FCC PART 15.247

TEST REPORT

For

Xunison Ltd

25th Kilcarbery Business Park, Upper Nangor Road, Dublin 22, Ireland

FCC ID: 2AP2F-XD2

Report Type:	**Product Type:**
Original Report	Doorbell

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Reviewed By: Jacob Kong, RF Engineer

Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen)
5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China
Tel: +86-755-33320018
Fax: +86-755-33320008
www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Doorbell
Tested Model	XD2
Frequency Range	Wi-Fi: 2412-2472MHz
Maximum Conducted Peak Power	Wi-Fi:11.48dBm(802.11b), 16.13dBm(802.11g) 14.86dBm(802.11n-HT20)
Modulation Technique	Wi-Fi: DSSS, OFDM
Antenna Specification*	5.09dBi(It is provided by the applicant)
Voltage Range	DC3.7V From Battery or DC 5V By Micro USB
Date of Test	2021-08-30 to 2021-09-10
Sample number	SZ1210803-32368E-RF-S1 (Assigned by BACL, Shenzhen)
Received date	2021-08-03
Sample/EUT Status	Good condition

Objective

This 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 Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.
Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.60dB
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

For Radiated emission above 1GHz test site as below:

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 1st Floor, East (3) Block, Laobing Building, Xingye Road, Baoan District, Shenzhen, Guangdong, P.R.C

Other test as below:

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, 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.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For 802.11b, 802.11g and 802.11n-HT20 mode, 13 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	12	2467
6	2437	13	2472
7	2442	/	/

For 802.11b, 802.11g, 802.11n-HT20 mode, EUT was tested with Channel 1, 7 and 13

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

"sscom5.13.1.exe"* software was use to the EUT tested

The device was tested with the worst case was performed as below:

Mode	Data rate	Power Level*		
		Low Channel	Middle Channel	High Channel
802.11b	1 Mbps	-20	-20	-20
802.11g	6 Mbps	-20	-20	-20
802.11n-HT20	MCS0	-20	-20	-20

The software and power level was provided by the applicant.

Duty cycle

Test Result Compliant. Please refer to the Appendix .

Support Equipment List and Details

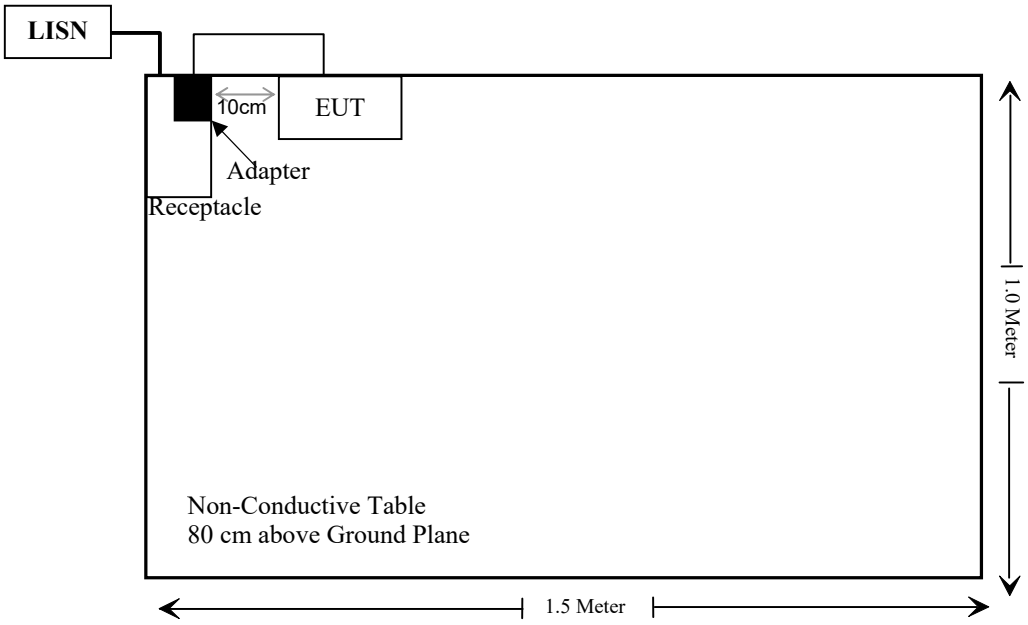
Manufacturer	Description	Model	Serial Number
ZTE	Adapter	STC-A51A	Unknown
Dongguan Aohai Power Technology Co.,Ltd.	Adapter	A8-501000	A1906034835
BULL	Receptacle	GN-415K	5503290068073

External I/O Cable

Cable Description	Length(m)	From Port	To
Un-shielding Detachable USB Cable	1.5	EUT	Adapter

Block Diagram of Test Setup

For conducted emission



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	Compliant
§15.247(b)(3)	Maximum Conducted Output Power	Compliant
§15.247(d)	100kHz 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	101120	2021/07/07	2022/07/06
Rohde & Schwarz	LISN	ENV216	101613	2021/07/07	2022/07/06
Rohde & Schwarz	Transient Limitor	ESH3Z2	DE25985	2020/11/29	2021/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2020/11/29	2021/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Radiated Emission Test below 1GHz					
R&S	EMI Test Receiver	ESR3	102455	2021/07/06	2022/07/05
Sonoma instrument	Pre-amplifier	310 N	186238	2021/08/03	2022/08/02
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2020/12/22	2023/12/21
Unknown	Cable	Chamber Cable 1	F-03-EM236	2021/08/03	2022/08/02
Unknown	Cable	Chamber Cable 4	EC-007	2021/08/03	2022/08/02
Rohde & Schwarz	Auto test software	EMC 32	V9.10.00	NCR	NCR
CHIGO	Temperature & Humidity Meter	HTC-1S	T-03-EM451	2021/04/07	2022/04/06
Radiated Emission Test above 1GHz					
Rohde & Schwarz	Spectrum Analyzer	FSV40	101590	2020/12/14	2021/12/13
Preamplifer	Pre-amplifier	PAM-0118	226	2020/11/29	2021/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2021/06/29	2022/06/29
Agilent	Horn Antenna	AHA-118S	3017	2021-02-25	2024-2-24
Unknown	Cable	Chamber Cable 1	UFB311A-0-0788-50V50VTV	2021/02/03	2022/02/03
Unknown	Cable	Chamber Cable 2	UFB311A-0-0789-50V50VTV	2021/02/03	2022/02/03
Ducommun Technolagies	Horn antenna	ARH-4223-02	1007726-02 1304	2020/12/06	2023/12/05
wainwrigh	Band Reject filter	WRCG2400	2.4G filter	2021/04/20	2022/04/20
CHIGO	Temperature & Humidity Meter	HTC-1S	T-03-EM458	2021/4/12	2022/4/11

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Tonscend	RF control Unit	JS0806-2	19D8060154	2021/07/06	2022/07/05
Rohde & Schwarz	Signal and Spectrum Analyzer	FSV40	101473	2021/07/06	2022/07/05
Agilent	MXG Vector Signal Generator	N5182B	MY53051503	2021/07/07	2022/07/06
Yijia	Temperature & Humidity Meter	10316377	T-03-EM397	2021/3/1	2022/2/28

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) 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				
FrequencyRange (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)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Mode	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)			
2.4G Wi-Fi	2412-2472	5.09	3.23	17	50.12	20	0.032	1

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

Result: Compliance

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 an integral antenna arrangement, whichwas permanently attached and the antenna gain is 5.09dBi, fulfill the requirement of this section. Please refer to the EUT photos.

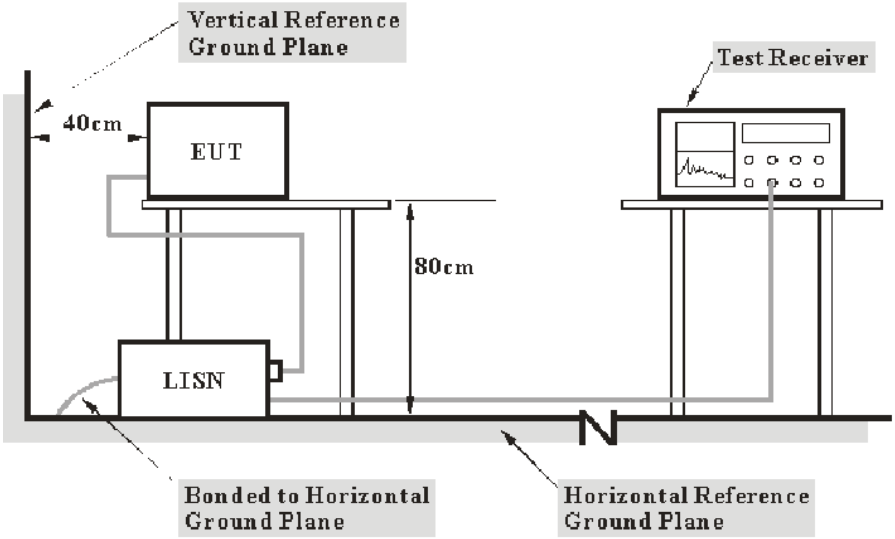
Result: Compliant.

