TEST REPORT

Applicant Name :	Giant Tech America LLC
Address :	11820 S Sam Houston Pkwy W, Houston, Texas, 77031 United States
Report Number :	XMTN1211028-55519E-RF
FCC ID:	2A3ZF-WLS01

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	Smart wireless printing settlement system
Trade Mark:	Receipt Smart wireless printing settlement system
Model No.:	WLS01
Date Received:	2021-10-28
Date of Test:	2021-11-16 to 2021-11-29
Report Date:	2021-12-09

Test Result:	Pass*

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Ting Lü
EMC Engineer

Approved By:

Candy Li
EMC Engineer

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Frequency Range	Zigbee: 2405-2480MHz
Maximum Conducted Peak Output Power	10.53dBm
Modulation Technique	Zigbee: O-QPSK
Antenna Specification*	Antenna: 1.0dBi(provided by the applicant)
Voltage Range	DC 5-24V
Sample serial number	XMTN1211028-55519E-RF-S1(Assigned by ATC)
Sample/EUT Status	Good condition

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
Emissions, Radiated	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
Temperature		1℃
Humidity		6%
Supply voltages		0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358, the FCC Designation No.: CN1189. Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

Listed by Innovation, Science and Economic Development Canada (ISEDC), the Registration Number is 5077A.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For Zigbee mode, 16 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
11	2405	19	2445
12	2410	20	2450
13	2415	21	2455
14	2420	22	2460
15	2425	23	2465
16	2430	24	2470
17	2435	25	2475
18	2440	26	2480

EUT was tested with Channel 11, 18 and 26.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

Software “sscom5131”* was used during testing and the power level was 90*.

Duty cycle

Please refer to the Appendix.

Support Equipment List and Details

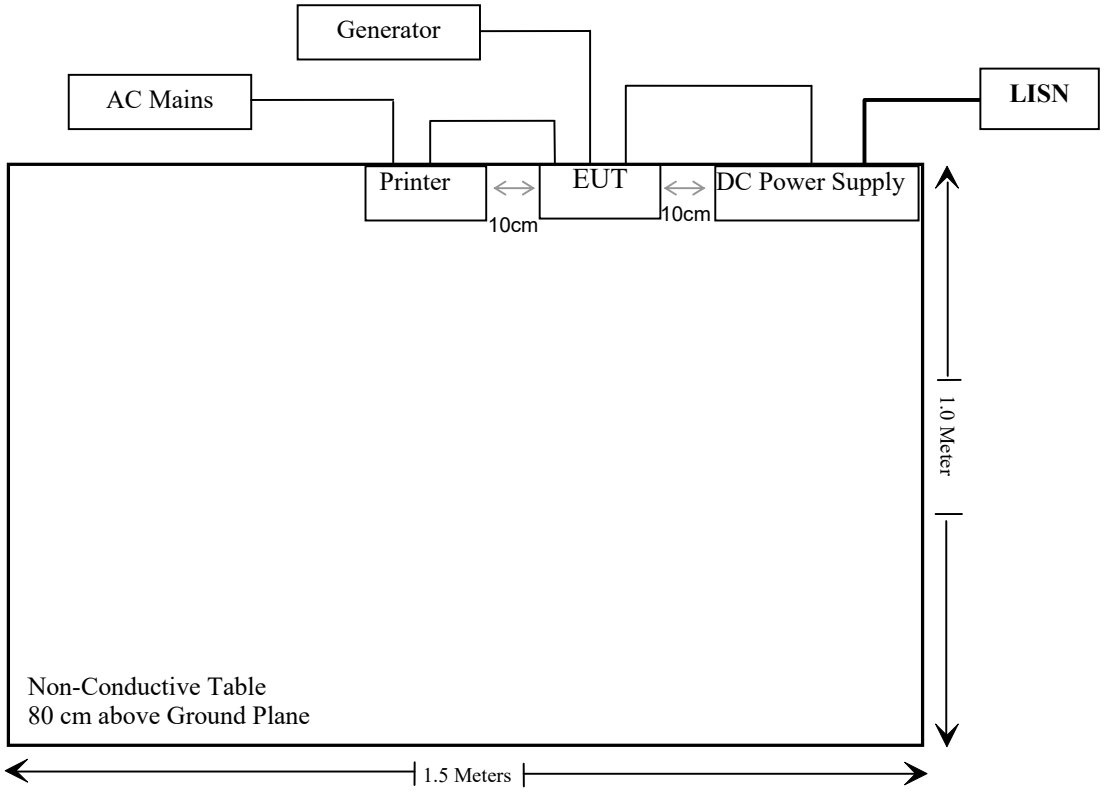
Manufacturer	Description	Model	Serial Number
ATP	Thermal printer	RP31	Unknown
XUNHENG	Adapter for printer	XH2400-200	Unknown
UNI-T	DC Power Supply	UTP136S	2109D0903324
AGILENT	Vector Signal Generator	N5182A	MY50143401

External I/O Cable

Cable Description	Length (m)	From Port	To
DC Cable	1.95	DC Power Supply	EUT
Signal Cable	2.5	Vector Signal Generator	EUT
Network Cable	0.97	Printer	EUT

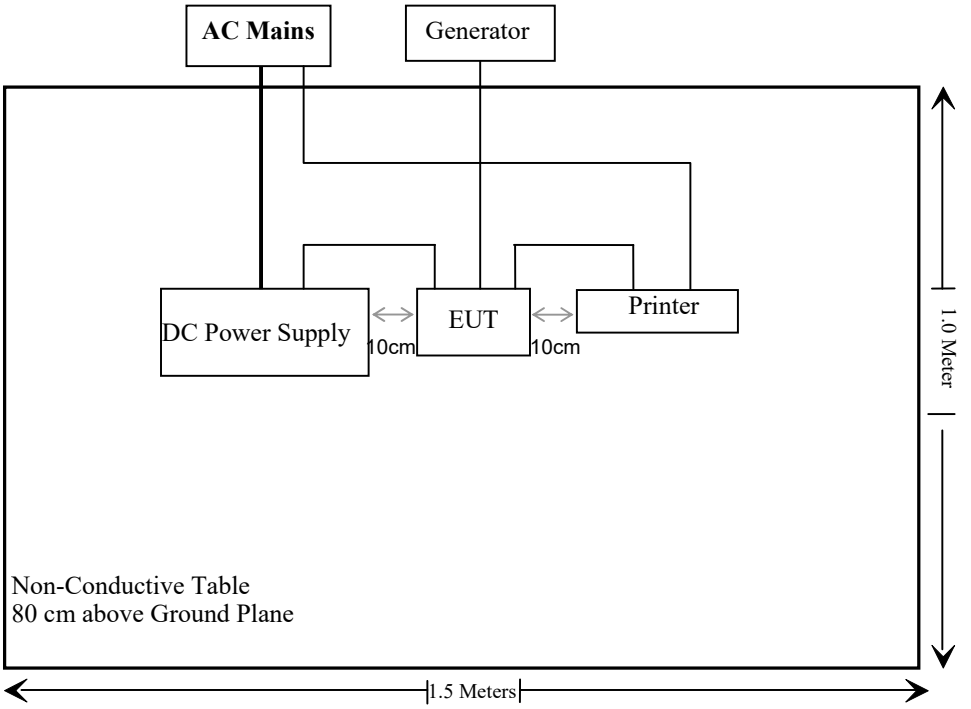
Block Diagram of Test Setup

For conducted emission:

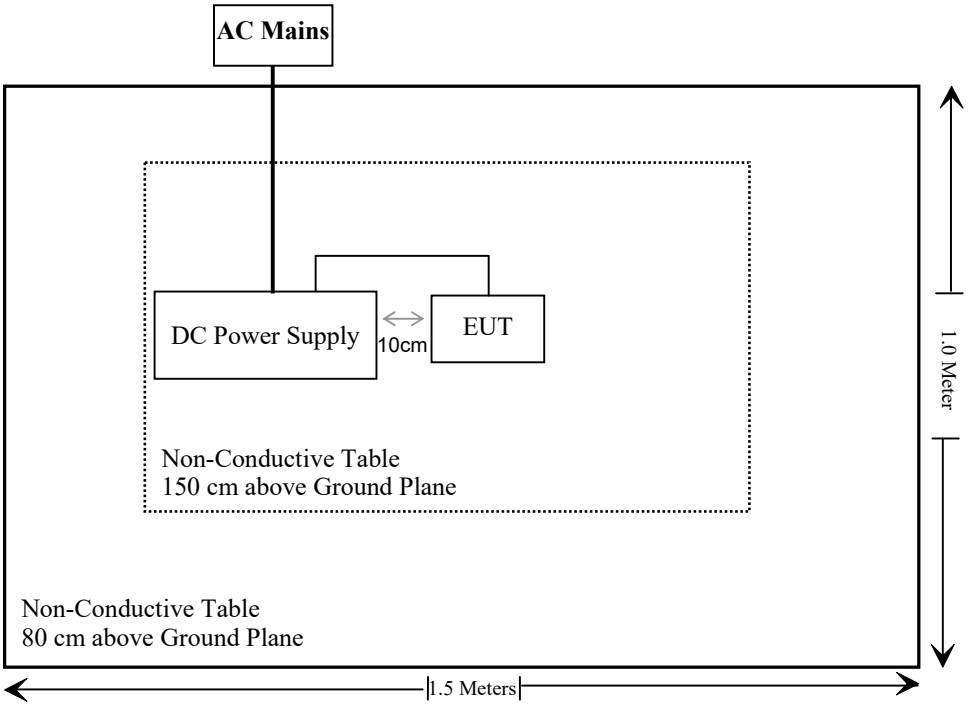


For Radiated Emission:

Below 1GHz:



