

CTC Laboratories, Inc.

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Т	EST REPORT				
Report No. ······	GTI20190526F-1				
FCC ID······:	2AKIT-AK024				
Applicant·····:	Lumi United Technology Co., Ltd				
Address	8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen, China				
Manufacturer	Lumi United Technology Co., Ltd				
Address······	8th Floor, JinQi Wisdom Valley, No.1 Ta Taoyuan Residential District, Nanshan I	• •			
Product Name·····:	Smart Wall Switch(With Neutral, Doul	ble Rocker)			
Trade Mark······:	AQara				
Model/Type reference······:	WS-USC04				
Listed Model(s) ······	Please see the page 7				
Standard:	FCC CFR Title 47 Part 15 Subpart C Section 15.247 RSS 247 Issue 2				
Date of receipt of test sample:	Mar. 20, 2019				
Date of testing	Mar. 21, 2019 to Apr. 07, 2019				
Date of issue	Apr. 08, 2019				
Result:	PASS				
Compiled by:		Terry.Su			
(Printed name+signature)	Terry Su				
Supervised by: ( Printed name+signature)	Eric Zhang	Terry.Su Zric shang			
Approved by:					
(Printed name+signature)	Walter Chen	Matter chis			
Testing Laboratory Name	CTC Laboratories, Inc.				
Address	1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China				
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test report shall be invalid without all the signatures of testing engineers, reviewer and approver. Any objections must be raised to CTC within 15 days since the date when the report is received. It will not be taken into consideration beyond this limit. The test report merely correspond to the test sample.



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# 1. TEST SUMMARY

# 1.1. Test Standards

The tests were performed according to following standards:

<u>FCC Rules Part 15.247</u>: Operation within the bands of 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz. <u>RSS 247 Issue 2</u>: Standard Specifications for Frequency Hopping Systems (FHSs) and Digital Transmission Systems (DTSs) Operating in the Bands 902-928MHz, 2400-2483.5MHz and 5725-5850MHz. <u>ANSI C63.10-2013</u>: American National Standard for Testing Unlicensed Wireless Devices.

# 1.2. Report version

Revised No.	Date of issue	Description
01	Apr. 08, 2019	Original

CTC Laboratories, Inc. 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China Tel.: (86)755-27521059 中国国家认证认可监督管理委员会 For anti-fake verification, please visit the official website of Certification and Accreditation Administration of the People's Republic of China : <u>vz.cncaic.cn</u>



# **1.3. Test Description**

FCC Part 15 Subpart C(15.247)/ RSS 247 Issue 2						
Test Item	Standard	Result				
rest item	FCC IC		Result	Test Engineer		
Antenna Requirement	15.203	/	Pass	Terry Su		
Conducted Emission	15.207(a)	RSS-GEN 7.2.4	Pass	Terry Su		
Band-Edge & Unwanted Emissions into Restricted Frequency	15.205&15.247(d)	RSS-GEN 7.2.2	Pass	Terry Su		
6dB Bandwidth	15.247(a)(2)	RSS 247 5.2 (1)	Pass	Terry Su		
Conducted Max Output Power	15.247(b)(3)	RSS 247 5.4 (4)	Pass	Terry Su		
Power Spectral Density	15.247(e)	RSS 247 5.2 (2)	Pass	Terry Su		
Transmitter Radiated Spurious &Unwanted Emissions into Restricted Frequency	15.205, 15.209&15.247(d)	RSS 247 5.5	Pass	Terry Su		

Note: The measurement uncertainty is not included in the test result.



## Address of the report laboratory

### 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:

#### CNAS-Lab Code: L5365

CTC Laboratories, Inc. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories.

#### A2LA-Lab Cert. No.: CN1208

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 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

#### IC Registration No.: 9783A-1

The 3m alternate test site of CTC Laboratories, Inc. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: CN0029 on Dec, 2018.

#### FCC-Registration No.: 951311

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=1.96.

# **1.6. Environmental conditions**

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

Temperature:	15~35°C
Relative Humidity:	30~60 %
Air Pressure:	950~1050mba



# 2. GENERAL INFORMATION

# 2.1. Client Information

Applicant:	Lumi United Technology Co., Ltd	
Address:	8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen, China	
Manufacturer:	Lumi United Technology Co., Ltd	
Address:	8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen, China	

# 2.2. General Description of EUT

Product Name:	Smart Wall Switch(With Neutral, Double Rocker)
Marketing Name:	AQara
Model/Type reference:	WS-USC04
Listed Model(s):	Smart Wall Switch(With Neutral, Single Rocker):WS-USC03, WS-USC03-C1, WS-USC03-C2, WS-USC03-C3,WS-USC03-C4, WS-USC03-C5, WS-USC03-C6, QBKG15LM,QBKG15LM-C1, QBKG15LM-C2, QBKG15LM-C3, QBKG15LM-C4,QBKG15LM-C5, QBKG15LM-C6Smart Wall Switch(With Neutral, Double Rocker):WS-USC04-C1, WS-USC04-C2, WS-USC04-C3, WS-USC04-C4,WS-USC04-C5, WS-USC04-C2, WS-USC04-C3, WS-USC04-C4,QBKG16LM-C2, QBKG16LM-C3, QBKG16LM, QBKG16LM-C1,QBKG16LM-C2, QBKG16LM-C3, QBKG16LM-C4, QBKG16LM-C5,QBKG16LM-C6
Model Difference:	All these models are identical in the same PCB, layout and electrical circuit, the only difference is rocker quantity.
Power supply:	AC 120V/60Hz
Hardware version:	V1.0.1
Software version:	V1.0.1
Zigbee	
Operation frequency:	2405MHz~2480MHz
Max Peak Output Power:	18.04dBm
Channel number:	16
Channel separation:	5MHz
Antenna type:	PCB Antenna
Antenna gain:	2dBi



# 2.3. Operation state

Operation Frequency List: 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)	Test software power Settings
11	2405	-5
12	2410	
:	÷	÷
17	2435	
18	2440	-5
19	2445	
÷	÷	÷
25	2475	
26	2480	-15.75

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

## Test mode

For RF test items:

The software test program was provided and enabled to make EUT continuous transmit (duty cycle>98%).