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 10cm.

EMI Test Receiver Setup

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

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

FrequencyRange	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

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.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by addingLISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Correction Factor = LISN VDF + Cable Loss+ Transient Limiter Attenuation

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicablelimit. For example, a margin of 7dB means the emission is 7 dB below the limit. The equation for margincalculation is as follows:

Margin = Limit – Corrected Amplitude

Test Data

Environmental Conditions

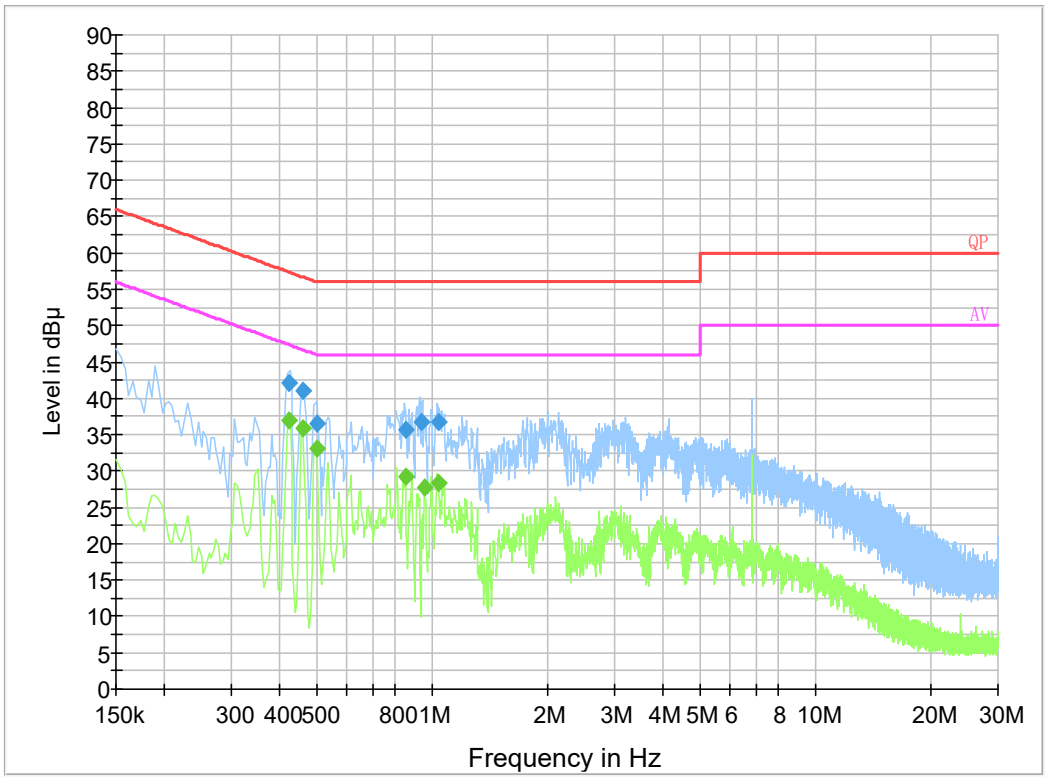
Temperature:	25℃
Relative Humidity:	67%
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Lion 2021-08-30.

EUT operation mode: Transmitting

Scan with 802.11b, 802.11g, 802.11n HT20 mode, the worst case is 802.11g Mode Middle channel

AC 120V/60 Hz, Line



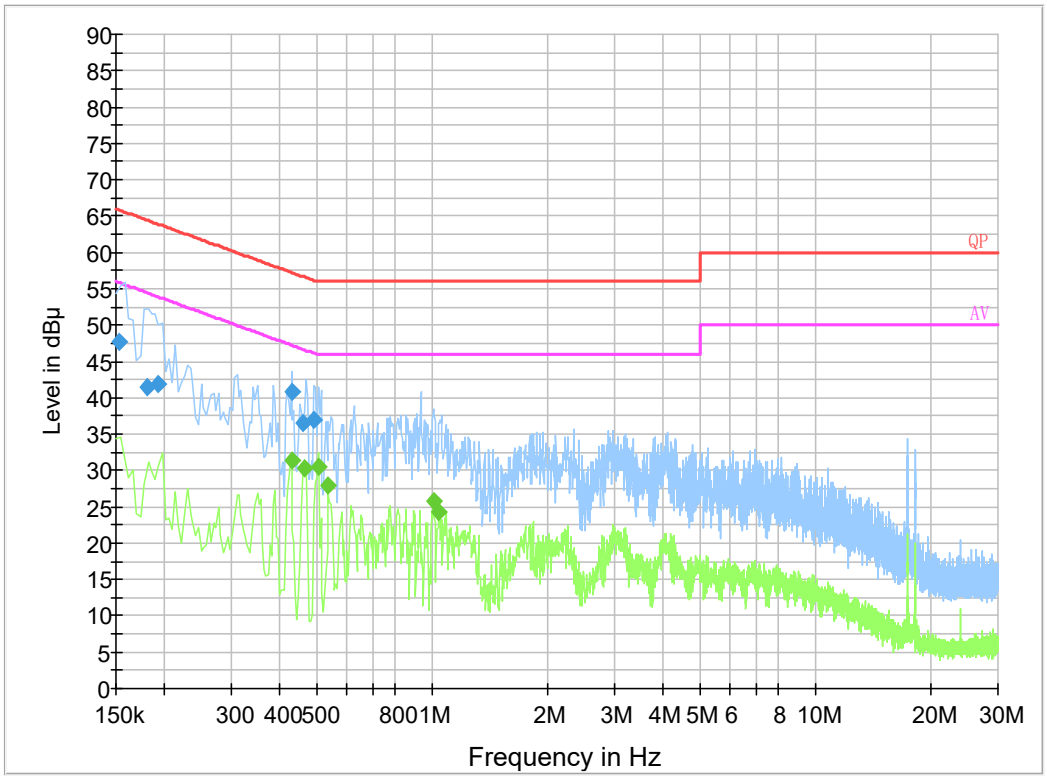
Final Result 1

Frequency (MHz)	Quasi Peak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.423610	42.1	9.000	L1	19.9	15.3	57.4
0.459130	40.9	9.000	L1	19.8	15.8	56.7
0.502470	36.5	9.000	L1	19.8	19.5	56.0
0.853250	35.6	9.000	L1	19.8	20.4	56.0
0.940050	36.6	9.000	L1	19.8	19.4	56.0
1.038490	36.7	9.000	L1	19.9	19.3	56.0

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.423610	37.0	9.000	L1	19.9	10.4	47.4
0.459130	35.8	9.000	L1	19.8	10.9	46.7
0.502470	33.1	9.000	L1	19.8	12.9	46.0
0.853250	29.3	9.000	L1	19.8	16.7	46.0
0.954000	27.6	9.000	L1	19.8	18.4	46.0
1.038490	28.4	9.000	L1	19.9	17.6	46.0

AC 120V/60 Hz, Neutral



Final Result 1

Frequency (MHz)	Quasi Peak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.153500	47.7	9.000	N	19.8	18.1	65.8
0.181500	41.5	9.000	N	19.8	22.9	64.4
0.193500	41.8	9.000	N	19.8	22.1	63.9
0.431550	40.8	9.000	N	19.8	16.4	57.2
0.462950	36.6	9.000	N	19.8	20.0	56.6
0.494590	36.9	9.000	N	19.8	19.2	56.1

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.430000	31.3	9.000	N	19.8	16.0	47.3
0.466000	30.3	9.000	N	19.8	16.3	46.6
0.506000	30.6	9.000	N	19.8	15.4	46.0
0.538000	27.9	9.000	N	19.8	18.1	46.0
1.010000	25.7	9.000	N	19.8	20.3	46.0
1.046000	24.3	9.000	N	19.8	21.7	46.0

