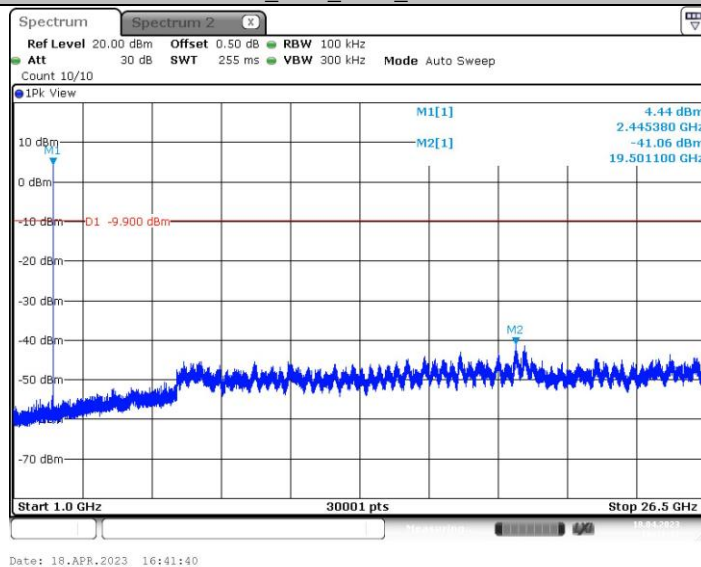
For anti-fake verification, please visit the official website of Certification and Accreditation Administration of the People's Republic of China : [yz.cnca.cn](http://yz.cnca.cn)



ZIGBEE\_Ant1\_2445\_30~1000



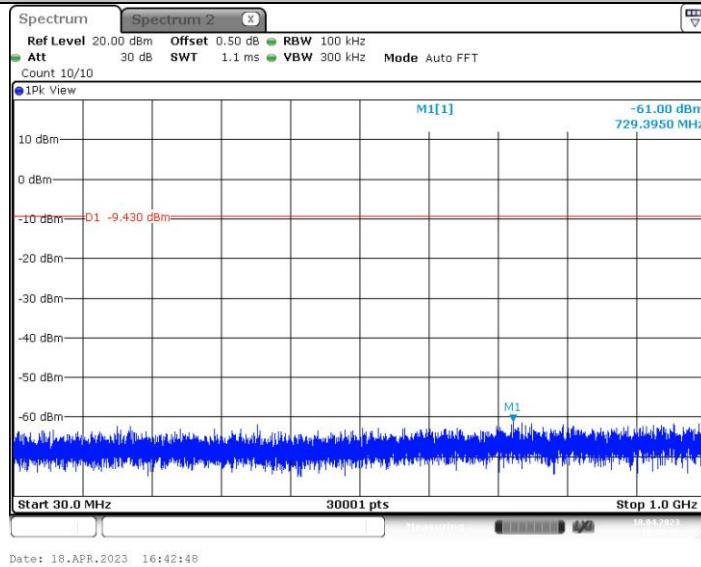
ZIGBEE\_Ant1\_2445\_1000~26500



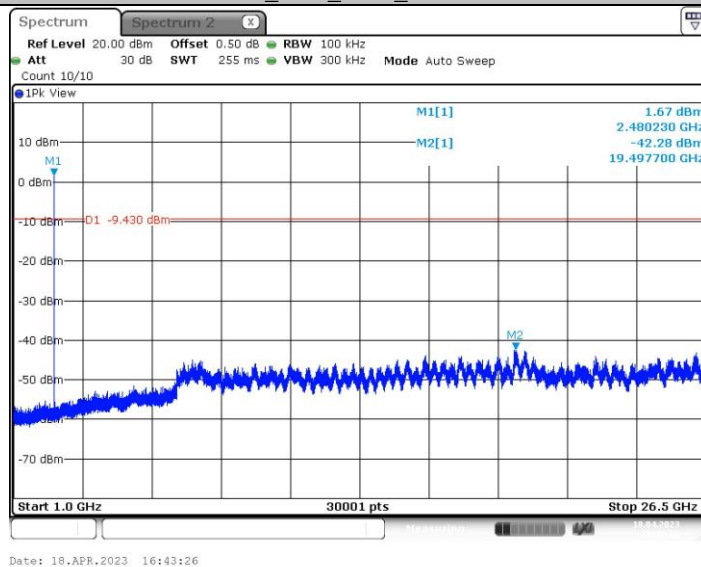
ZIGBEE\_Ant1\_2480\_0~Reference



ZIGBEE\_Ant1\_2480\_30~1000



ZIGBEE\_Ant1\_2480\_1000~26500





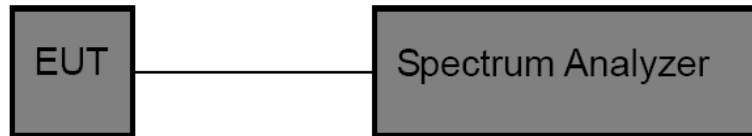
### 3.5. DTS Bandwidth

**Limit**

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(2)/ RSS-247 5.2 a:

Test Item	Limit	Frequency Range(MHz)
DTS Bandwidth	≥500 KHz (6dB bandwidth)	2400~2483.5

**Test Configuration**



**Test Procedure**

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- DTS Spectrum Setting:
  - Set RBW = 100 kHz.
  - Set the video bandwidth (VBW) ≥ 3 RBW.
  - Detector = Peak.
  - Trace mode = Max hold.
  - Sweep = Auto couple.
- OCB Spectrum Setting:
  - Set RBW = 1% ~ 5% occupied bandwidth.
  - Set the video bandwidth (VBW) ≥ 3 RBW.
  - Detector = Peak.
  - Trace mode = Max hold.
  - Sweep = Auto couple.

NOTE: The EUT was set to continuously transmitting in each mode and low, Middle and high channel for the test.

**Test Mode**

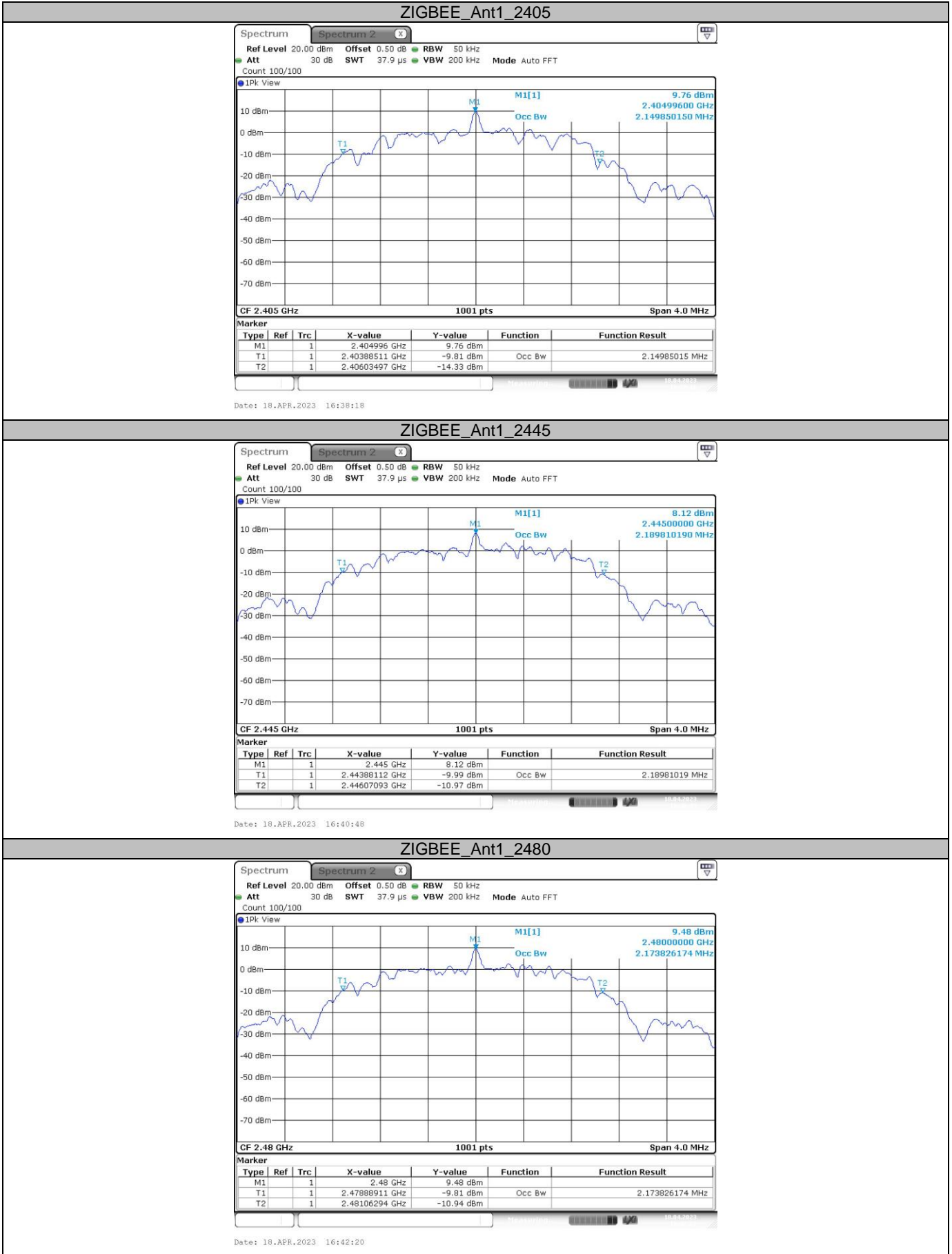
Please refer to the clause 2.4.