Above 1GHz:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §2.1091	MAXIMUM PERMISSIBLE EXPOSURE (MPE)	Compliant
§15.203	Antenna Requirement	Compliant
§15.207 (a)	AC Line Conducted Emissions	Compliant
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliant
§15.247 (a)(2)	6 dB Emission Bandwidth & Occupied Bandwidth	Compliant
§15.247(b)(3)	Maximum Conducted Output Power	Compliant
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
§15.247(e)	Power Spectral Density	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde& Schwarz	EMI Test Receiver	ESCI	100784	2021/02/03	2022/02/02
R & S	L.I.S.N.	ESH3-Z6	100929	2020/12/25	2021/12/24
Anritsu Corp	50Ω Coaxial Switch	MP59B	6200506474	2020/12/25	2021/12/24
RF Coaxial Cable	Unknown	N-2m	No.2	2020/12/25	2021/12/24
Conducted Emission Test Software: e3 19821b (V9)					
Radiated Emissions Test					
Rohde&Schwarz	Test Receiver	ESR	101817	2020/12/24	2021/12/23
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2020/12/24	2021/12/23
A.H. Systems, inc.	Preamplifier	PAM-0118P	531	2021/07/08	2022/07/07
SONOMA INSTRUMENT	Amplifier	310 N	186131	2020/12/25	2021/12/24
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2020/12/25	2021/12/24
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2020/01/04	2023/01/03
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Schwarzbeck	Horn Antenna	BBHA9170	9170-359	2020/01/05	2023/01/04
Quinstar	Amplifier	QLW-184055 36-J0	15964001002	2020/11/28	2021/11/27
RF Coaxial Cable	Unknown	N-5m	No.3	2020/12/25	2021/12/24
RF Coaxial Cable	Unknown	N-5m	No.4	2020/12/25	2021/12/24
RF Coaxial Cable	Unknown	N-1m	No.5	2020/12/25	2021/12/24
RF Coaxial Cable	Unknown	N-1m	No.6	2020/12/25	2021/12/24
Radiated Emission Test Software: e3 19821b (V9)					
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2020/12/24	2021/12/23
WEINSCHEL	10dB Attenuator	5324	AU 3842	Each time	

*** Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (Minutes)**
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Frequency (MHz)	**Antenna Gain**		**Tune up conducted power**		**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**MPE Limit (mW/cm^2)**
	(dBi)	**(numeric)**	**(dBm)**	**(mW)**			
2405-2480	1.0	1.26	11	12.59	20	0.003	1

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.
And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has one External Antenna arrangement, which was used a unique coupling and the antenna gain is 1 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

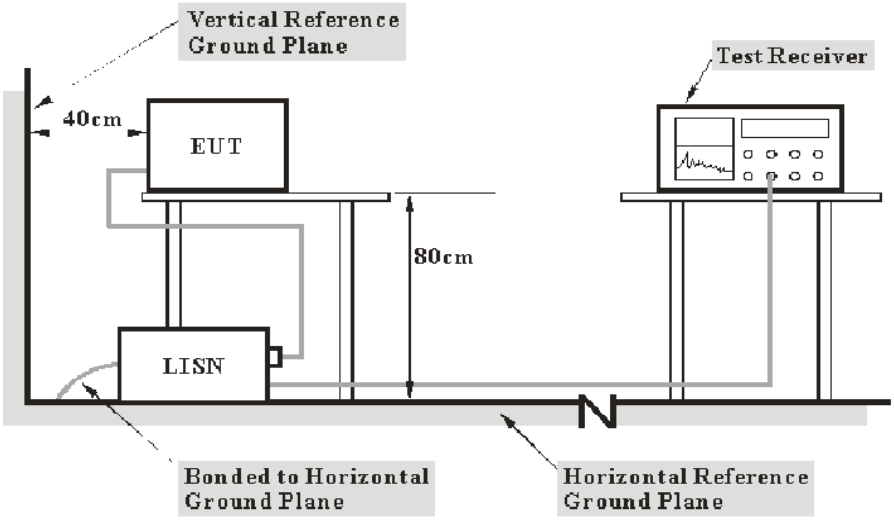
Result: Compliant.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Transd Factor & Margin Calculation

The Transd factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss. The basic equation is as follows:

Correct Factor = LISN VDF + Cable Loss

The "**Over limit**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over limit of -7 dB means the emission is 7 dB below the limit. The equation for calculation is as follows:

Over Limit = Level – Limit
Level = Read Level + Factor

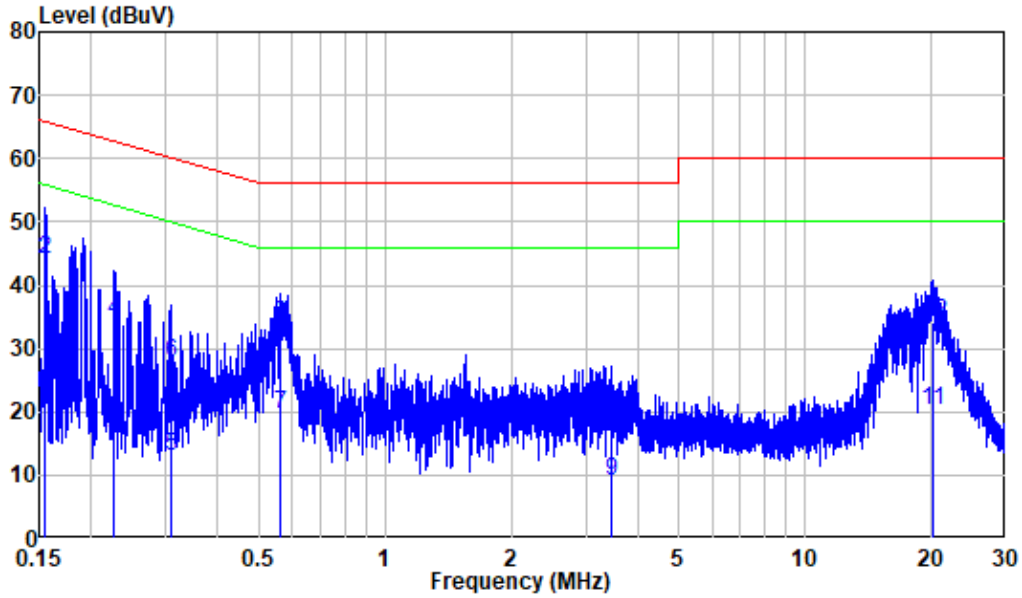
Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	64 %
ATM Pressure:	101.0 kPa

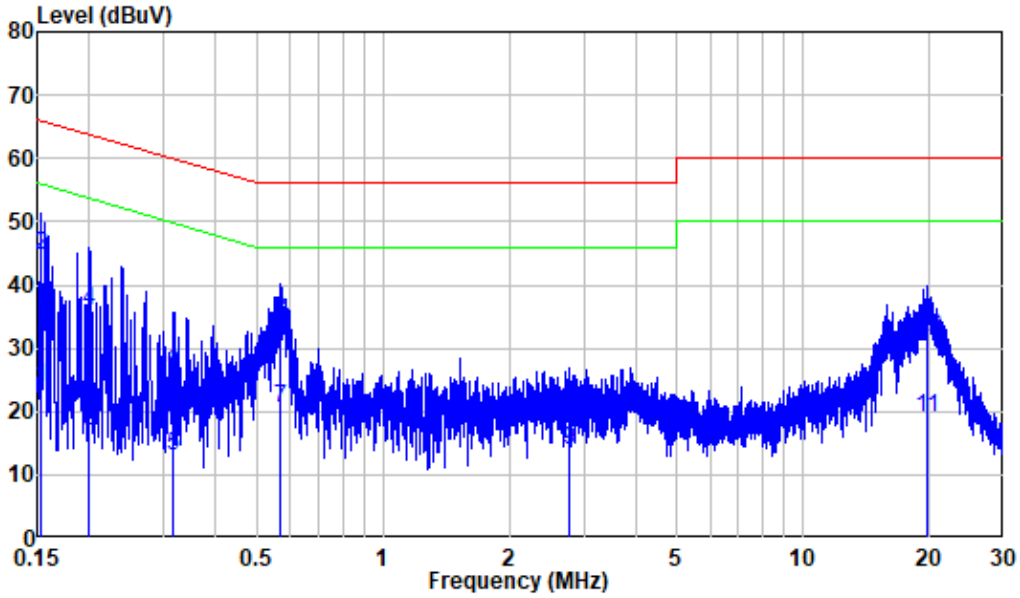
The testing was performed by Bin Duan on 2021-11-29.