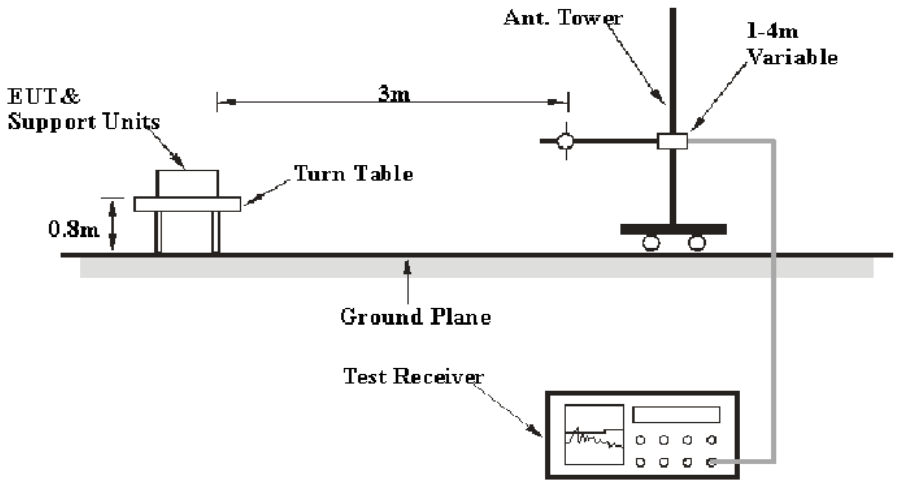
FCC §15.209, §15.205 &§15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

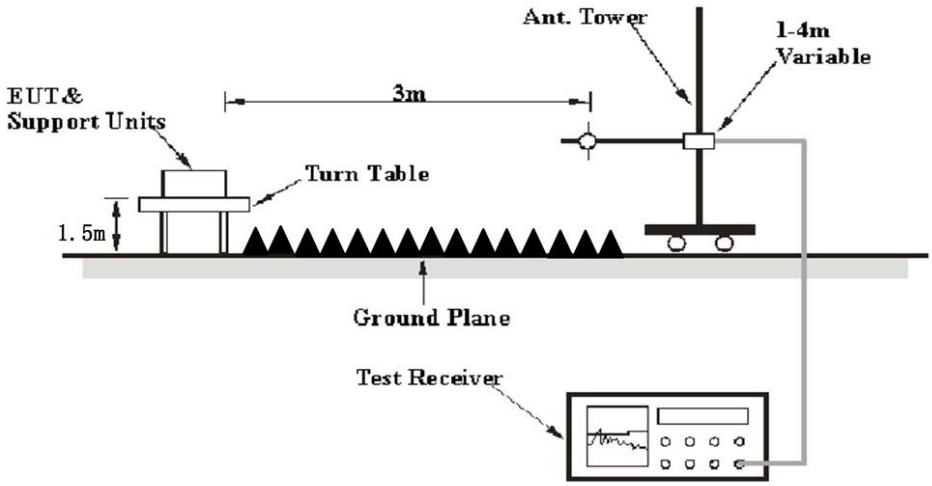
FCC §15.247 (d); §15.209;§15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3meters 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
30MHz – 1000 MHz	100 kHz	300 kHz	120kHz	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 allinstallation combinations.

Corrected Amplitude & Margin Calculation

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

Corrected Amplitude = MeterReading + Antenna Factor + Cable Loss - Amplifier Gain

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

Margin = Limit –Corrected Amplitude

Test Data

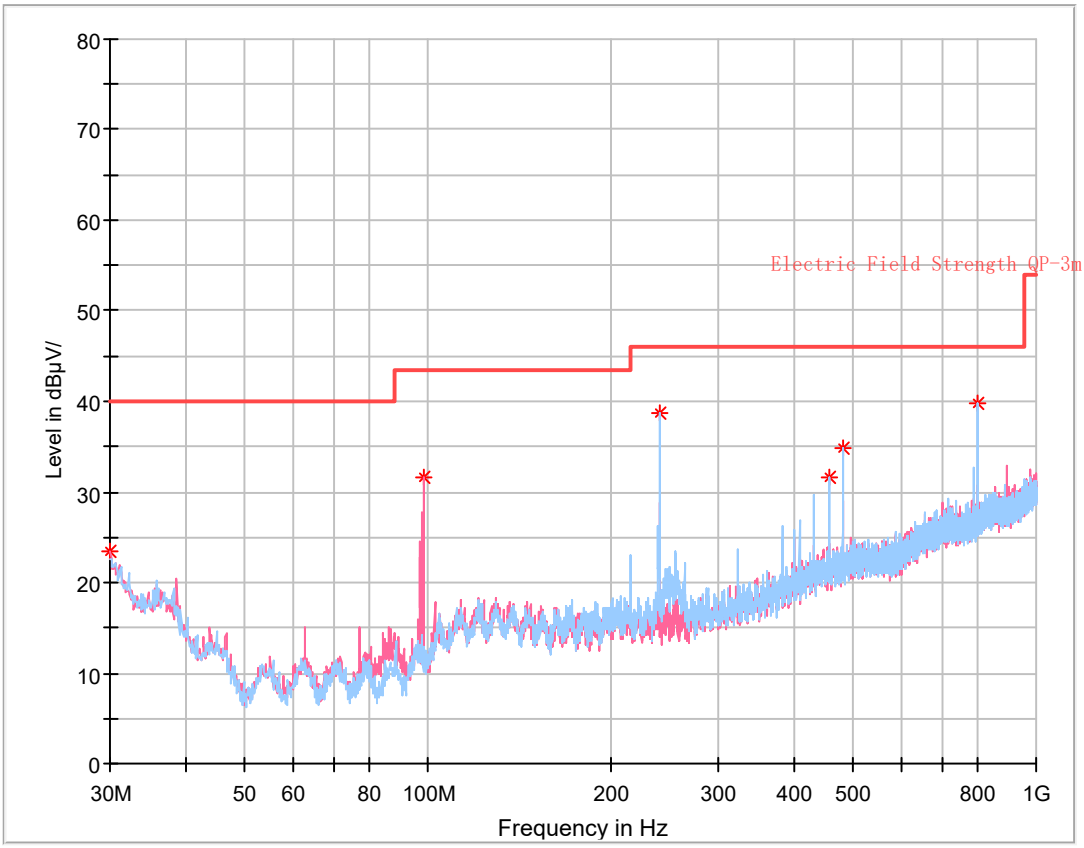
Environmental Conditions

Temperature:	24~26℃
Relative Humidity:	56 %
ATM Pressure:	101kPa

The testing was performed by Cloud Qiu on 2021-09-01 for below 1GHz and Mark Guo on 2021-09-04 for above 1GHz.

EUT operation mode: Transmitting

30 MHz~1 GHz:*(Scan with 802.11b, 802.11g, 802.11n HT20 mode, the worst case is 802.11g Mode Middle channel)*



Critical_Freqs

Frequency (MHz)	MaxPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.000000	23.40	40.00	16.60	100.0	V	275.0	-3.5
98.506250	31.66	43.50	11.84	200.0	V	294.0	-14.1
240.005000	38.79	46.00	7.21	100.0	H	233.0	-11.7
455.951250	31.66	46.00	14.34	200.0	H	136.0	-5.5
479.958750	34.94	46.00	11.06	200.0	H	307.0	-5.3
800.058750	39.80	46.00	6.20	100.0	H	271.0	-0.5

1 GHz-25 GHz (Wi-Fi):

802.11b Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2384.65	31.68	PK	93	1.1	V	30.91	62.59	74.0	11.41
2384.65	19.86	Ave.	93	1.1	V	30.91	50.77	54.0	3.23
2486.14	28.91	PK	129	1.2	V	30.72	59.63	74.0	14.37
2486.14	15.36	Ave.	129	1.2	V	30.72	46.08	54.0	7.92
4824.00	53.29	PK	118	1.5	V	-3.52	49.77	74.0	24.23
4824.00	46.15	Ave.	118	1.5	V	-3.52	42.63	54.0	11.37
Middle Channel (2442 MHz)									
4884.00	52.07	PK	235	1.7	V	-2.94	49.13	74.0	24.87
4884.00	44.26	AV	235	1.7	V	-2.94	41.32	54.0	12.68
High Channel (2472 MHz)									
2385.54	28.44	PK	254	1.6	V	30.91	59.35	74.0	14.65
2385.54	15.46	Ave.	254	1.6	V	30.91	46.37	54.0	7.63
2493.87	30.43	PK	162	1.2	V	30.72	61.15	74.0	12.85
2493.87	19.78	Ave.	162	1.2	V	30.72	50.50	54.0	3.50
4944.00	51.56	PK	104	1.4	V	-2.84	48.72	74.0	25.28
4944.00	42.37	AV	104	1.4	V	-2.84	39.53	54.0	14.47

802.11g Mode:

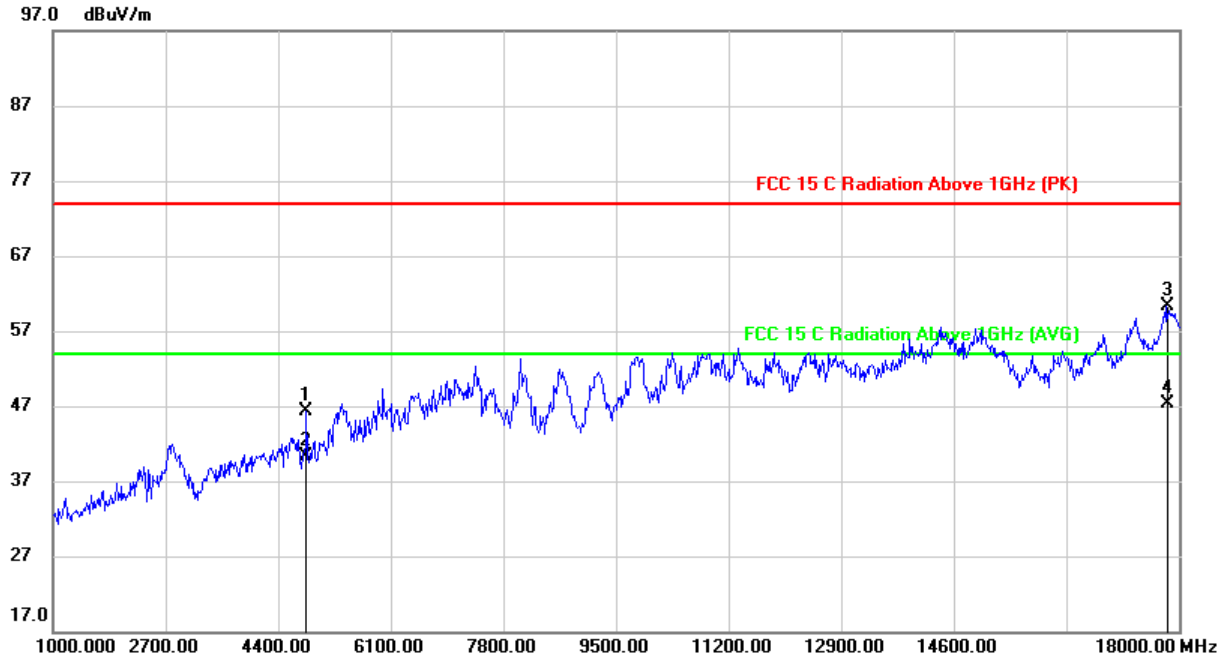
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2389.59	32.35	PK	339	1.1	V	30.91	63.26	74.0	10.74
2389.59	19.81	Ave.	339	1.1	V	30.91	50.72	54.0	3.28
2488.26	28.89	PK	84	2.3	V	30.72	59.61	74.0	14.39
2488.26	15.44	Ave.	84	2.3	V	30.72	46.16	54.0	7.84
4824.00	53.91	PK	141	1.4	V	-3.52	50.39	74.0	23.61
4824.00	37.94	Ave.	141	1.4	V	-3.52	34.42	54.0	19.58
Middle Channel (2442 MHz)									
4884.00	52.86	PK	88	1.6	V	-2.94	49.92	74.0	24.08
4884.00	36.63	Ave.	88	1.6	V	-2.94	33.69	54.0	20.31
High Channel (2472 MHz)									
2317.47	28.91	PK	77	1.6	V	30.83	59.74	74.0	14.26
2317.47	15.55	Ave.	77	1.6	V	30.83	46.38	54.0	7.62
2483.67	32.17	PK	330	2.2	V	30.72	62.89	74.0	11.11
2483.67	20.06	Ave.	330	2.2	V	30.72	50.78	54.0	3.22
4944.00	51.64	PK	335	2.3	V	-2.84	48.80	74.0	25.20
4944.00	35.17	Ave.	335	2.3	V	-2.84	32.33	54.0	21.67

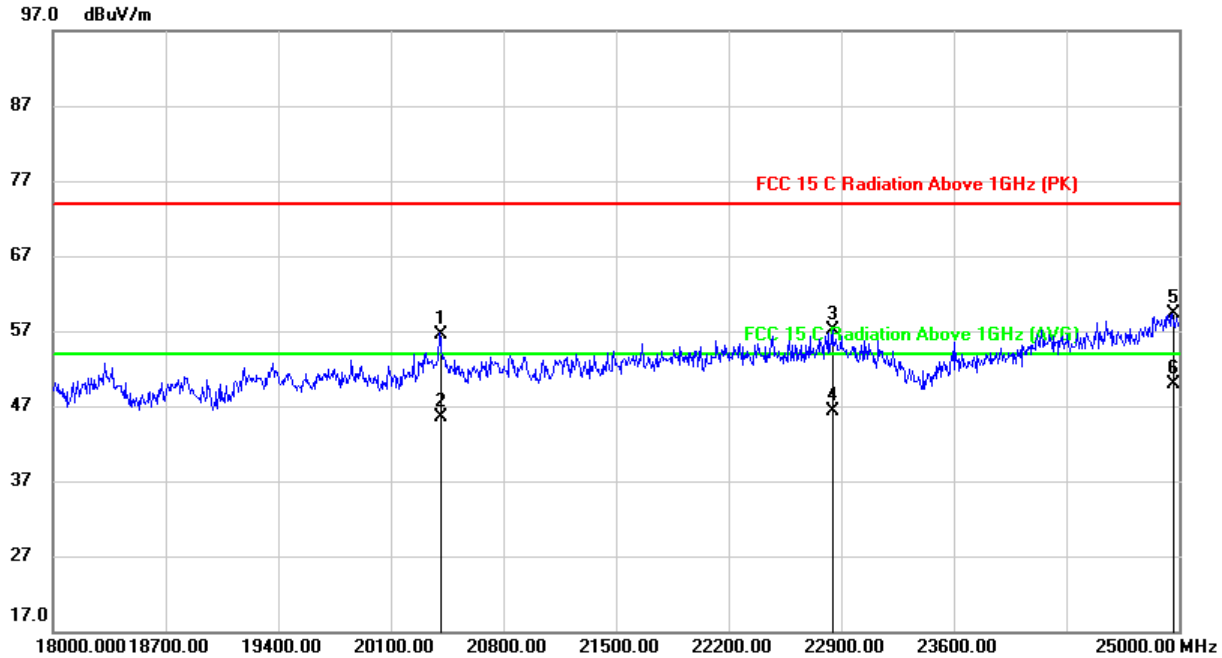
802.11n-HT20 Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2389.71	38.72	PK	181	2.2	V	30.91	69.63	74.0	4.37
2389.71	19.79	Ave.	181	2.2	V	30.91	50.70	54.0	3.30
2486.35	29.94	PK	223	2.1	V	30.72	60.66	74.0	13.34
2486.35	15.48	Ave.	223	2.1	V	30.72	46.20	54.0	7.80
4824.00	51.32	PK	123	1.6	V	-3.52	47.80	74.0	26.20
4824.00	35.02	Ave.	123	1.6	V	-3.52	31.50	54.0	22.50
Middle Channel (2442 MHz)									
4884.00	49.36	PK	288	1.3	V	-2.94	46.42	74.0	27.58
4884.00	33.98	Ave.	288	1.3	V	-2.94	31.04	54.0	22.96
High Channel (2472 MHz)									
2389.56	28.77	PK	345	1.1	V	30.91	59.68	74.0	14.32
2389.56	14.56	Ave.	345	1.1	V	30.91	45.47	54.0	8.53
2486.00	37.01	PK	191	1.1	V	30.72	67.73	74.0	6.27
2486.00	20.14	Ave.	191	1.1	V	30.72	50.86	54.0	3.14
4944.00	47.63	PK	143	1.8	V	-2.84	44.79	74.0	29.21
4944.00	32.68	Ave.	143	1.8	V	-2.84	29.84	54.0	24.16

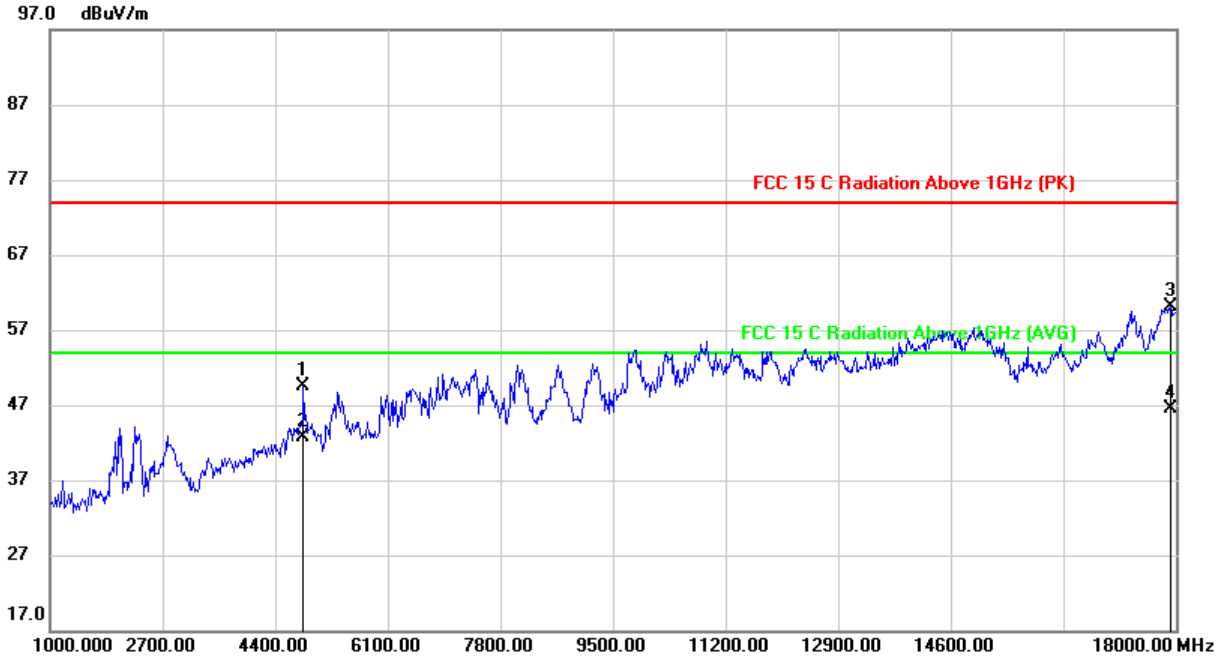
Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is 20dB below the limit or on the noise floor was not recorded.