**Test Results**

Test Mode	Channel	99% Bandwidth (MHz)	DTS Bandwidth (MHz)	Limit (kHz)	Result
Zigbee	2405	2.150	0.788	≥500	Pass
	2445	2.190	0.945		
	2480	2.174	1.296		



99% Bandwidth:



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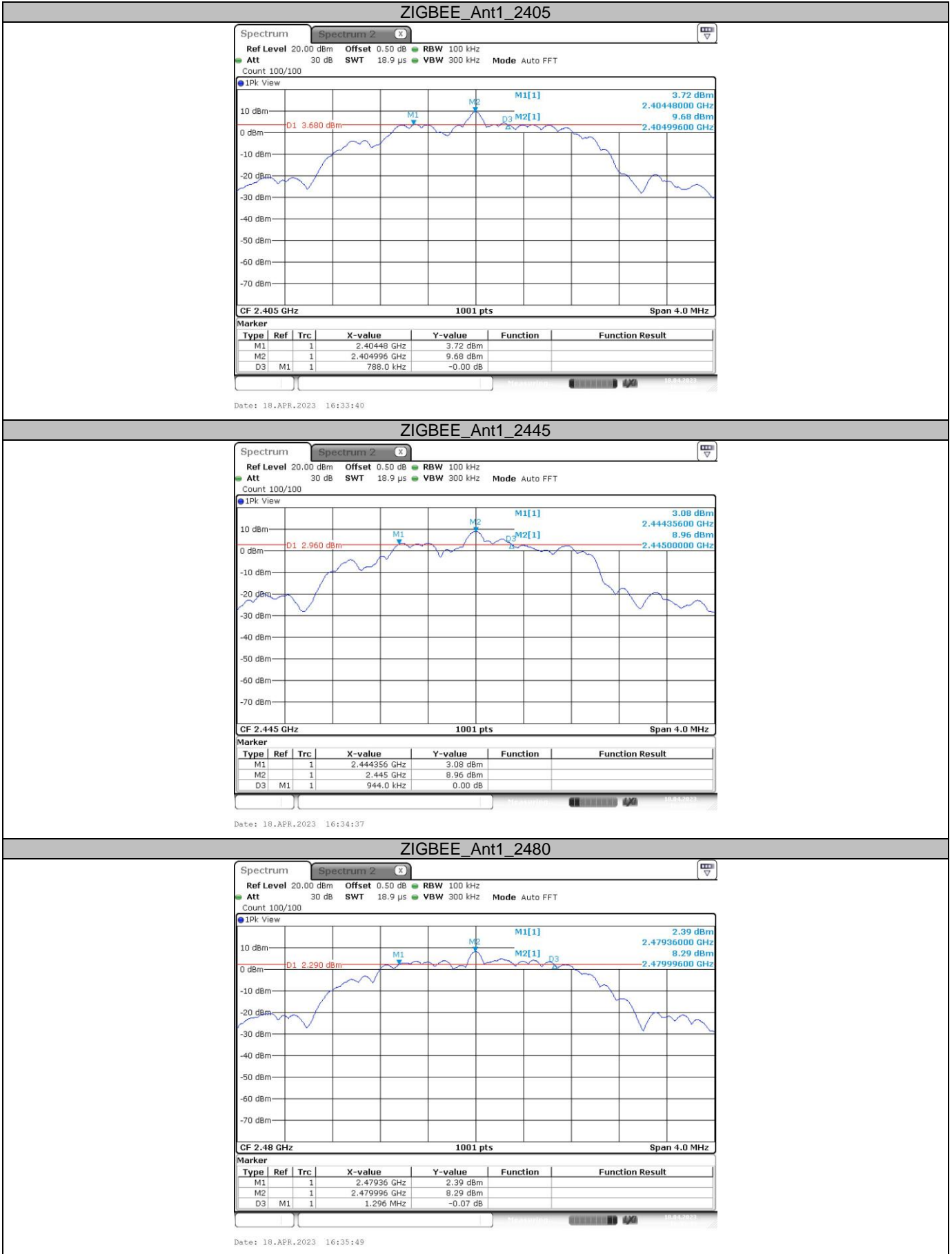
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DTS Bandwidth:



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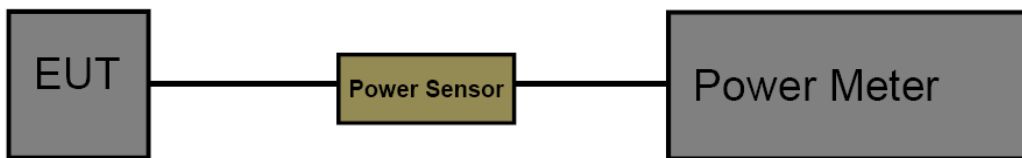
### 3.6. Peak Output Power

**Limit**

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (b)(3)/ RSS-247 5.4 d:

Section	Test Item	Limit	Frequency Range(MHz)
CFR 47 FCC 15.247(b)(3)	Maximum conducted output power	1 Watt or 30dBm	2400~2483.5
ISED RSS-247 5.4 d	EIRP	4 Watt or 36dBm	2400~2483.5

**Test Configuration**



**Test Procedure**

1. The maximum conducted output power may be measured using a broadband Peak RF power meter.
2. Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor.
3. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.
4. Record the measurement data.

**Test Mode**

Please refer to the clause 2.4.

**Test Result**

Test Mode	Channel	Output power (dBm)	Limit (dBm)	Result
Zigbee	2405	11.45	≤30.00	Pass
	2445	11.41		
	2480	11.40		

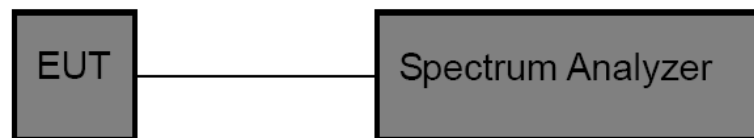
### 3.7. Power Spectral Density

#### Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (e)/ RSS-247 5.2 b:

Test Item	Limit	Frequency Range(MHz)
Power Spectral Density	8dBm(in any 3 kHz)	2400~2483.5

#### Test Configuration



#### Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in the block diagram above. The measurement according to section 10.2 of KDB 558074 D01 DTS Meas Guidance v05r02.
3. Spectrum Setting:  
Set analyzer center frequency to DTS channel center frequency.  
Set the span to 1.5 times the DTS bandwidth.  
Set the RBW to: 3 kHz  
Set the VBW to: 10 kHz  
Detector: peak  
Sweep time: auto  
Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