EUT operation mode: Transmitting



Site : Shielding Room
Condition: Line
Mode : Transmitting
Model : WLS01
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.155	9.89	13.44	23.33	55.70	-32.37	Average
2	0.155	9.89	34.28	44.17	65.70	-21.53	QP
3	0.227	9.80	6.50	16.30	52.56	-36.26	Average
4	0.227	9.80	24.58	34.38	62.56	-28.18	QP
5	0.310	9.80	3.10	12.90	49.98	-37.08	Average
6	0.310	9.80	17.90	27.70	59.98	-32.28	QP
7	0.563	9.81	9.69	19.50	46.00	-26.50	Average
8	0.563	9.81	23.89	33.70	56.00	-22.30	QP
9	3.472	9.93	-1.02	8.91	46.00	-37.09	Average
10	3.472	9.93	8.72	18.65	56.00	-37.35	QP
11	20.069	10.20	9.92	20.12	50.00	-29.88	Average
12	20.069	10.20	24.01	34.21	60.00	-25.79	QP



Site : Shielding Room
Condition: Neutral
Mode : Transmitting
Model : WLS01
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.153	9.91	13.89	23.80	55.84	-32.04	Average
2	0.153	9.91	34.82	44.73	65.84	-21.11	QP
3	0.200	10.00	6.83	16.83	53.62	-36.79	Average
4	0.200	10.00	25.83	35.83	63.62	-27.79	QP
5	0.316	9.95	3.11	13.06	49.81	-36.75	Average
6	0.316	9.95	15.96	25.91	59.81	-33.90	QP
7	0.571	9.91	10.53	20.44	46.00	-25.56	Average
8	0.571	9.91	24.42	34.33	56.00	-21.67	QP
9	2.770	9.98	4.05	14.03	46.00	-31.97	Average
10	2.770	9.98	10.21	20.19	56.00	-35.81	QP
11	19.674	10.19	8.80	18.99	50.00	-31.01	Average
12	19.674	10.19	21.61	31.80	60.00	-28.20	QP

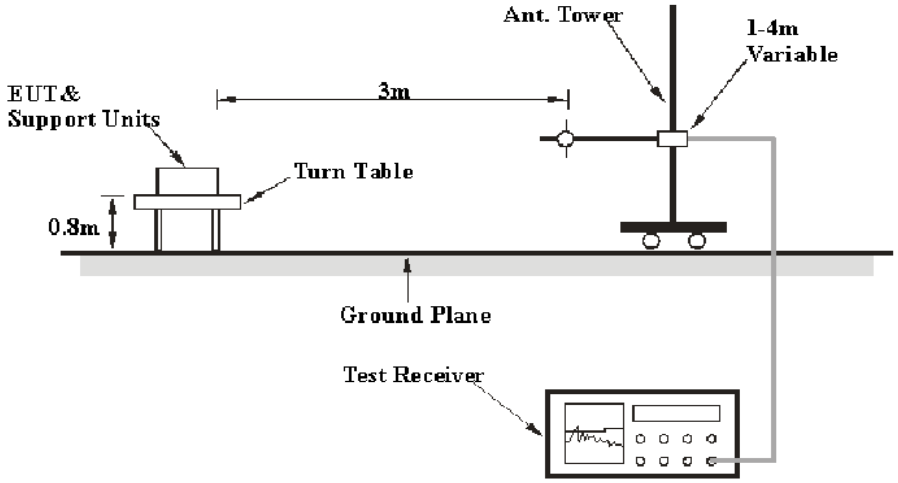
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

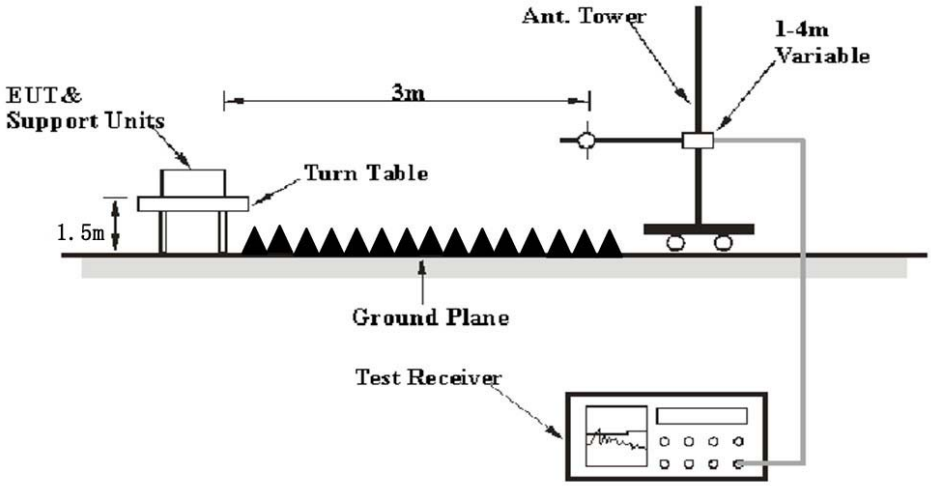
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz Note 1	/	Average
	1MHz	＞1/T Note 2	/	Average

Note 1: when duty cycle is no less than 98%
Note 2: when duty cycle is less than 98%

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

Factor & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain. The basic equation is as follows:

Factor = Antenna Factor + Cable Loss - Amplifier Gain

The "**Over Limit/Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit/margin of -7dB means the emission is 7dB below the limit. The equation for calculation is as follows:

Over Limit = Level / Absolute Level – Limit
Level / Absolute Level = Read Level + Factor

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	50-64 %
ATM Pressure:	101.0-103.0 kPa

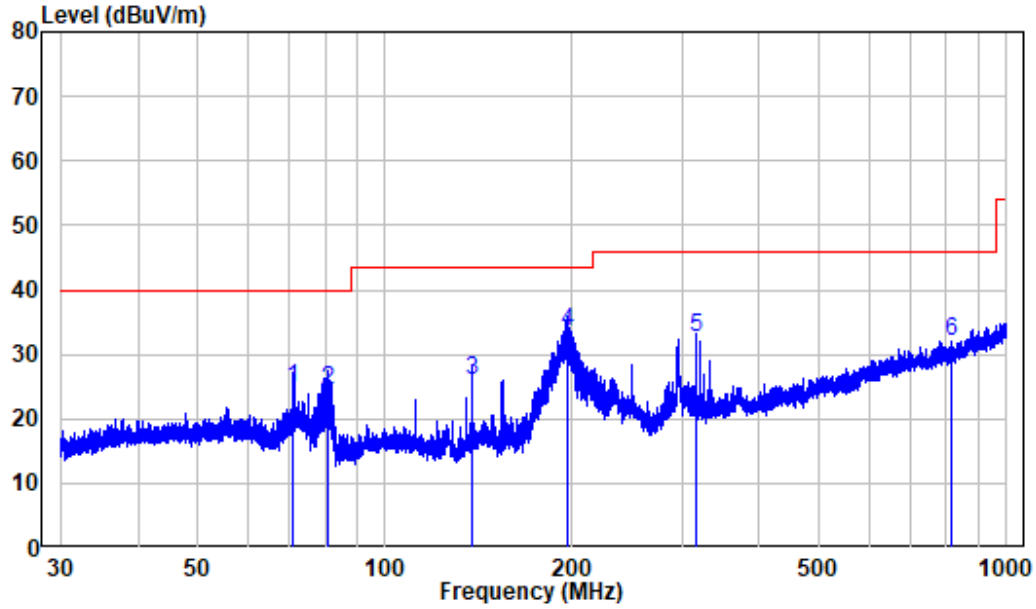
The testing was performed by Chao Mo on 2021-11-16.

EUT operation mode: Transmitting

30 MHz~1 GHz:

EUT operation mode: Transmitting

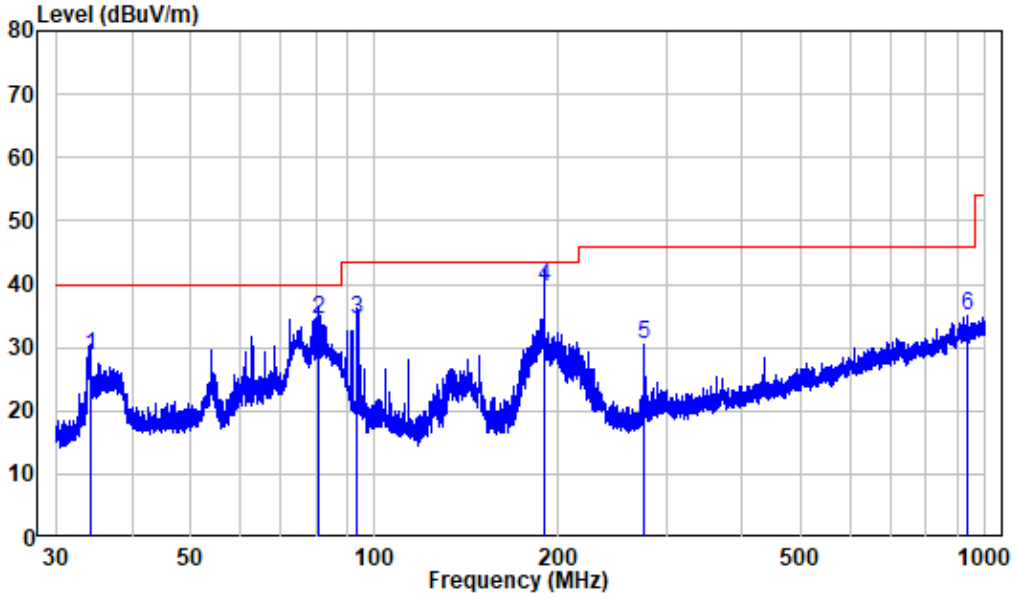
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : XMTN1211028-55519E-RF
Test Mode: Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	71.17	-15.27	40.12	24.85	40.00	-15.15	QP
2	81.03	-16.73	41.23	24.50	40.00	-15.50	QP
3	137.66	-15.31	41.32	26.01	43.50	-17.49	QP
4	195.99	-11.57	45.23	33.66	43.50	-9.84	QP
5	317.14	-8.60	41.12	32.52	46.00	-13.48	QP
6	814.90	-0.21	32.33	32.12	46.00	-13.88	QP

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : XMTN1211028-55519E-RF
Test Mode: Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	34.16	-11.80	40.42	28.62	40.00	-11.38	QP
2	80.75	-16.74	51.27	34.53	40.00	-5.47	QP
3	93.69	-12.78	47.12	34.34	43.50	-9.16	QP
4	188.99	-11.71	51.15	39.44	43.50	-4.06	QP
5	276.24	-9.83	40.36	30.53	46.00	-15.47	QP
6	938.01	1.76	33.21	34.97	46.00	-11.03	QP

Above 1 GHz: (Worst case)