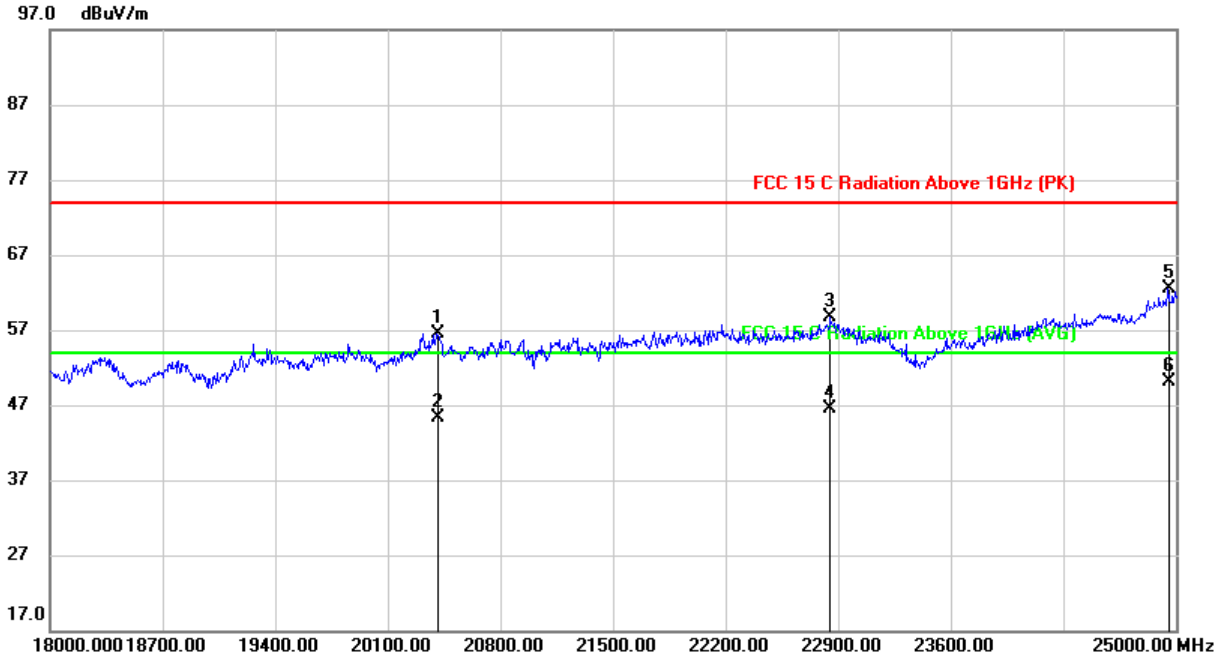
Pre-scan with 802.11b Mode, Low channel
Horizontal





Vertical


97.0 dBuV/m
87
77
67
57
47
37
27
17.0
FCC 15 C Radiation Above 1GHz (PK)
FCC 15 C Radiation Above 1GHz (AVG)
1
2
3
4
1000.000 2700.00 4400.00 6100.00 7800.00 9500.00 11200.00 12900.00 14600.00 18000.00 MHz


97.0 dBuV/m
87
77
67
57
47
37
27
17.0
FCC 15 C Radiation Above 1GHz (PK)
FCC 15 C Radiation Above 1GHz (AVG)
1
2
3
4
5
6
18000.000 18700.00 19400.00 20100.00 20800.00 21500.00 22200.00 22900.00 23600.00 25000.00 MHz

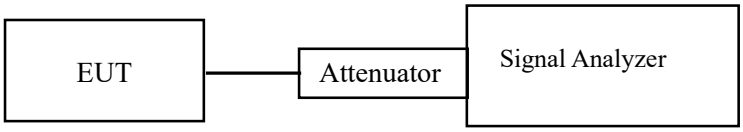
FCC §15.247(a) (2) – 6dB EMISSION BANDWIDTH

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:	27℃
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

The testing was performed by Bravos Zhao on 2021-09-10.

EUT operation mode: Transmitting

Test Result Compliant. Please refer to the Appendix Wi-Fi.

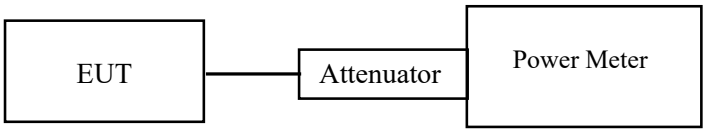
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

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:	27℃
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

The testing was performed by Bravos Zhao on 2021-09-10.

EUT operation mode: Transmitting

Test Result Compliant. Please refer to the Appendix Wi-Fi.

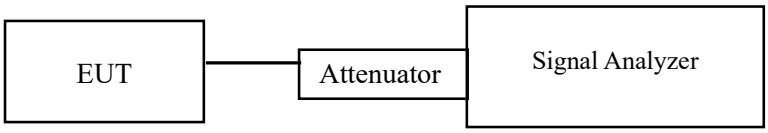
FCC §15.247(d) – 100kHz BANDWIDTH OF FREQUENCY BAND EDGE

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:	27℃
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

The testing was performed by Bravos Zhao on 2021-09-10.

EUT operation mode: Transmitting

Test Result Compliant. Please refer to the Appendix Wi-Fi.

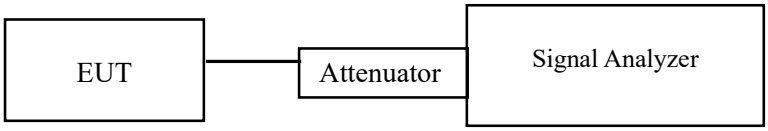
FCC §15.247(e)- POWER SPECTRAL DENSITY

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 usedto 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:	27℃
Relative Humidity:	57 %
ATM Pressure:	101.0 kPa

The testing was performed by Bravos Zhao on 2021-09-10.

EUT operation mode: Transmitting

Test Result Compliant. Please refer to the Appendix Wi-Fi.

APPENDIX Wi-Fi

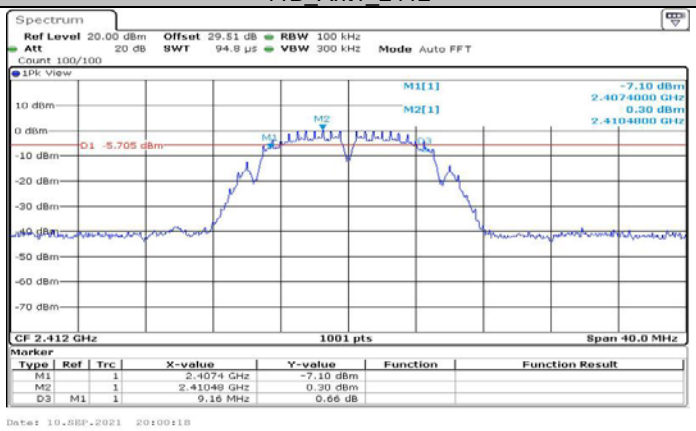
Appendix A: DTS Bandwidth

Test Result

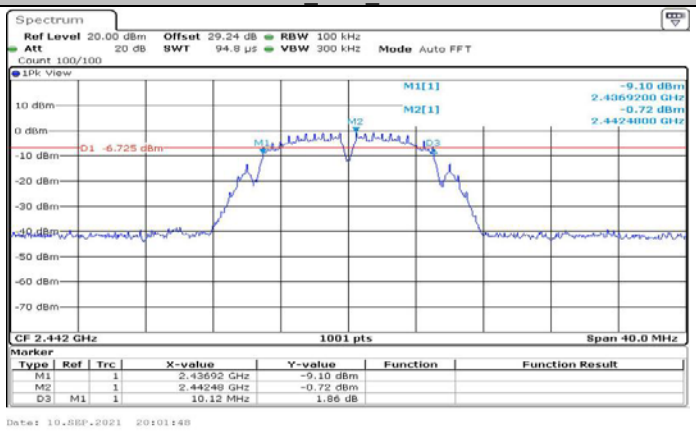
Test Mode	Antenna	Channel	DTS BW [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	9.160	0.5	PASS
		2442	10.120	0.5	PASS
		2472	9.160	0.5	PASS
11G	Ant1	2412	16.440	0.5	PASS
		2442	16.440	0.5	PASS
		2472	16.480	0.5	PASS
11N20SISO	Ant1	2412	17.640	0.5	PASS
		2442	17.680	0.5	PASS
		2472	17.680	0.5	PASS