For AC power line conducted emissions:

The EUT was set to connect with the Zigbee 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.



# 2.4. Measurement Instruments List

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated until
1	Spectrum Analyzer	Rohde & Schwarz	FSU26	100105	Dec. 27, 2018	Dec. 28, 2019
2	Spectrum Analyzer	Rohde & Schwarz	FUV40-N	101331	Jun. 21, 2018	Jun. 22, 2019
3	MXG Vector Signal Generator	Agilent	N5182A	MY47420864	Dec. 27, 2018	Dec. 28, 2019
4	Signal Generator	Agilent	E8257D	MY46521908	Dec. 27, 2018	Dec. 28, 2019
5	Power Sensor	Agilent	U2021XA	MY5365004	Dec. 27, 2018	Dec. 28, 2019
6	Power Sensor	Agilent	U2021XA	MY5365006	Dec. 27, 2018	Dec. 28, 2019
7	Simultaneous Sampling DAQ	Agilent	U2531A	TW54493510	Dec. 27, 2018	Dec. 28, 2019
8	Climate Chamber	TABAI	PR-4G	A8708055	Dec. 27, 2018	Dec. 28, 2019
9	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	116410	Dec. 27, 2018	Dec. 28, 2019
10	Climate Chamber	ESPEC	MT3065	/	Dec. 27, 2018	Dec. 28, 2019
11	300328 v2.1.1 test system	TONSCEND	v2.6	/	/	/

Conducted Emission						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated until
1	LISN	R&S	ENV216	101112	Dec. 27, 2018	Dec. 28, 2019
2	LISN	R&S	ENV216	101113	Dec. 27, 2018	Dec. 28, 2019
3	EMI Test Receiver	R&S	ESCI	100920	Dec. 27, 2018	Dec. 28, 2019
4	ISN CAT6	Schwarzbeck	NTFM 8158	8158-0046	Dec. 27, 2018	Dec. 28, 2019

Radiated Emission						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated until
1	EMI Test Receiver	Rohde & Schwarz	ESCI	100658	Dec. 27, 2018	Dec. 28, 2019
2	High pass filter	micro-tranics	HPM50111	142	Dec. 27, 2018	Dec. 28, 2019
3	Log-Bicon Antenna	Schwarzbeck	CBL6141A	4180	Dec. 27, 2018	Dec. 28, 2019
4	Ultra-Broadba nd Antenna	SchwarzBeck	BBHA9170	25841	Dec. 27, 2018	Dec. 28, 2019
5	Loop Antenna	LAPLAC	RF300	9138	Dec. 27, 2018	Dec. 28, 2019
6	Spectrum Analyzer	Rohde & Schwarz	FSU26	100105	Dec. 27, 2018	Dec. 28, 2019
7	Horn Antenna	Schwarzbeck	BBHA 9120D	647	Dec. 27, 2018	Dec. 28, 2019
8	Pre-Amplifier	HP	8447D	1937A030 50	Dec. 27, 2018	Dec. 28, 2019
9	Pre-Amplifier	EMCI	EMC051835	980075	Dec. 27, 2018	Dec. 28, 2019
10	Antenna Mast	UC	UC3000	N/A	N/A	N/A
11	Turn Table	UC	UC3000	N/A	N/A	N/A
12	Cable Below 1GHz	Schwarzbeck	AK9515E	33155	Dec. 27, 2018	Dec. 28, 2019
13	Cable Above 1GHz	Hubersuhner	SUCOFLEX10 2	DA1580	Dec. 27, 2018	Dec. 28, 2019
14	Splitter	Mini-Circuit	ZAPD-4	400059	Dec. 27, 2018	Dec. 28, 2019
15	RF Connection Cable	HUBER+SUHN ER	RE-7-FL	N/A	Dec. 27, 2018	Dec. 28, 2019
16	RF Connection	Chengdu			Dec. 27, 2018	Dec. 28, 2019

CTC Laboratories, Inc.

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	Cable	E-Microwave				
17	High pass filter	Compliance Direction systems	BSU-6	34202	Dec. 27, 2018	Dec. 28, 2019
18	Attenuator	Chengdu E-Microwave	EMCAXX-10R NZ-3		Dec. 27, 2018	Dec. 28, 2019

Note: 1. The cable loss has calculated in test result which connection between each test instruments.



# 3. TEST ITEM AND RESULTS

# 3.1. Conducted Emission

# <u>Limit</u>

## **Conducted Emission Test Limit**

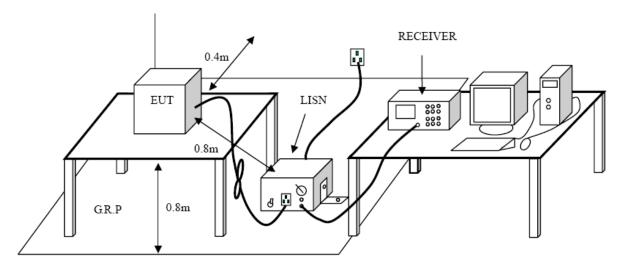
Frequency	Maximum RF Line Voltage (dBμV)						
Frequency	Quasi-peak Level	Average Level					
150kHz~500kHz	66 ~ 56 *	56 ~ 46 *					
500kHz~5MHz	56	46					
5MHz~30MHz	60	50					

#### Notes:

(1) \*Decreasing linearly with logarithm of the frequency.