#### Test Mode

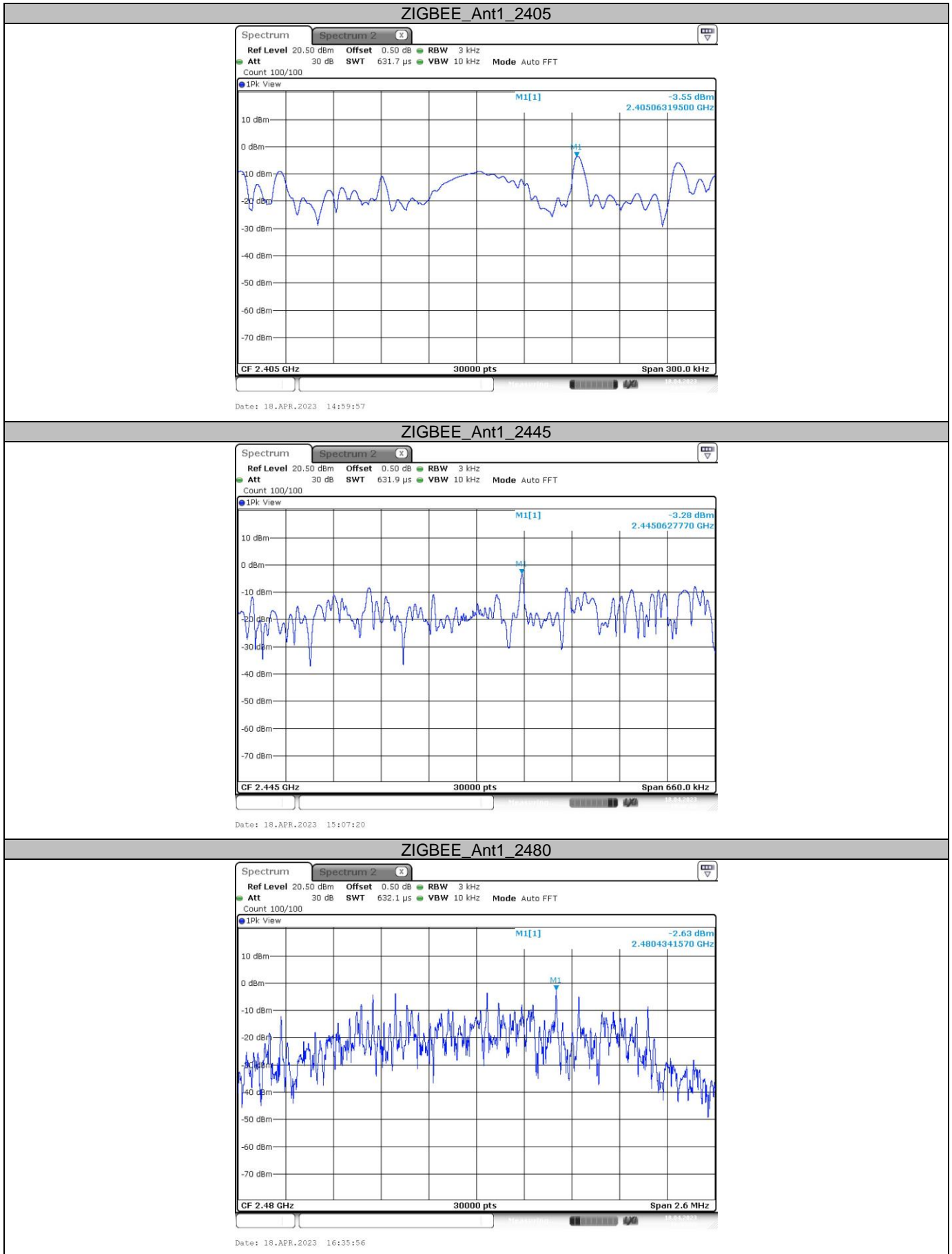
Please refer to the clause 2.4.

#### Test Result

Test Mode	Channel	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
Zigbee	2405	-3.55	≤8.00	Pass
	2445	-3.28		
	2480	-2.63		



Test plot as follows:



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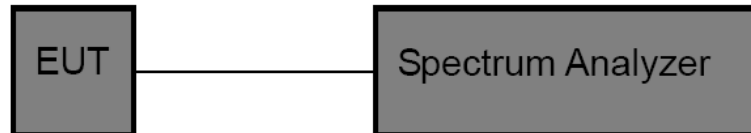
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### 3.8. Duty Cycle

#### Limit

None, for report purposes only.

#### Test Configuration



#### Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in the block diagram above. The measurement according to section 10.2 of KDB 558074 D01 DTS Meas Guidance v05r02.
3. Spectrum Setting:  
Set analyzer center frequency to test channel center frequency.  
Set the span to 0Hz  
Set the RBW to 10MHz  
Set the VBW to 10MHz  
Detector: Peak  
Sweep time: Auto  
Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

#### Test Mode

Please refer to the clause 2.4.

#### Test Result

Test Mode	Frequency [MHz]	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]	1/T Minimum VBW (kHz)	Final setting For VBW (kHz)
Zigbee	2405	0.34	20.49	1.66	2.94	3
	2445	0.34	20.49	1.66	2.94	3
	2480	0.34	20.49	1.66	2.94	3

Note: Duty Cycle>98%, VBW=10Hz





Test plot as follows:



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### 3.9. Antenna Requirement

#### Requirement

**FCC CFR Title 47 Part 15 Subpart C Section 15.203:**

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

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

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

#### Test Result

The directional gain of the antenna less than 6dBi, please refer to the EUT internal photographs antenna photo.

\*\*\*\*\*THE END\*\*\*\*\*