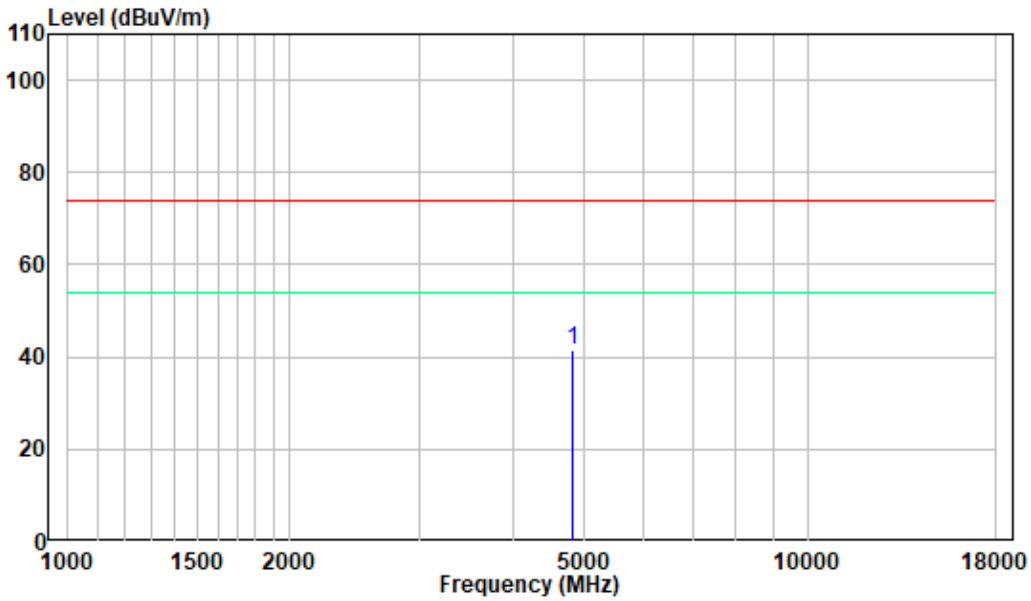
Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
	Reading (dBuV)	PK/AV		Height (m)	Polar (H/V)				
Zigbee, Low Channel									
2310	53.05	PK	112	1.6	H	-6.84	46.21	74	-27.79
2310	52.64	PK	130	2.1	V	-6.84	45.8	74	-28.2
2390	51.15	PK	353	1.8	H	-6.44	44.71	74	-29.29
2390	50.51	PK	312	1.9	V	-6.44	44.07	74	-29.93
4810	38.62	PK	93	1.7	H	2.94	41.56	74	-32.44
4810	44.93	PK	225	1.3	V	2.94	47.87	74	-26.13
Zigbee, Middle Channel									
4880	38.31	PK	294	1.1	H	3.04	41.35	74	-32.65
4880	43.53	PK	224	1.6	V	3.04	46.57	74	-27.43
Zigbee, High Channel									
2483.5	57.95	PK	255	1.5	H	-5.96	51.99	74	-22.01
2483.5	59.9	PK	309	2.1	V	-5.96	53.94	74	-20.06
2500	53.57	PK	347	1.7	H	-5.88	47.69	74	-26.31
2500	52.56	PK	272	1.1	V	-5.88	46.68	74	-27.32
4960	37.3	PK	287	1.5	H	3.29	40.59	74	-33.41
4960	43.07	PK	209	1.8	V	3.29	46.36	74	-27.64

Note:
Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Absolute Level = Factor + Reading
Margin = Absolute Level - Limit
The other spurious emission which is in the noise floor level was not recorded.
The test result of peak was 20dB below to the limit of peak, which can be compliant to the average limit, so just peak value was recorded.

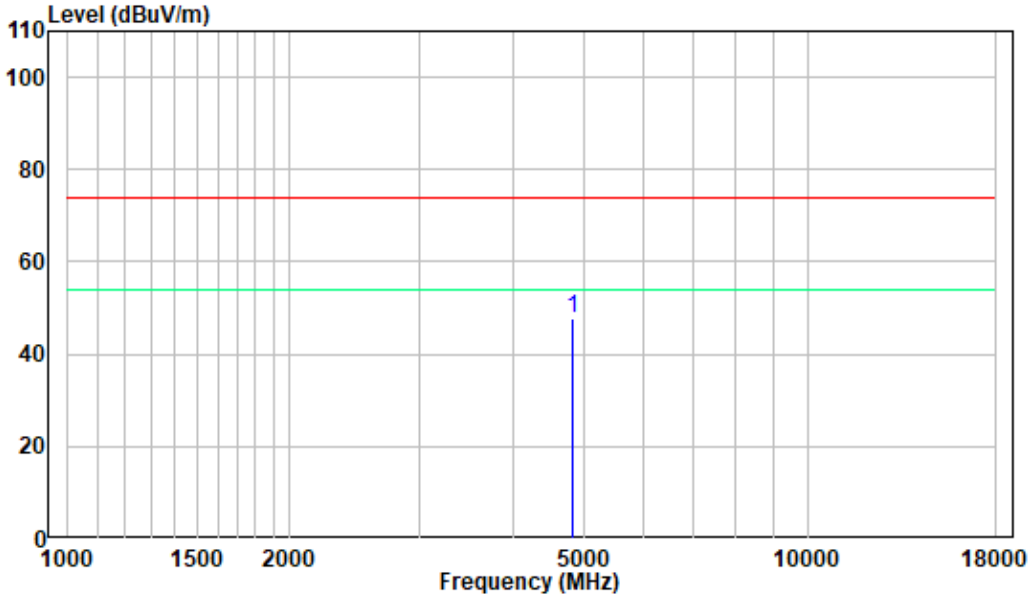
1-18 GHz:

Pre-scan plots:

Low Channel
Horizontal



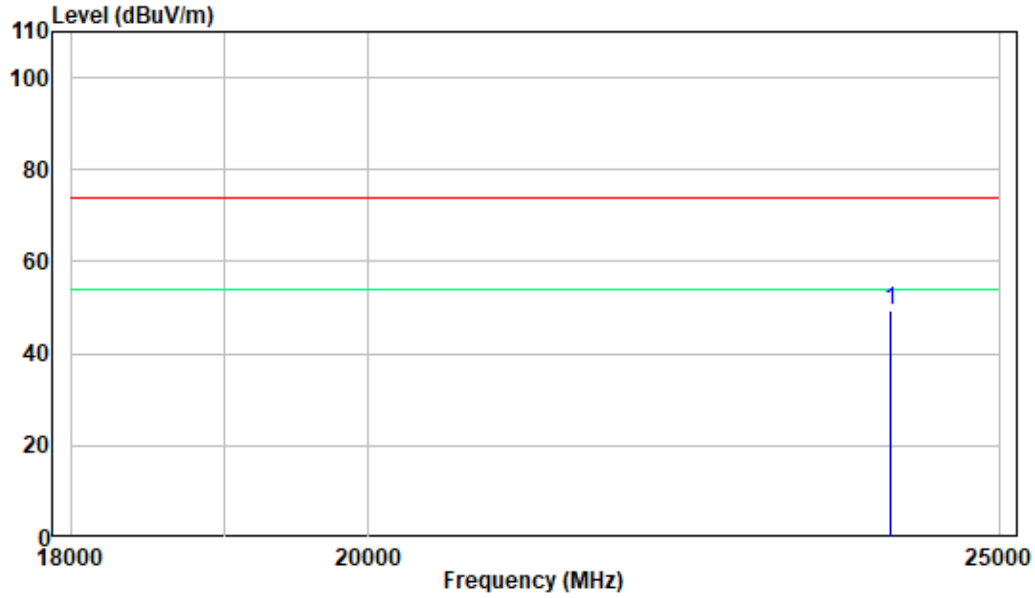
Vertical



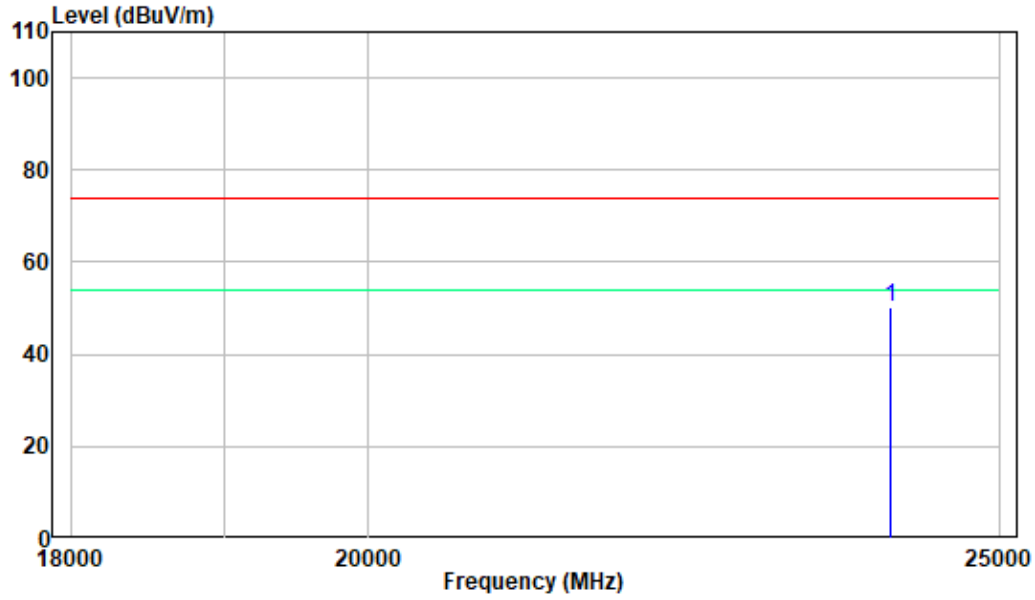
18 -25GHz:

Pre-scan plots:

Low Channel
Horizontal



Vertical



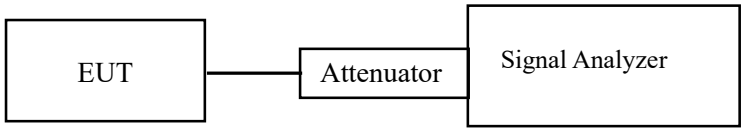
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH & OCCUPIED BANDWIDTH

Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.