- (2) The lower limit shall apply at the transition frequencies.
- (3) The limit decrease in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

#### **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.

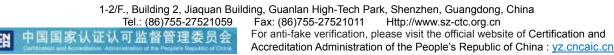
The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs)

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.

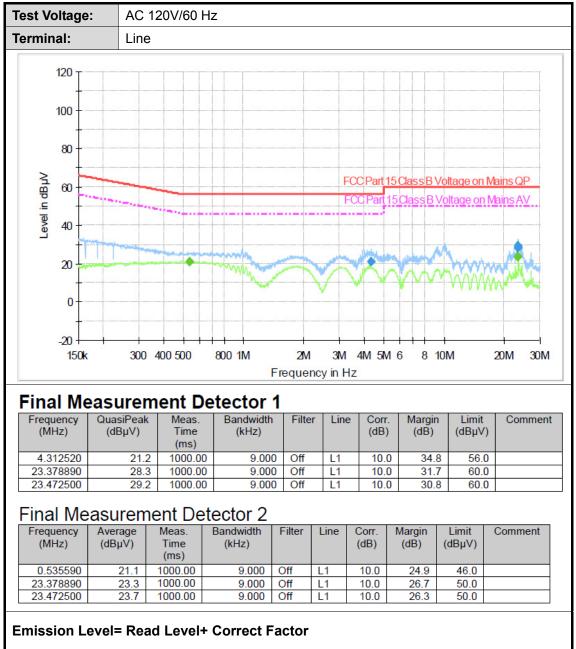
7. During the above scans, the emissions were maximized by cable manipulation.



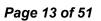


Please refer to the clause 2.2.

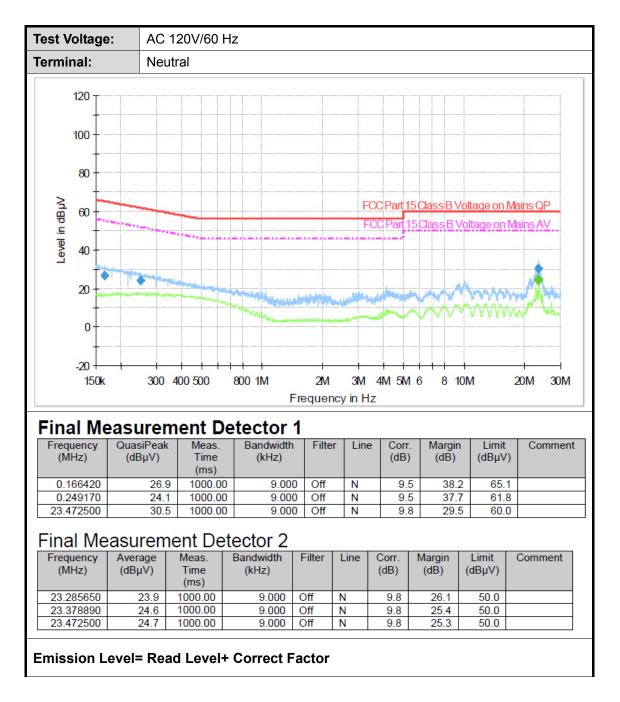
## **Test Results**

















## <u>Limit</u>

# Radiated Emission Limits (9 kHz~1000 MHz)

Frequency (MHz)	Field Strength (microvolt/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		

## Radiated Emission Limit (Above 1000MHz)

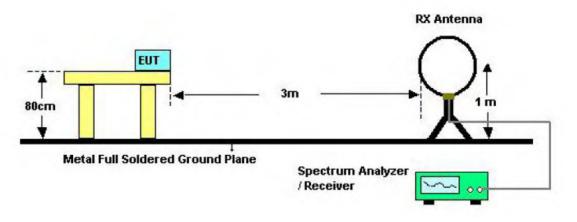
Frequency	Distance Meters(at 3m)					
(MHz)	Peak	Average				
Above 1000	74	54				

#### Note:

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

(2) Emission Level (dBuV/m)=20log Emission Level (uV/m).

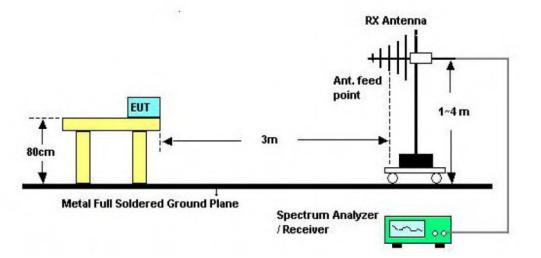
## **Test Configuration**



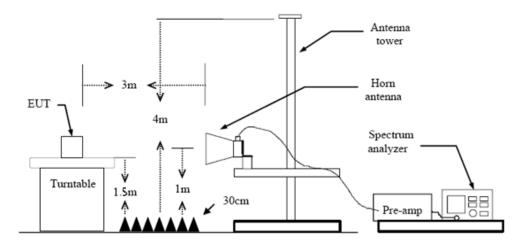
Below 30MHz Test Setup







Below 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  $10^{\text{th}}$  harmonic:

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





RBW=1MHz, VBW=3MHz RMS detector for Average value.

#### Test Mode

Please refer to the clause 2.2.