Test Graphs

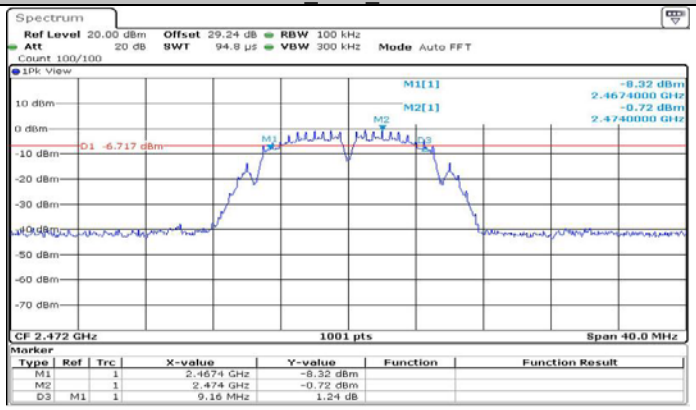
11B_Ant1_2412



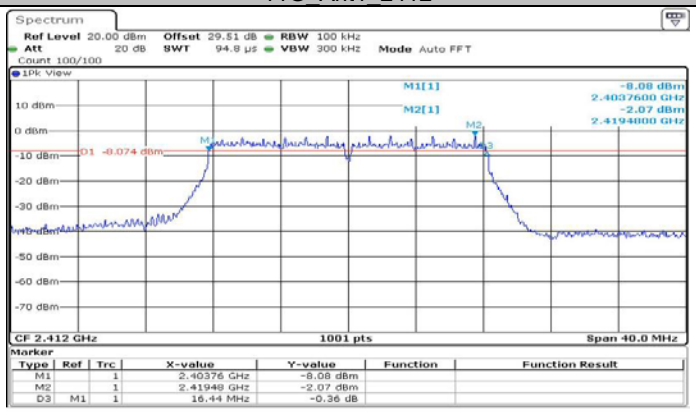
11B_Ant1_2442



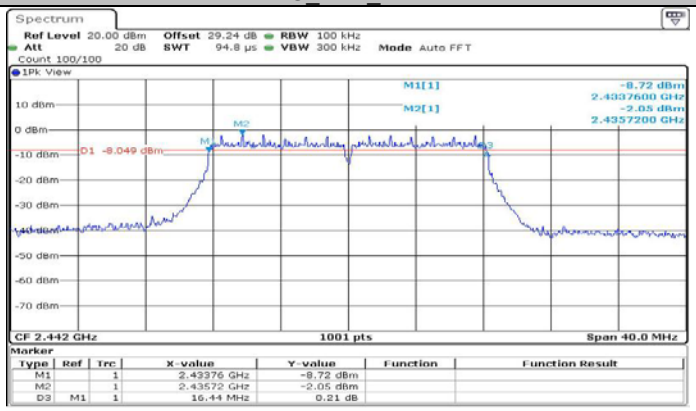
11B_Ant1_2472



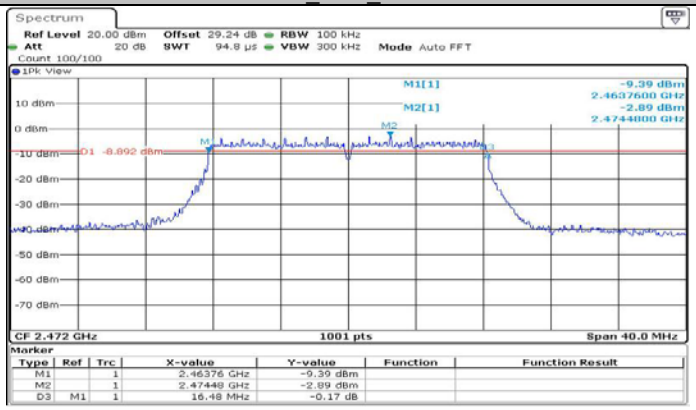
11G_Ant1_2412



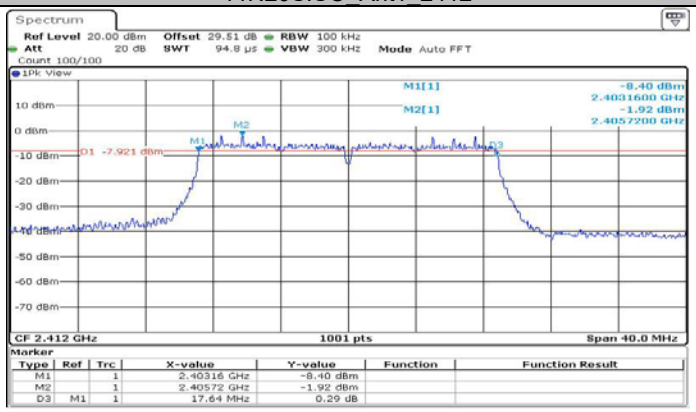
11G_Ant1_2442



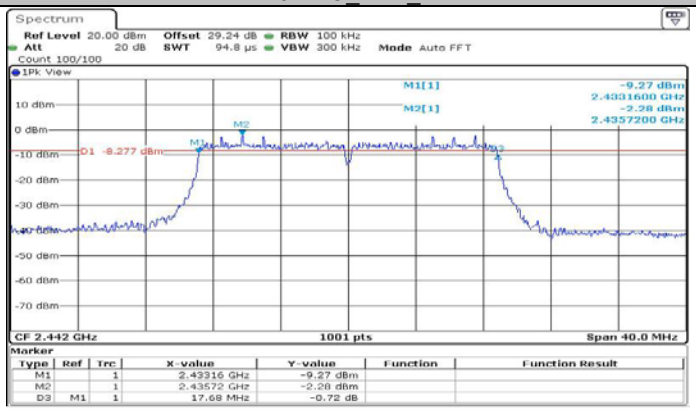
11G_Ant1_2472



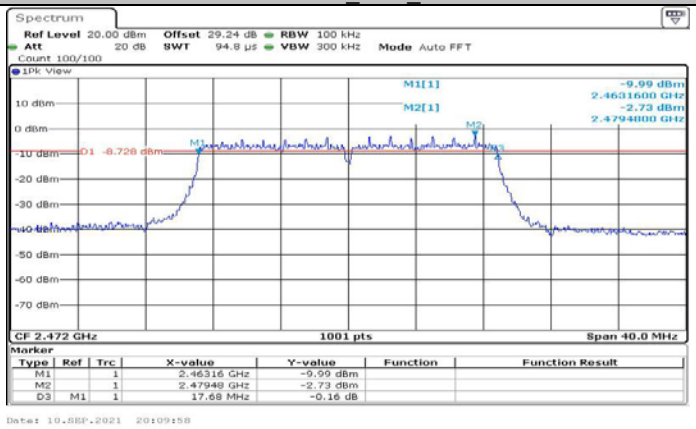
11N20SISO_Ant1_2412



11N20SISO_Ant1_2442



11N20SISO_Ant1_2472



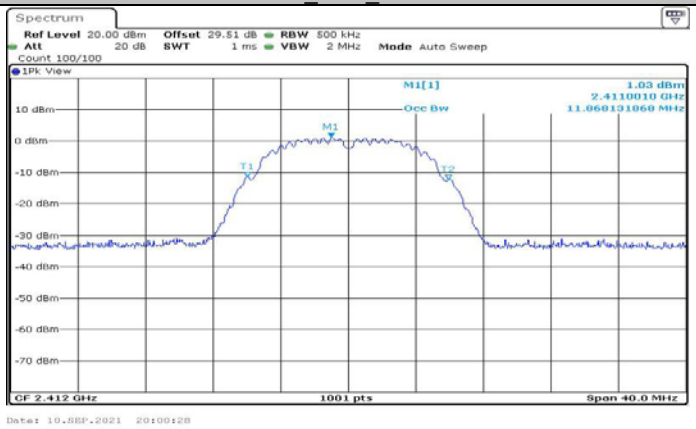
Appendix B: Occupied Channel Bandwidth

Test Result

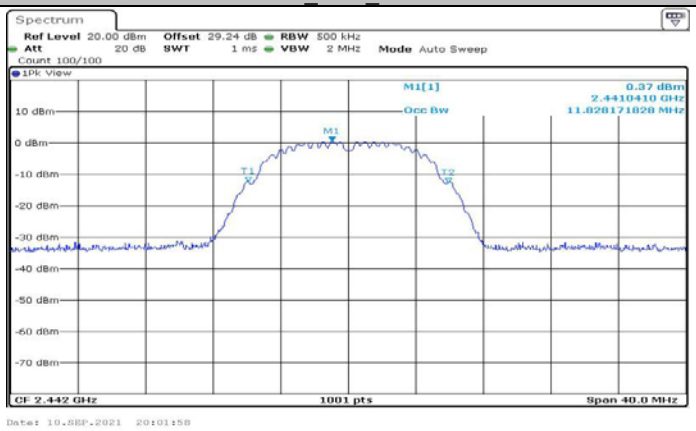
Test Mode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	11.868	---	PASS
		2442	11.828	---	PASS
		2472	11.868	---	PASS
11G	Ant1	2412	17.143	---	PASS
		2442	17.103	---	PASS
		2472	17.103	---	PASS
11N20SISO	Ant1	2412	17.942	---	PASS
		2442	17.982	---	PASS