Test Data

Environmental Conditions

Temperature:	25.9 ℃
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Ting Lü on 2021-11-16.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix Zigbee.

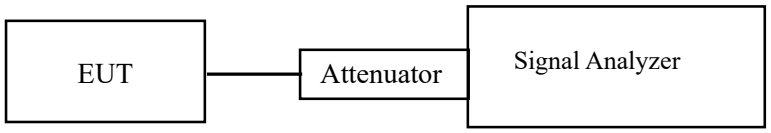
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	25.9 ℃
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Ting Lü on 2021-11-16.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix Zigbee

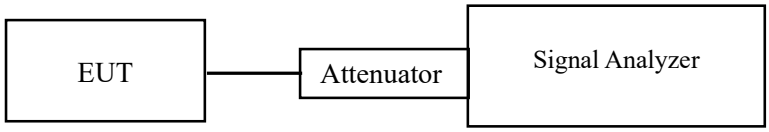
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

Applicable Standard

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

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. 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.
3. 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.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.



Test Data

Environmental Conditions

Temperature:	25.9 ℃
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Ting Lü on 2021-11-16.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix Zigbee.

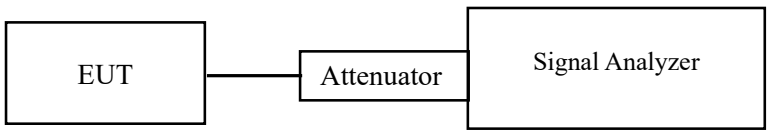
FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 1.5 times the DTS bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test Data

Environmental Conditions

Temperature:	25.9 ℃
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Ting Lü on 2021-11-16.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix Zigbee.

APPENDIX ZIGBEE

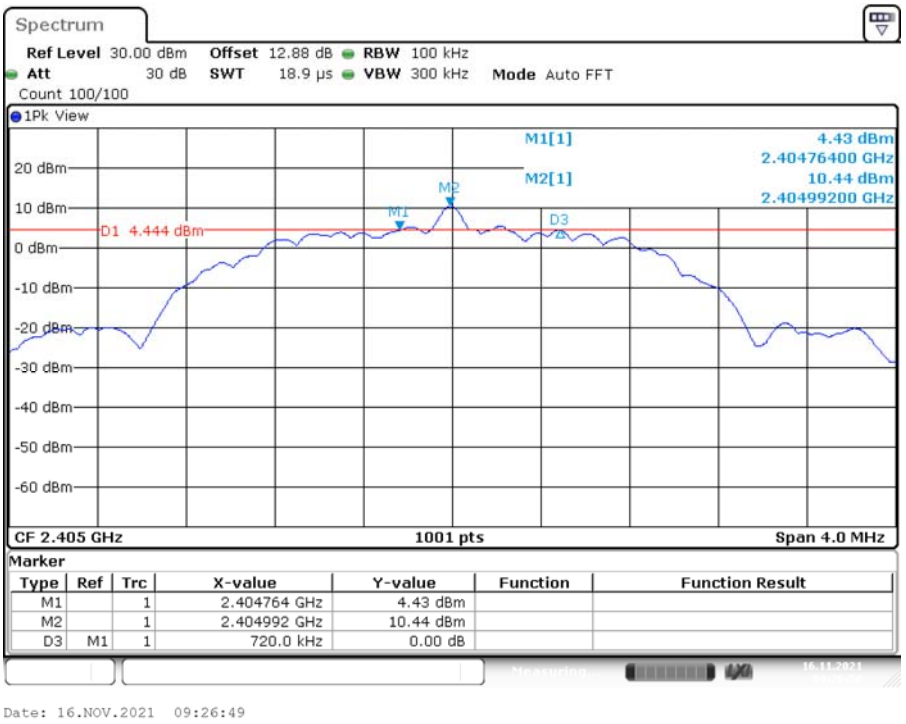
Appendix A: 6dB Emission Bandwidth

Test Result

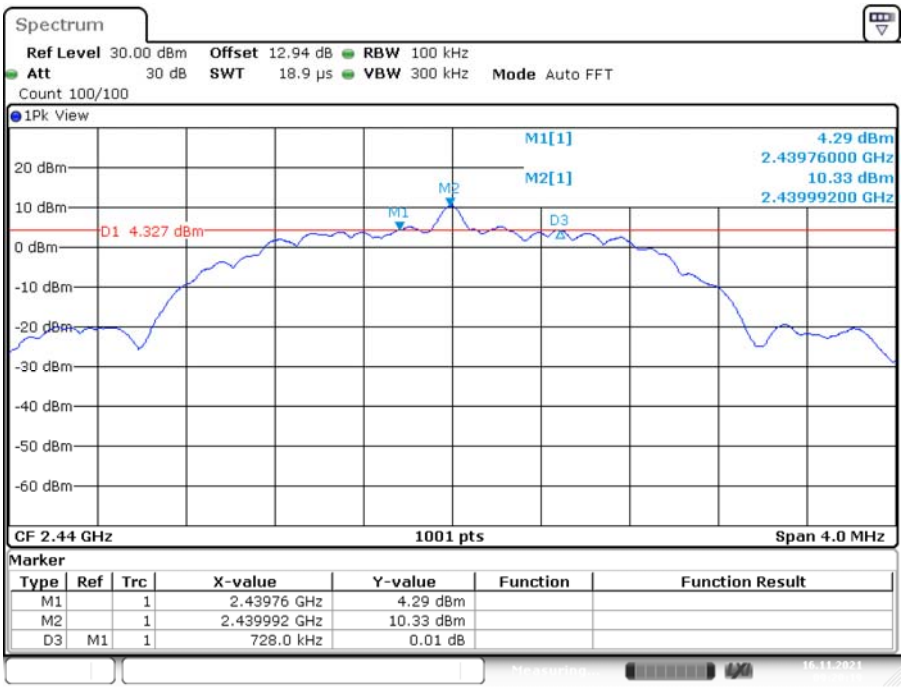
TestMode	Channel	DTS BW [MHz]	Limit[MHz]	Verdict
Zigbee	2405	0.720	0.5	PASS
	2440	0.728	0.5	PASS
	2480	0.726	0.5	PASS

Test Graphs

6dB Bandwidth, Zigbee Low Channel



6dB Bandwidth, Zigbee Middle Channel



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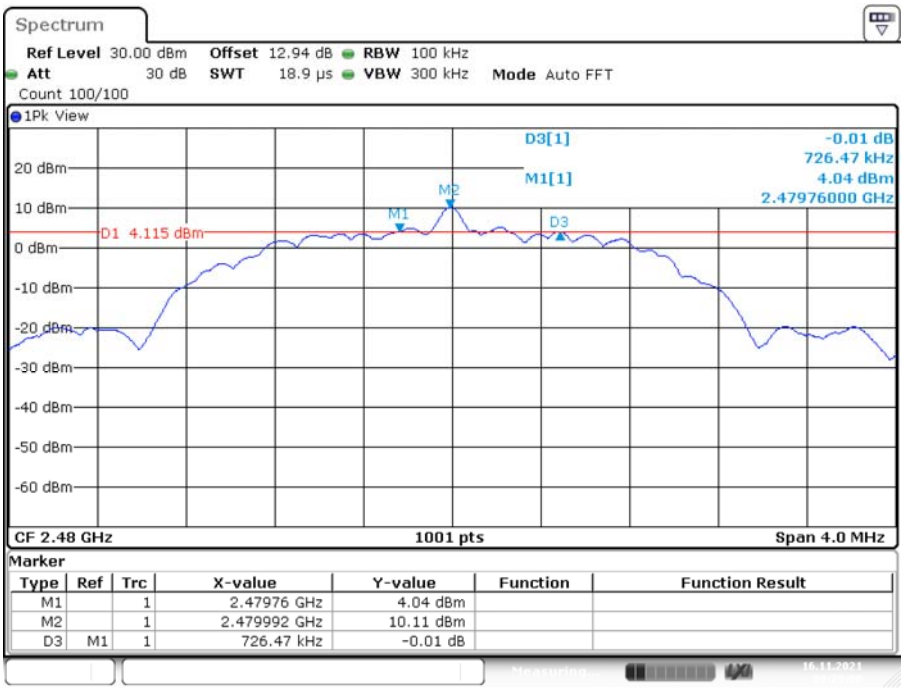
6dB Bandwidth, Zigbee High Channel



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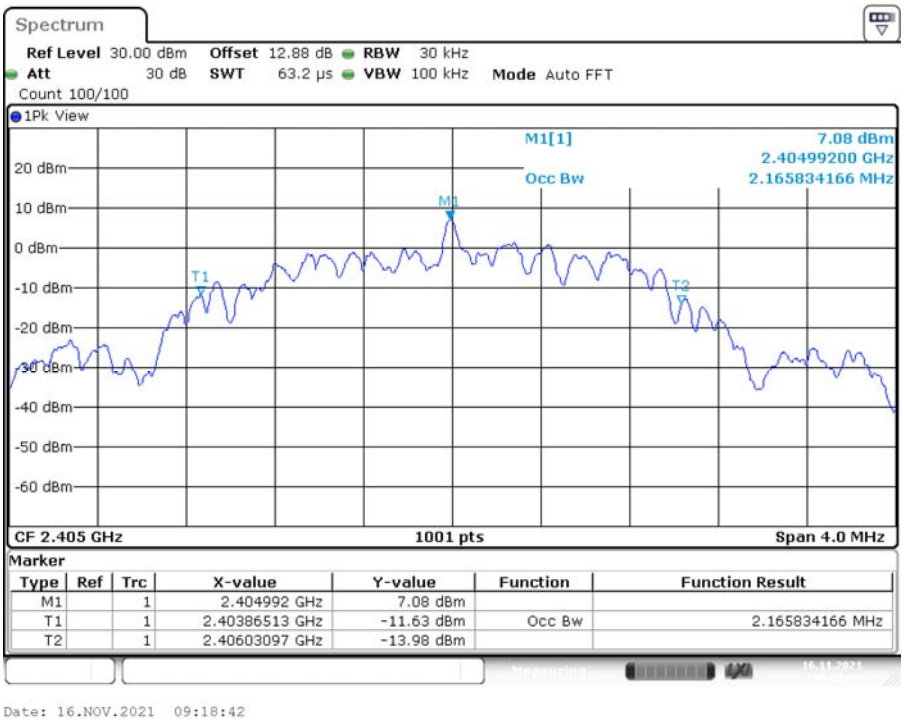
Appendix B: Occupied Channel Bandwidth