## <u>Test Result</u>

#### 9 KHz~30 MHz

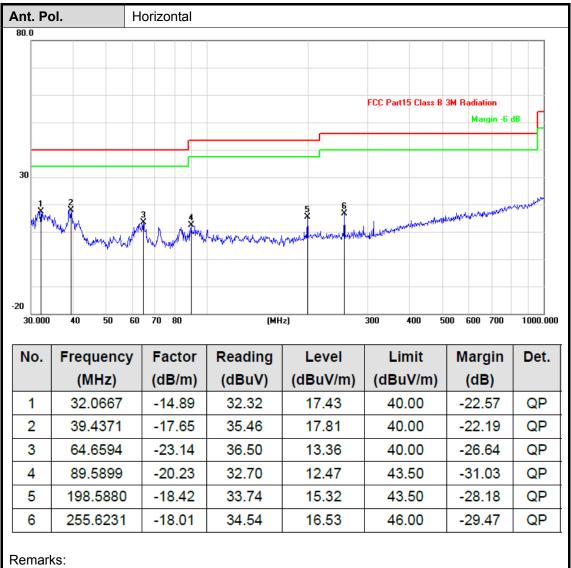
From 9 KHz to 30 MHz: Conclusion: PASS

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

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



ol. V	ertical					
				FCC Part15 Class B	3M Radiation	
					Margin -6 d	1B [
				6		and the second
home in	2	3 X	4 ×	1. In and maker how policy	elwarden Brand Million Part	
the work wards	they admenter the	wannowhen	- and the second of the second s	mpt shallow		
	.Without					
40 50 60	70 80	(MH	z)	300 400 5	00 600 700	1000.0
Frequency	Factor	Reading	Level	Limit	Margin	Det.
(8.41.1_)						
(MHz)	(dB/m)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
(MHZ) 32.9791	(dB/m) -9.58	(dBuV) 27.12	(dBuV/m) 17.54	(dBuV/m) 40.00	( <b>aB</b> ) -22.46	QP
						QP QP
32.9791	-9.58	27.12	17.54	40.00	-22.46	-
32.9791 93.1132	-9.58 -19.89	27.12 28.20	17.54 8.31	40.00 43.50	-22.46 -35.19	QP
32.9791 93.1132 141.8262	-9.58 -19.89 -19.17	27.12 28.20 30.87	17.54 8.31 11.70	40.00 43.50 43.50	-22.46 -35.19 -31.80	QP QP
	40 50 60	40 50 60 70 80 Frequency Factor	40     50     60     70     80     (MH       Frequency     Factor     Reading	Image: Contract of the second secon	FCC Part15 Class B       FCC Part16 Class B	FCC Part15 Class B     3M Radiation       Margin -6     Margin -6       Margin -6     Margin       Margin     Margin       Margin     Margin       Margin     Margin       Margin     Margin

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Remarks:

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



Ant. Po	Ι.	Hori	zontal								
lest Mo	de:	TX Z	igbee Mode	e 2405MHz							
Remark	:	No r	No report for the emission which more than 10 dB below the prescribed limit.								
110.0 dBu	ıV/m										
					FCC Par	15 Class C 3M Abo	ove-16 Peak				
60	1.				FCC F	Part15 Class C 3M /	Above-1G AV				
	3										
10.0	3500.00	6000.00	8500.00 110	000.00 13500.00	) 16000.00 1	8500.00 21000.		26000.00 MH			
No.	Freque (MH	-	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector			
1	4810.	660	1.37	51.93	53.30	74.00	-20.70	peak			
2 4810.		798	1.37	37.65	39.02	54.00	-14.98	AVG			
Remark:		A	a Eactor (dP	/m)+Cabla [		re-amplifier	Factor				

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Ant	t. Pol		Vert	cal									
Tes	t Mo	de:	TX Z	Zigbee	e Mode	e 2405M	IHz						
Rer	nark:			No report for the emission which more than 10 dB below the prescribed limit.									
110.0	0 dBu\	//m											
									FCC Pa	t15 Class C 3M Ab	iove-16 Peak		
60							_		FCC	Part15 Class C 3M	Above-1G AV		
		Ϋ́											
		2											
		Î											
10.0 10	000.000	3500.00	6000.00	8500.0	0 110	000.00 13	500.0	0 160	DD.00 1	8500.00 21000	).00	26000.00 MI	Hz
1	No.	Frequ	-		ctor	Readi	<u> </u>	1	vel	Limit	Margin	Detector	
$\vdash$	1	(Mł			3/m)	(dBuV) 51.87			.24	(dBuV/m) 74.00	(dB) -20.76	neek	+
	-	4810.836 1.37									peak	+	
	2	4810.918 1.37		.37	37.44 38.81			54.00	-15.19	AVG			
1.Fa	Remark: 1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor 2.Margin value = Level -Limit value												

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Ant. Po	I.	Horiz	Horizontal									
Test Mo	ode:	тх z	TX Zigbee Mode 2440MHz									
Remark	κ:		No report for the emission which more than 10 dB below the prescribed limit.									
110.0 dBu	i¥7m											
					FCC Par	t15 Class C 3M Ab	o <del>ve</del> -16 Peak					
60					FCC	Part15 Class C 3M .	Above-1G AV					
	*											
10.0	3500.00 6	00.00	8500.00 11	000.00 13500.0	0 16000.00 1	8500.00 21000.		26000.00 MH				
No.	Freque (MHz	-	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector				
1	4879.		1.56	49.63	51.19	74.00	-22.81	peak				
2	4880.	778 1.56		36.09	37.65	54.00	-16.35	AVG				
Remark: 1.Factor		ntenn	a Factor (dE	3/m)+Cable I	<sup>=</sup> actor (dB)-F	Pre-amplifier	Factor					