		2472	18.022	---	PASS

Test Graphs

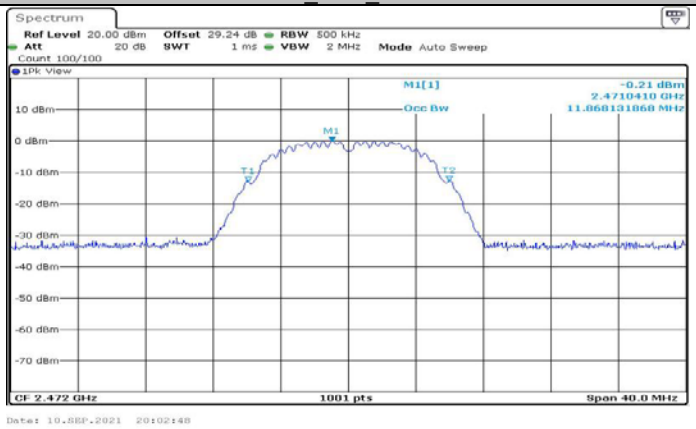
11B_Ant1_2412



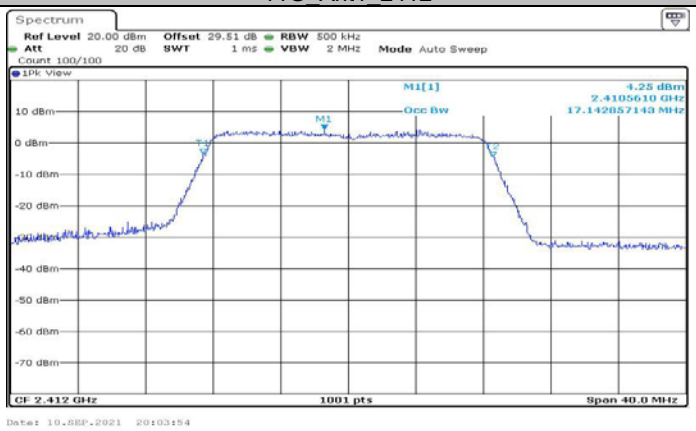
11B_Ant1_2442



11B_Ant1_2472

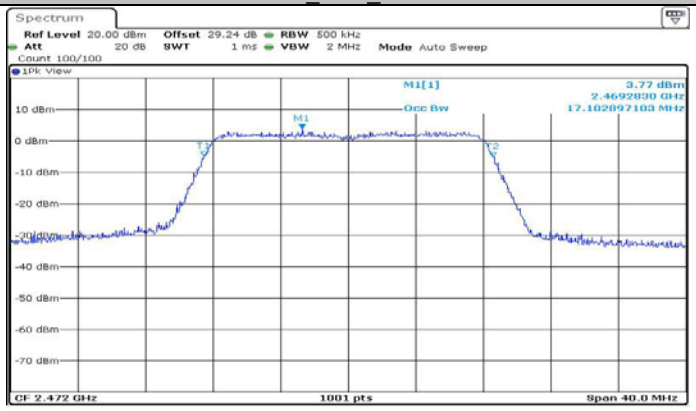


11G_Ant1_2412

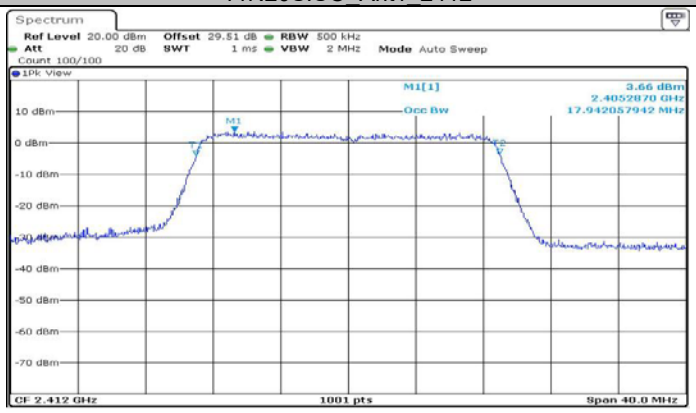


11G_Ant1_2442

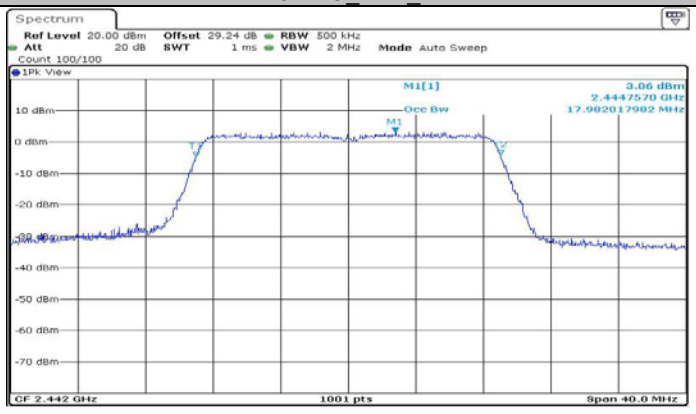
11G_Ant1_2472

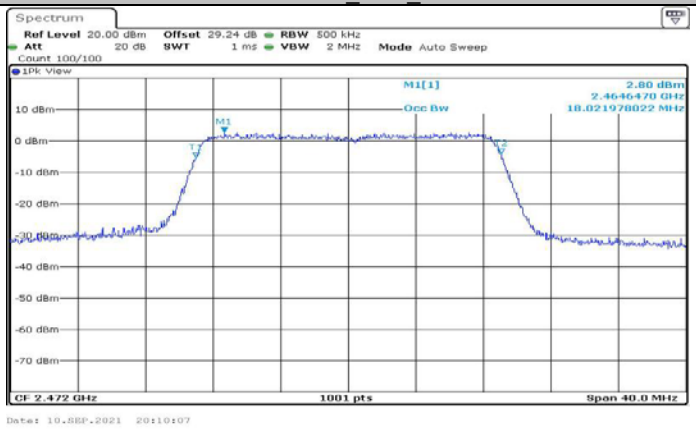


11N20SISO_Ant1_2412



11N20SISO_Ant1_2442



11N20SISO_Ant1_2472


Appendix C: Maximum conducted peak output power

Test Result

Test Mode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
11B	Ant1	2412	11.48	≤30	PASS
		2442	11.04	≤30	PASS
		2472	10.88	≤30	PASS
11G	Ant1	2412	16.13	≤30	PASS
		2442	15.46	≤30	PASS
		2472	15.74	≤30	PASS
11N20SISO	Ant1	2412	14.77	≤30	PASS
		2442	14.86	≤30	PASS
		2472	14.61	≤30	PASS

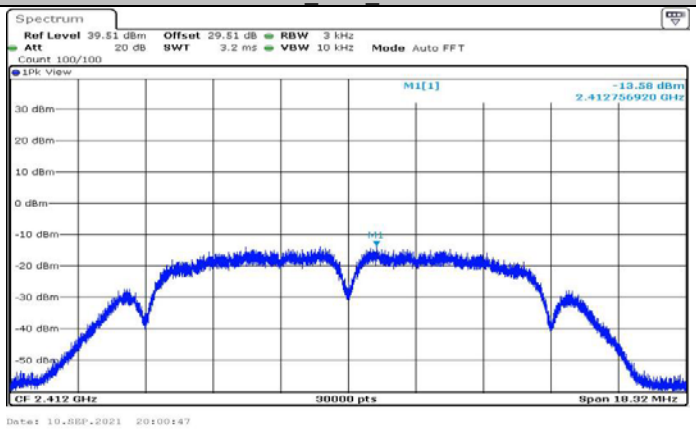
Appendix D: Maximum power spectral density