Test Result

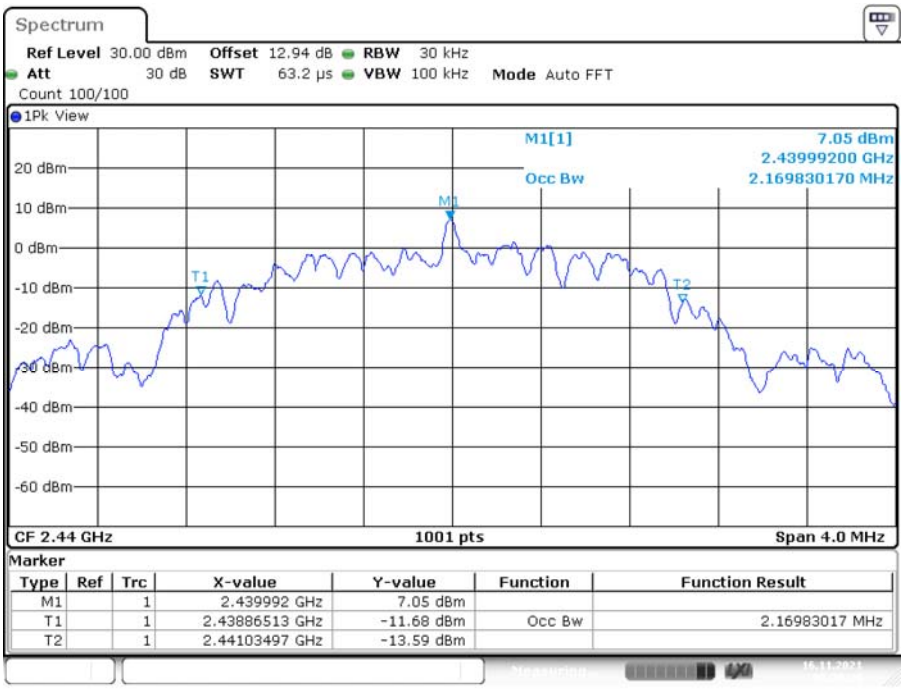
TestMode	Channel [MHz]	OCB [MHz]	Limit[dBm]	Verdict
Zigbee	2405	2.166	---	PASS
	2440	2.170	---	PASS
	2480	2.174	---	PASS

Test Graphs

99% Bandwidth, Zigbee Low Channel



99% Bandwidth, Zigbee Middle Channel



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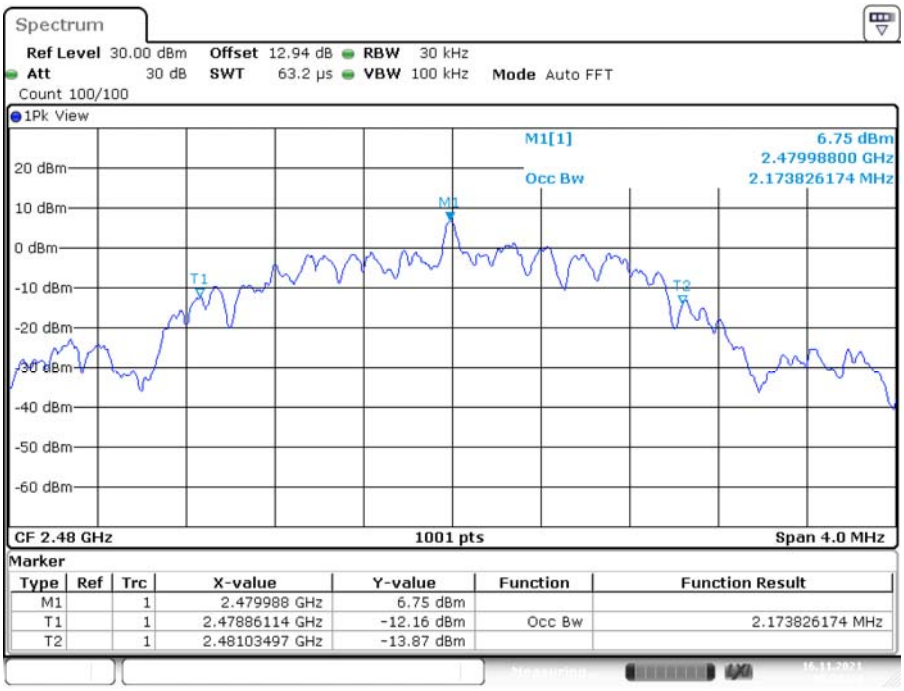
99% Bandwidth, Zigbee High Channel



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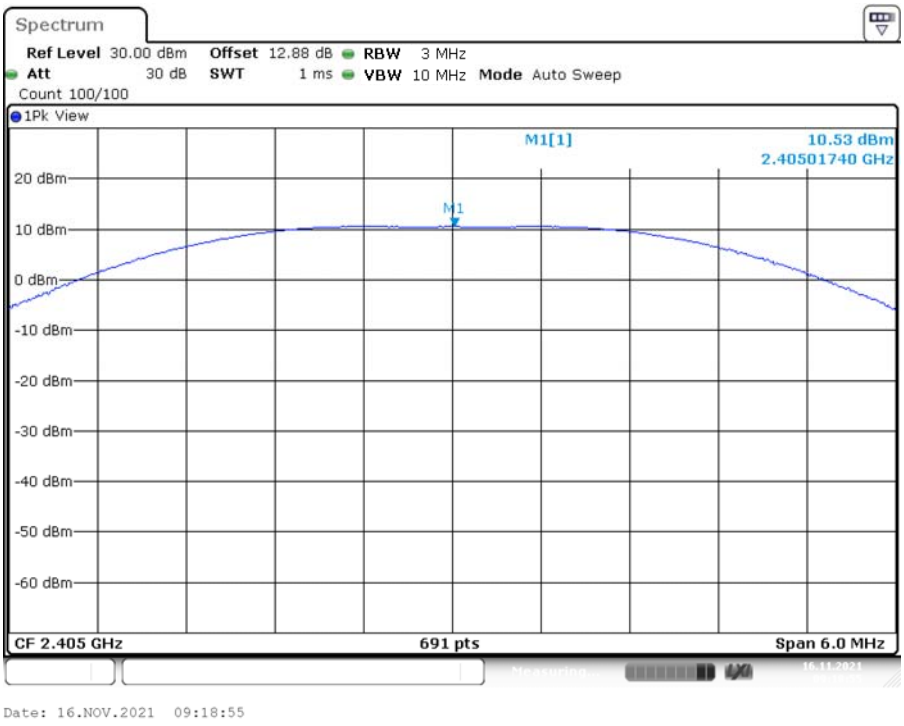
Appendix C: Maximum conducted Peak output power

Test Result

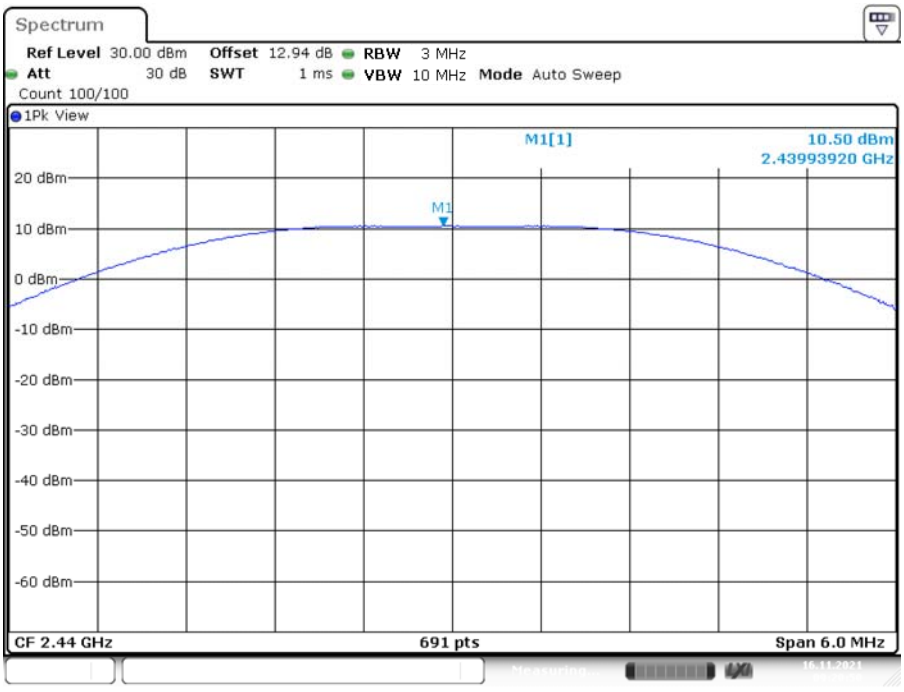
Test Mode	Channel [MHz]	Result[dBm]	Limit[dBm]	Verdict
Zigbee	2405	10.53	<=30	PASS
	2440	10.50	<=30	PASS
	2480	10.24	<=30	PASS