Ant. Po		Verti	cal									
Test Mo	de:	TX Z	Zigbee Mod	e 2440MHz								
Remark	:		No report for the emission which more than 10 dB below the prescribed limit.									
110.0 dBu	V/m	pres	cribed limit									
60		000.00	8500.00 11	000.00 13500.0	FCC	10500.00 21000	Above-1G AV	26000.00 MHz				
No.	Freque (MHz	-	Factor	Reading (dBuV)		Limit (dBuV/m)	Margin	Detector				
1	4879.4		(dB/m) 1.56	(uBuV) 51.51	53.07	(dBuV/III) 74.00	(dB) -20.93	peak				
2			1.56	37.61	39.17	54.00	-14.83	AVG				
Remark: 1.Factor	I	ntenn	a Factor (dl	1	Factor (dB)-F	I						

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Ant. Po	I.	Horiz	Horizontal								
Test Mode: TX Zigbee Mode 2480MHz											
<b>Remark:</b> No report for the emission which more than 10 dB below prescribed limit.											
110.0 dBuV/m											
					FCC Par	t15 Class C 3M Ab	o <del>ve</del> -16 Peak				
60					FCC I	Part15 Class C 3M .	Above-1G AV				
	X										
	2										
	×										
10.0	) 3500.00 6	00.00	8500.00 110	00.00 13500.00	0 16000.00 1	8500.00 21000.	.00	26000.00 MHz			
No.	Freque (MHz		Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector			
1	4960.2	220	1.78	49.56	51.34	74.00	-22.66	peak			
2	4960.5	514	1.78	35.37	37.15	54.00	-16.85	AVG			
				/m)+Cable F	Factor (dB)-P	Pre-amplifier	Factor				



Ant	. Pol		Verti	ical									
Tes	t Mo	de:			ee Mode								
Ren	nark	:		No report for the emission which more than 10 dB below the prescribed limit.									
110.0	) dBu'	∕/m											
									FCC Par	t15 Class C 3M A	bove-1G Peak		
60									FCC	Part15 Class C 31	Above-1G AV		
10.0													
,			000.00	8500		000.00	13500.00			8500.00 2100 Limit		26000.00 MHz	
N	lo.	Frequer (MHz	-		actor B/m)		ding uV)		vel V/m)		Margin (dB)	Detector	
	1 4959.3		44	1	1.78	35.	.49	37	.27	54.00	-16.73	AVG	
	2	4960.326 1.78		.78	49.15		50	.93	74.00	-23.07	peak		
Ren	nark:												
	1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor												

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2.Margin value = Level -Limit value

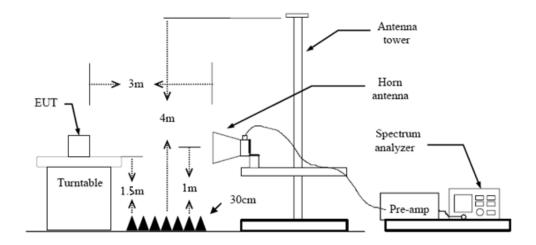


# 3.3. Band Edge Emissions

# Limit

Restricted Frequency Band	(dBuV/m)(at 3m)								
(MHz)	Peak	Average							
2310 ~2390	74	54							
2483.5 ~2500	74	54							
Note: All restriction bands have been tested, only the worst case is reported.									

## **Test Configuration**



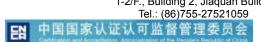
## **Test Procedure**

- The EUT was setup and tested according to ANSI C63.10:2013 requirements. 1.
- The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to 2. 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.
- The receiver set as follow: 5. RBW=1MHz, VBW=3MHz PEAK detector for Peak value. RBW=1MHz, VBW=10Hz with PEAK Detector for Average Value.

#### **Test Mode**

Please refer to the clause 2.2.

#### **Test Results**





# (1) Radiation Test

Ant. Pol.		Horiz	zontal										
Test Mode: TX		TX Z	igbee l	Mode	e 2405	5MHz							
110.0 dBu	V/m										4		1
								FCC Par	t15 Class	с эм аь	ove-16 Peek		
60								FCC	Part15 Cla	iss C 3M	Aboye 1G AV		
												Ĺ	
10.0													
2315.000	2325.00 23	335.00	2345.00	23	5.00	2365.00	2375	5.00 2	385.00	2395.0	0	2415.00	MHz
No.	Frequer (MHz		Fact (dB/r			ding uV)		vel V/m)	Lir (dBu		Margin (dB)	Detect	or
1	2400.0	000	-4.5	51	57	.55	53	.04	74	.00	-20.96	pea	k
2	2400.0	00	-4.5	51	47	.03	42	.52	54	.00	-11.48	AVC	3
3	2405.1	00	-4.4	9	109	.32	104	1.83			)	AVC	3
4	2405.5	00	-4.4	9	111	.29	106	6.80			)	pea	k
	(dB/m) = A value = Le				/m)+C	able F	actor	(dB)-F	Pre-am	plifier	Factor	•	<u> </u>



Ant.	. Pol	•		Verti	cal												
Test	t Mo	de:		TX Z	Zigbe	e Mo	de 24	405MI	Ηz								
110.0	dBu	∀/m															1
											FCC Pa	rt15 Class	C 3M AL		G Peak		
60											FCC	Part15 Cl	ass C 3M	Abov	=-1 <b>G</b> 41		
														X		l	
10.0																	
23	15.000	2325.00	233	5.00	2345	i. 00	2355.0	D 236	5.00	237	5.00	2385.00	2395.	00		2415.00	MHz
N	0.	Freq (M	ueno IHz)	cy		actor B/m)		eadin dBuV	-	1	vel V/m)	Lir (dBu			rgin B)	Detect	or
	1	240	0.00	0	_4	4.51		50.77		46	.26	74	.00	-2	7.74	pea	k
	2	240	0.00	0	_4	4.51		39.22		34.	.71	54	.00	-19	9.29	AVC	3
	3	240	4.50	0	_4	4.49	1	02.4	1	97	.92				!	pea	k
	4	240	5.10	0	_4	4.49	1	00.32	2	95.	.83					AVC	3
	ctor	(dB/m) value =					dB/m	)+Cab	le F	actor	(dB)-F	Pre-am	plifier	Fac	tor		

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Ant. Pol		Horizo	ontal						
Test Mo		TX Zigbee Mode 2480MHz							
110.0 dBu									
60	1 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3					rt15 Class C 3M Abr			
	/								
2470.000	2480.00 2	490.00		0.00 2520.00		2540.00 2550.0		2570.00 MHz	
No.	Freque (MHz	-	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	
1	2479.2	200	-4.20	92.70	88.50		)	peak	
2	2480.0	000	-4.20	90.07	85.87		,	AVG	
3	2483.5	500	-4.19	56.17	51.98	74.00	-22.02	peak	
4	2483.5	500	-4.19	50.50	46.31	54.00	-7.69	AVG	
	(dB/m) = A			/m)+Cable F	Factor (dB)-F	Pre-amplifier	Factor		

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2.Margin value = Level -Limit value



Ant. Pol		Vertio	cal					
Test Mo	de:	TX Z	igbee Mode	e 2480MHz				
110.0 dBu	∀/m							
	*				FCC Pe	nt15 Class C 3M Ab	o <del>ve</del> -16 Peak	
60					FCC	Part15 Class C 3N .	Above-1G AV	
10.0								
2470.000	2480.00 24	190.00	2500.00 251	0.00 2520.00	2530.00	2540.00 2550.0	0	2570.00 MHz
No.	Freque (MHz	-	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2479.3	300	-4.20	92.36	88.16		i	peak
2	2480.0	000	-4.20	90.36	86.16		ł	AVG
3	2483.5	500	-4.19	56.56	52.37	74.00	-21.63	peak
4	2483.5	500	-4.19	50.75	46.56	54.00	-7.44	AVG
	(dB/m) = A value = Le			/m)+Cable F	Factor (dB)-	Pre-amplifier	Factor	