Test Graphs

Zigbee Low Channel



Zigbee Middle Channel



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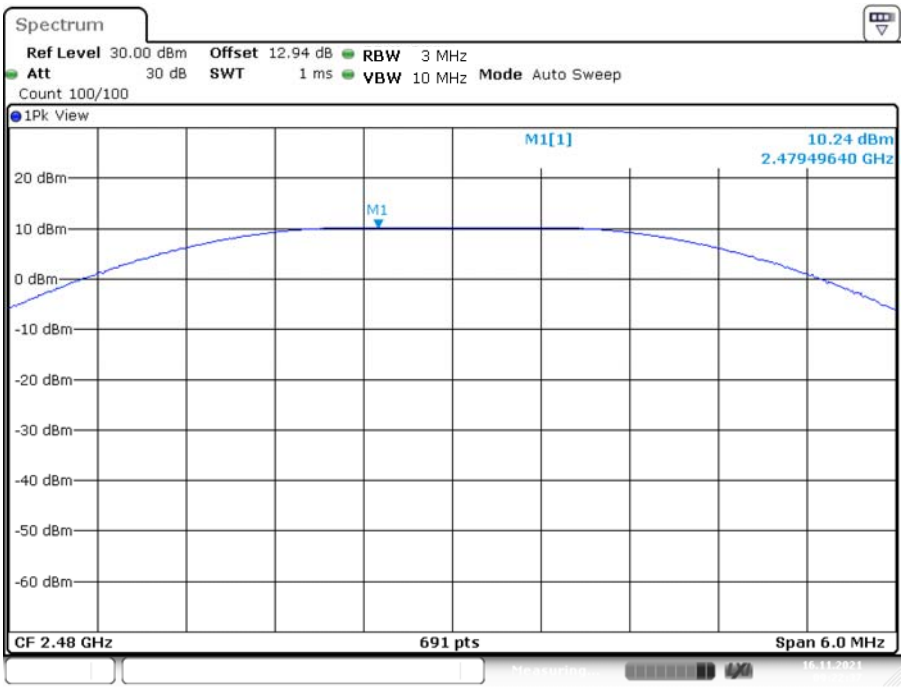
Zigbee High Channel



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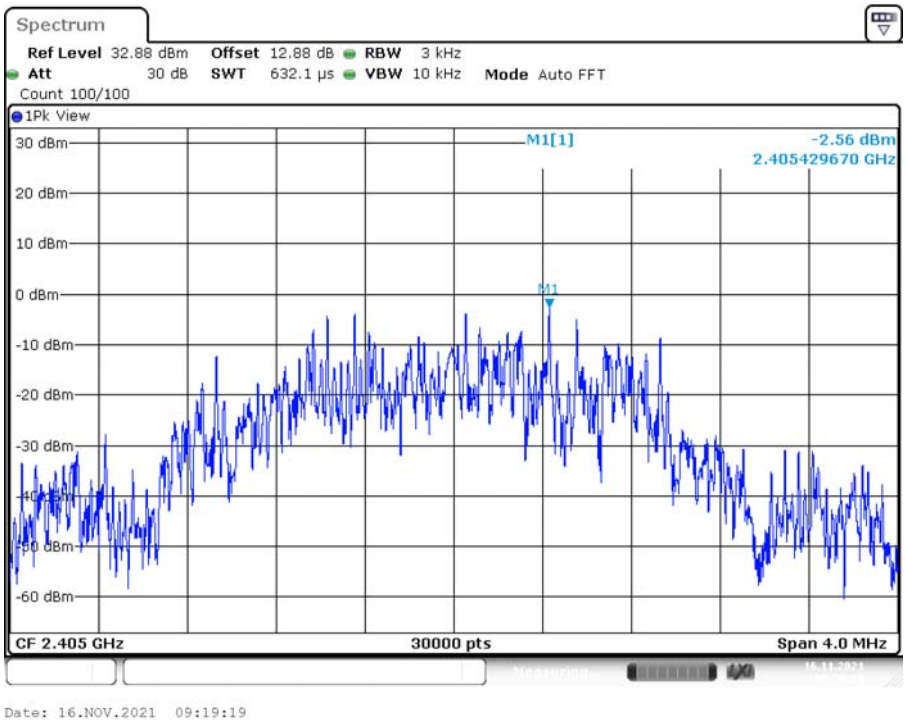
Appendix D: Power spectral density

Test Result

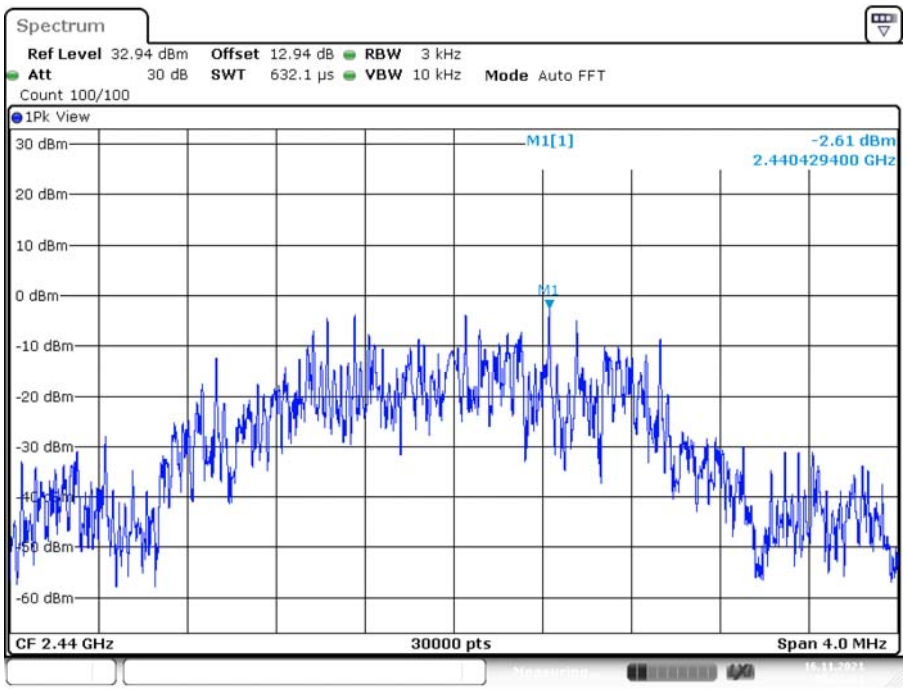
Test Mode	Channel[MHz]	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
Zigbee	2405	-2.56	<=8	PASS
	2440	-2.61	<=8	PASS
	2480	-2.92	<=8	PASS

Test Graphs

Power Spectral Density, Zigbee Low Channel



Power Spectral Density, Zigbee Middle Channel



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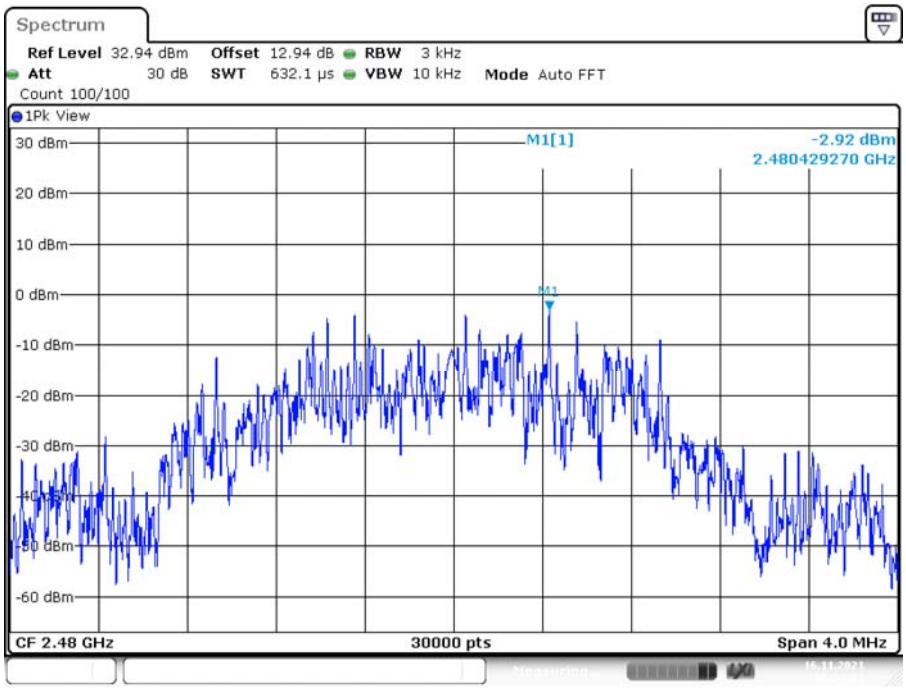
Power Spectral Density, Zigbee High Channel



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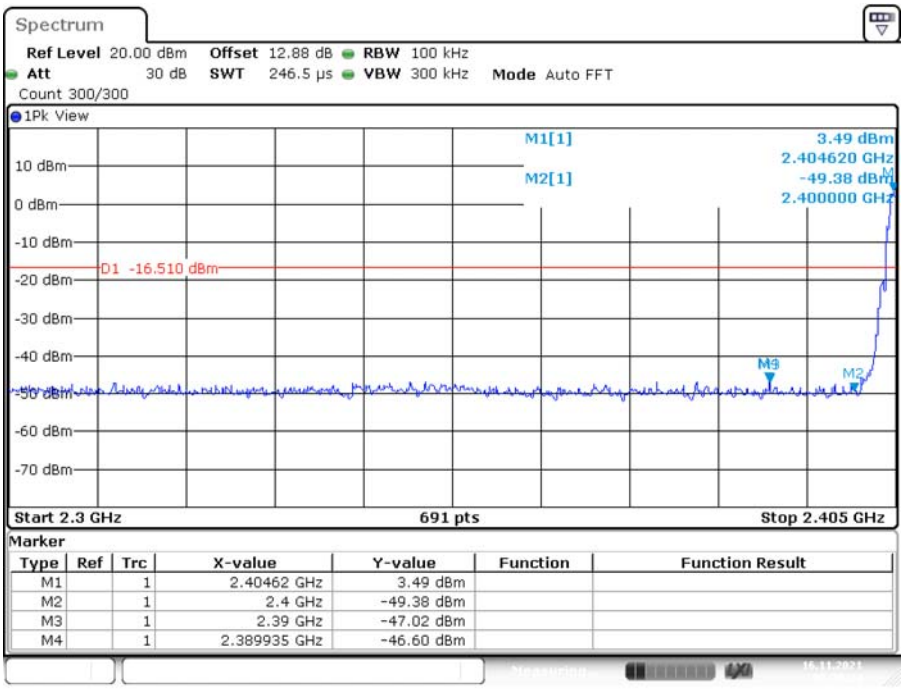
Appendix E: Band edge measurements