# (2) Conducted Test

			5 2-100		80 MHz	-			(
Spectrum									
Ref Level Att	evel 25.00 dBm Offset 0.50 dB 🖷 RBW 100 kHz 35 dB SWT 113.8 μs 🖷 VBW 300 kHz Mode Auto FFT								
1Pk View	jo upi jini 113.8 µs 🖶 YBW JUU KHZ Mode Auto FFT								
20 dBm-					M1	[1]			14.58 dBm
					M2	[1]			₩679 GHz •4856 dBm
10 dBm									юрфоо GHz
0 dBm									
	D1 -5.420 d	Bm							
-10 dBm									
-20 dBm									
-30 dBm									
-40 dBm								M2 /	
-50 dBm							M3	and the second s	- San
Marmuharle	mout	white white	and normany	mould	muum	mallow	work	~~	
-60 dBm									
-70 dBm									
CF 2.363 G	Hz			691	pts		I	Span :	100.0 MHz
Marker	1								
Type Ref	1 1 1	2.4046		Y-value 14.58 dB	Functi	ion	Fund	tion Result	
M2	1	2	2.4 GHz	-48.56 dB	m				
МЗ	1	2.3	39 GHz	-50.68 dB	m				
Date: 26.MA	_	0:07:51							Ē
Spectrum Ref Level	25.00 dBm	Offset		RBW 100 kł VBW 300 kł		Auto FET			
Spectrum	·	Offset		<b>RBW</b> 100 kH <b>VBW</b> 300 kH		Auto FFT			
Spectrum Ref Level	25.00 dBm	Offset							-3.81 dBm
Spectrum Ref Level Att 1Pk View 20 dBm	25.00 dBm	Offset			Hz Mode A	[1]			,
Spectrum Ref Level Att 1Pk View	25.00 dBm	Offset			Hz Mode /	[1]		-	-3.81 dBm 80320 GHz
Spectrum Ref Level Att 1Pk View 20 dBm	25.00 dBm	Offset			Hz Mode A	[1]		-	-3.81 dBm #80320 GHz •52.92 dBm
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm 0 dBm	25.00 dBm	Offset			Hz Mode A	[1]		-	-3.81 dBm #80320 GHz •52.92 dBm
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm	25.00 dBm	Offset			Hz Mode A	[1]		-	-3.81 dBm #80320 GHz •52.92 dBm
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm 0 dBm -10 dBm -20 dBm	25.00 dBm 35 dB	Offset SWT 1			Hz Mode A	[1]		-	-3.81 dBm #80320 GHz •52.92 dBm
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm 0 dBm -10 dBm -20 dBm	25.00 dBm	Offset SWT 1			Hz Mode A	[1]		-	-3.81 dBm #80320 GHz •52.92 dBm
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm	25.00 dBm 35 dB	Offset SWT 1			Hz Mode A	[1]		-	-3.81 dBm #80320 GHz •52.92 dBm
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm 0 dBm -10 dBm -20 dBm	25.00 dBm 35 dB	Offset SWT 1			Hz Mode A	[1]		-	-3.81 dBm #80320 GHz •52.92 dBm
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm -10 dBm -20 dBm -30 dBm -30 dBm -30 dBm -50 dBm	25.00 dBm 35 dB 01 -23.810	Offset SWT 1	113.8 µs 👄	VBW 300 kH	H2 Mode / M1 	[1]		2.4	-3.81 dBm 80320 GHz 52.92 dBm 83500 GHz
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -30 dBm -50 dBm	25.00 dBm 35 dB	Offset SWT 1	113.8 µs 👄		H2 Mode / M1 	[1]		2.4	-3.81 dBm #80320 GHz •52.92 dBm
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm -10 dBm -20 dBm -30 dBm -30 dBm -30 dBm -50 dBm	25.00 dBm 35 dB 01 -23.810	Offset SWT 1	113.8 µs 👄	VBW 300 kH	H2 Mode / M1 	[1]		2.4	-3.81 dBm 80320 GHz 52.92 dBm 83500 GHz
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -30 dBm -50 dBm	25.00 dBm 35 dB 01 -23.810	Offset SWT 1	113.8 µs 👄	VBW 300 kH	H2 Mode / M1 	[1]		2.4	-3.81 dBm 80320 GHz 52.92 dBm 83500 GHz
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm	25.00 dBm 35 dB D1 -23.810	Offset SWT 1	113.8 µs 👄	VBW 300 kH	H2 Mode / M1 	[1]		2.4	-3.81 dBm 80320 GHz 52.92 dBm 83500 GHz
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -30 dBm -30 dBm -50 dBm -60 dBm -70 dBm CF 2.522 G Marker	25.00 dBm 35 dB 01 -23.810	dBm	113.8 µs •	VBW 300 kH	H2 Mode / M1 M2 	[1] [1]		2.4	-3.81 dBm 80320 GHz 52.92 dBm 83500 GHz
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm 10 dBm -10 dBm -20 dBm -20 dBm -30 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dB	25.00 dBm 35 dB D1 -23.810 M2 Hz	dBm	113.8 µs •	VBW 300 kH	HZ Mode / M1 M2 M2 M2 M2 M2 M2 M2 M2 M2 M2	[1] [1]		2.4	-3.81 dBm 80320 GHz 52.92 dBm 83500 GHz
Spectrum       Ref Level       Att       1Pk View       20 dBm       10 dBm       0 dBm       -10 dBm       -20 dBm       -30 dBm       -30 dBm       -60 dBm       -70 dBm       CF 2.522 G       Marker       Type     Ref       M1	25.00 dBm 35 dB 01 -23.810 01 -23.810 Hz Hz 1 1	Offset SWT 1 dBm dBm <u>M3</u> <u>X-value</u> 2.490; 2.490;	113.8 µs ●	VBW 300 kH	HZ Mode / M1M2	[1] [1]		2.4	-3.81 dBm 80320 GHz 52.92 dBm 83500 GHz
Spectrum Ref Level Att 1Pk View 20 dBm 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -30 dBm -30 dBm -40 dBm -50 dBm -50 dBm -50 dBm -70 dBm <b>CF 2.522 G</b> Marker <b>Type Ref</b> M1	25.00 dBm 35 dB D1 -23.810	Offset SWT 1 dBm dBm <u>M3</u> <u>X-value</u> 2.490; 2.490;	113.8 µs ●	VBW 300 kH	HZ Mode / M1M2	[1] [1]	Func	2.4	-3.81 dBm 80320 GHz 52.92 dBm 83500 GHz
Spectrum       Ref Level       Att       1Pk View       20 dBm       10 dBm       0 dBm       -10 dBm       -20 dBm       -30 dBm       -30 dBm       -60 dBm       -70 dBm       CF 2.522 G       Marker       Type     Ref       M1	25.00 dBm 35 dB 01 -23.810 01 -23.810 Hz Hz 1 1	Offset SWT 1 dBm dBm <u>M3</u> <u>X-value</u> 2.490; 2.490;	113.8 µs ●	VBW 300 kH	HZ Mode / M1M2	[1] [1]		2.4	-3.81 dBm 80320 GHz 52.92 dBm 83500 GHz



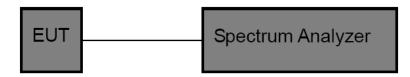


# 3.4. Bandwidth

<u>Limit</u>

Test Item	Limit	Frequency Range(MHz)
Bandwidth	>=500 KHz (6dB bandwidth)	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. Spectrum Setting:

Set RBW = 100 kHz. Set the video bandwidth (VBW)  $\geq$  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 2.2.

#### Test Results



Test Mode:	Zigbee	Mode					
Channel frequen (MHz)	су	99% OBW (MHz)	60	dB Bandwid (MHz)	th	Limit (kHz)	
2405		2.014		1.489			
2440		2.014		1.481		≧500	
2480		2.019		1.481			
	·	24	405 MHz		·		
Spectrur     Ref Leve     Att     ● 1Pk View     20 dBm     10. dBm     0 dBm     -10 dBm     -20 dBm     -30 dBm     -30 dBm     -50 dBm     -60 dBm     -70 dBm	n 35 dB D1 15.063 dB D2 9.063 T1 5 5 5 5 6 Hz	M1 -		1] Bw	2.0144	8.83 dBm 125760 GHz 71780 MHz 0.05 dB 48910 MHz 48910 MHz 1000 MHz 1000 MHz	







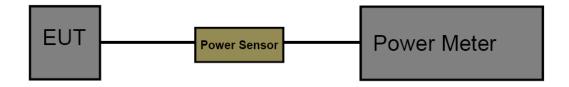


# 3.5. Peak Output Power

# <u>Limit</u>

Test Item	Limit	Frequency Range(MHz)
Peak Output Power	1 Watt or 30dBm	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. Spectrum Setting:

Peak Detector: RBW≥DTS Bandwidth, VBW≥3\*RBW. Sweep time=Auto. Detector= Peak. Trace mode= Maxhold.

Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

## Test Mode

Please refer to the clause 2.2

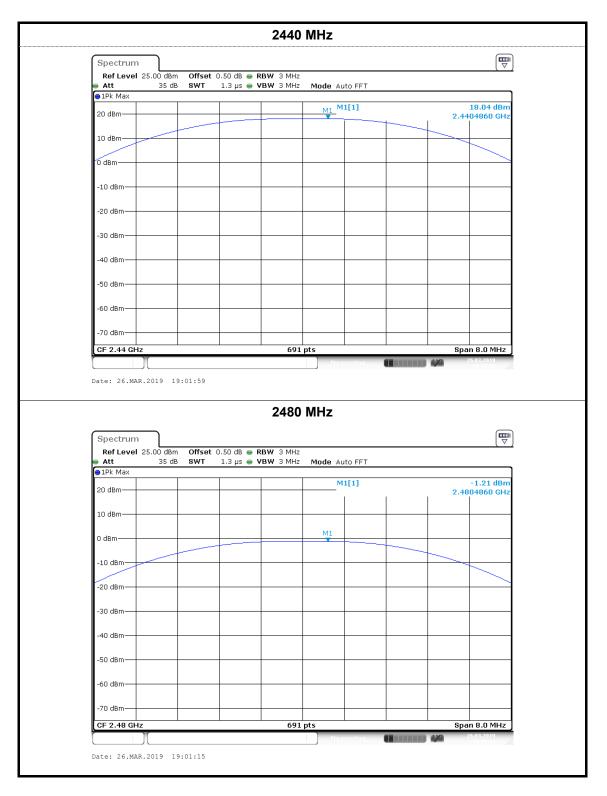
#### Test Result



est Mode:	Zigbee M	ode			
Channel frequen	cy (MHz)	Test Res	ult (dBm)	Limit (dBm)	
2405		17	.17		
2440		18	.04	30	
2480		-1	.21		
		2405	5 MHz		
Spectrum Ref Level Att		et 0.50 dB ● RBW 3 MH2 1.3 µs ● VBW 3 MH2	Mode Auto FFT		
20 dBm			M1[1]	17.17 dBm 2.4054750 GHz	
10 dBm		-			
-10 dBm					
-20 dBm					
-30 dBm					
-40 dBm					
-50 dBm					
-60 dBm					
-70 dBm					
CF 2.405 G	Hz	69	L pts	Span 8.0 MHz	

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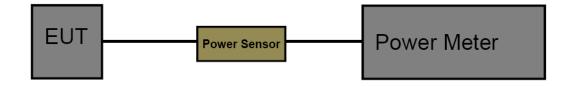


# 3.6. Power Spectral Density

# Limit

FCC Part 15 Subpart C(15.247)						
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.

The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in 2. the block diagram above. The measurement according to section 10.2 of KDB 558074 D01 DTS Meas Guidance v04.

3. Spectrum Setting:

Set analyser 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

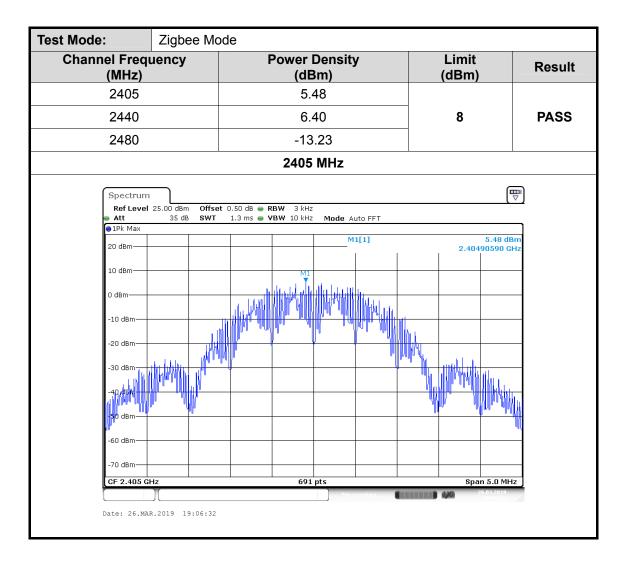
Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

## **Test Mode**

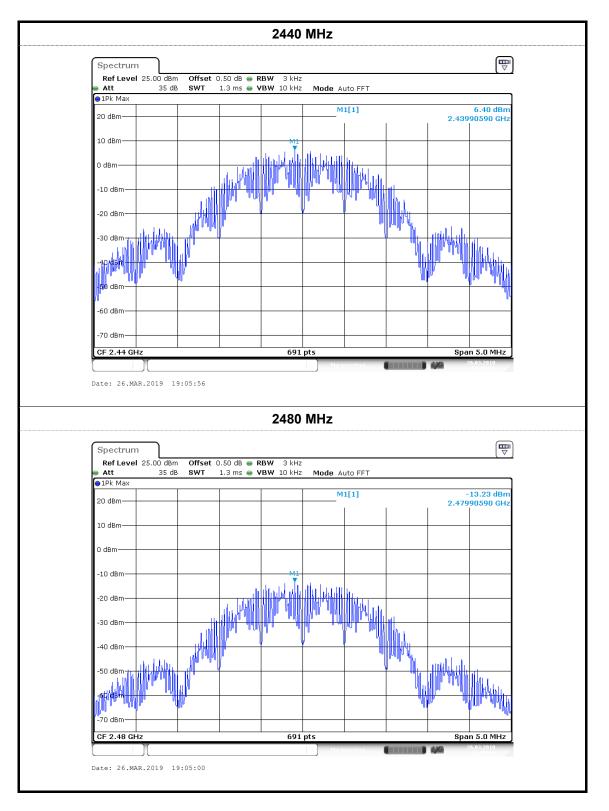
Please refer to the clause 2.2

## **Test Result**









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# 3.7. 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.