Test Graphs

Zigbee _Low_2405MHz



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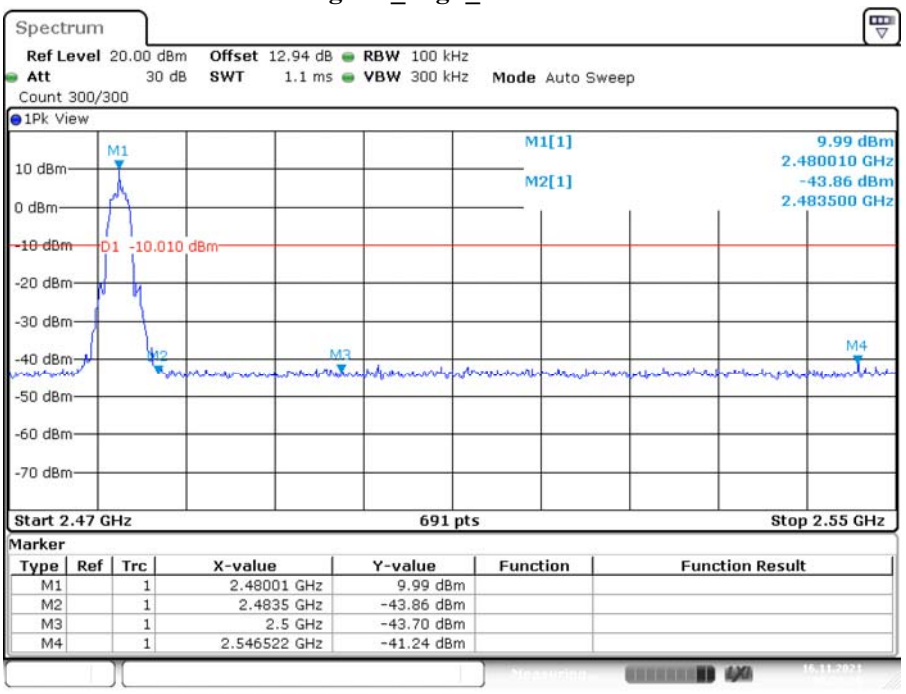
Zigbee _High_2480MHz



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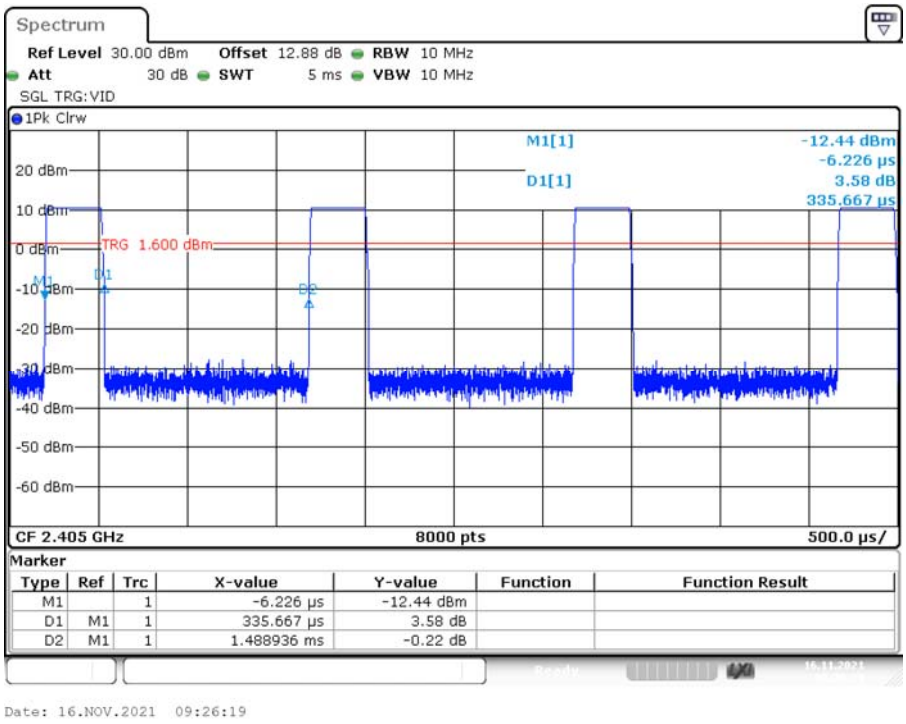
Appendix F: Duty Cycle

Test Result

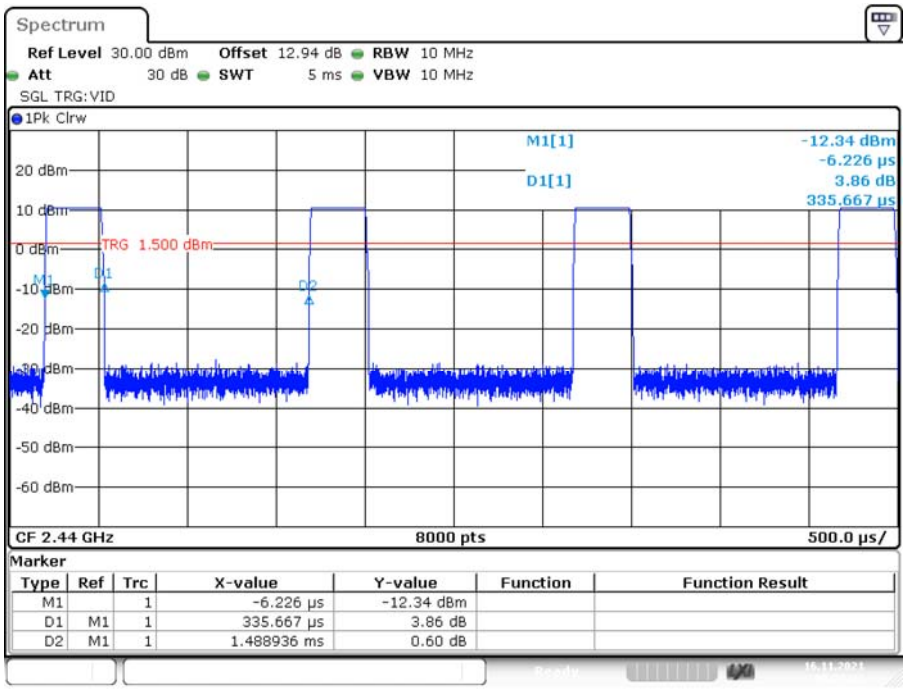
TestMode	Channel	TransmissionDuration [ms]	Transmission Period [ms]	Duty Cycle [%]
Zigbee	2405	0.336	1.489	22.57
	2440	0.336	1.489	22.57
	2480	0.336	1.489	22.57

Test Graphs

Duty Cycle, Zigbee, Low Channel



Duty Cycle, Zigbee, Middle Channel



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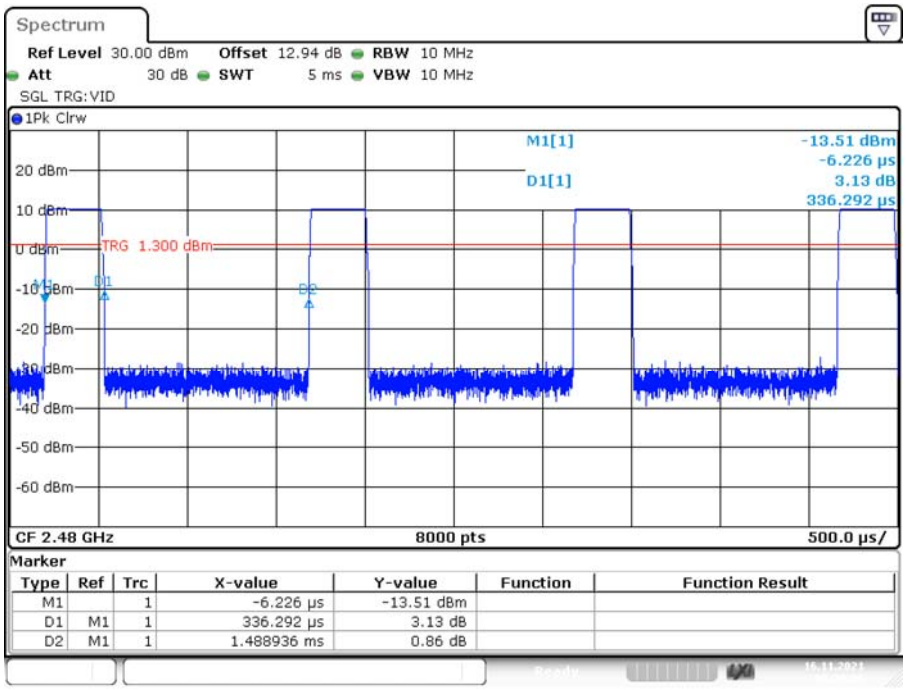
Duty Cycle, Zigbee, High Channel



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