Test Result

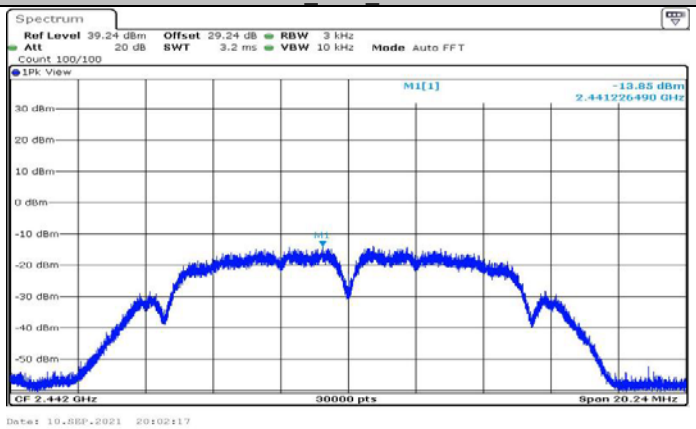
Test Mode	Antenna	Channel	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
11B	Ant1	2412	-13.58	≤8	PASS
		2442	-13.85	≤8	PASS
		2472	-14.33	≤8	PASS
11G	Ant1	2412	-14.46	≤8	PASS
		2442	-14.45	≤8	PASS
		2472	-14.91	≤8	PASS
11N20SISO	Ant1	2412	-14.39	≤8	PASS
		2442	-16.00	≤8	PASS
		2472	-16.37	≤8	PASS

Test Graphs

11B_Ant1_2412



11B_Ant1_2442



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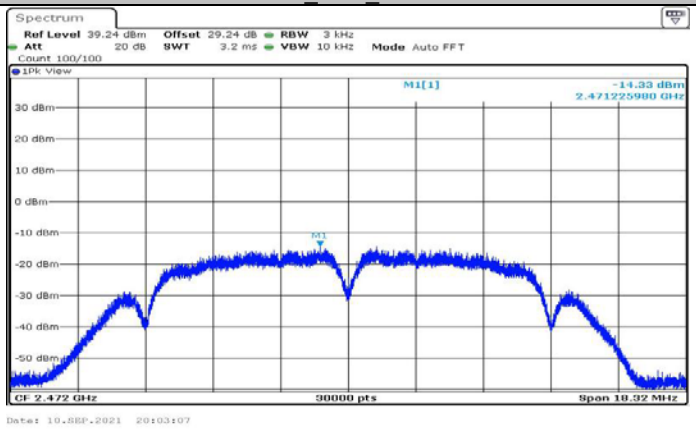

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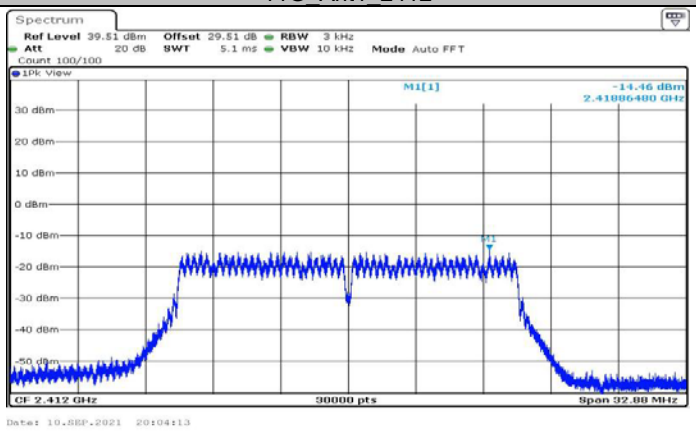

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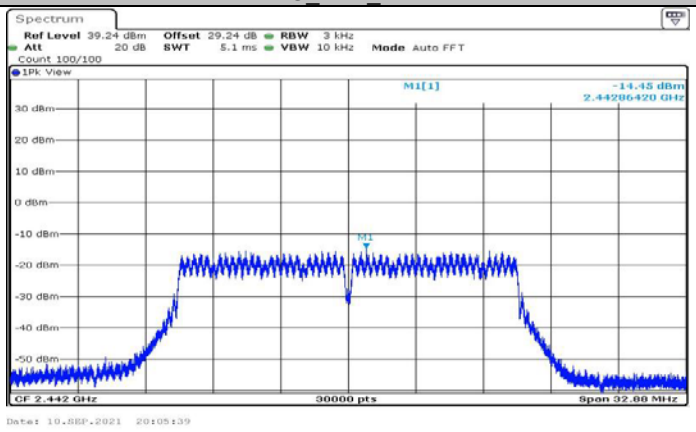

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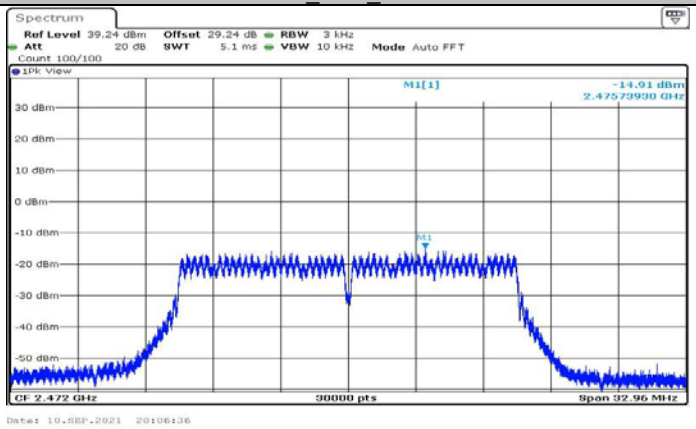

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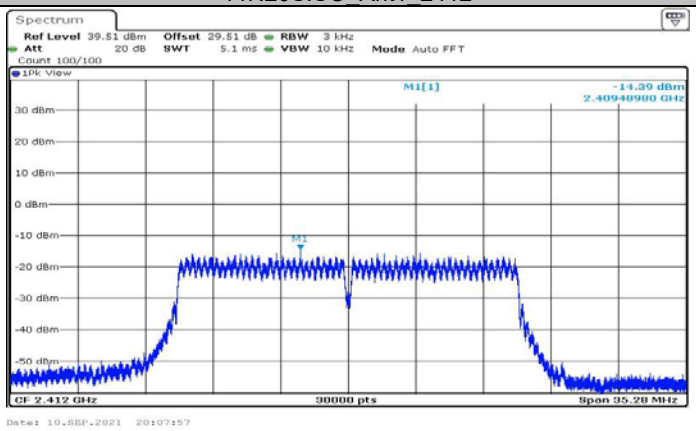

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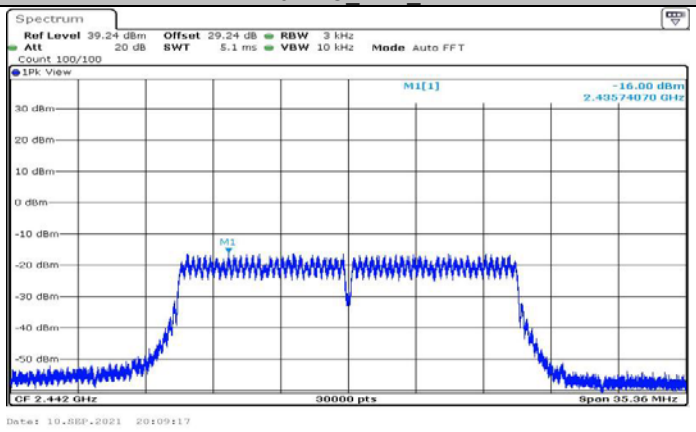

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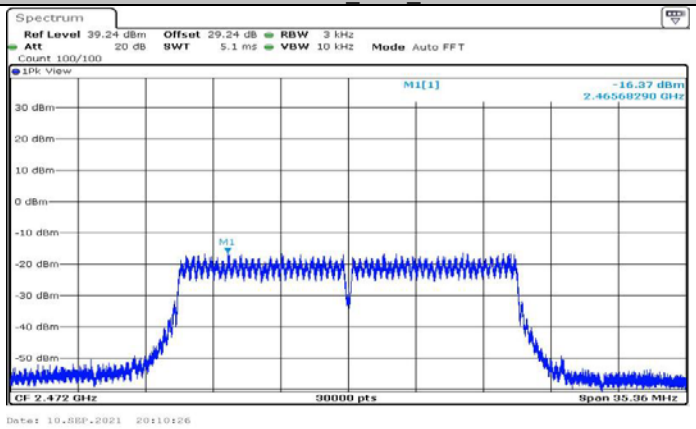
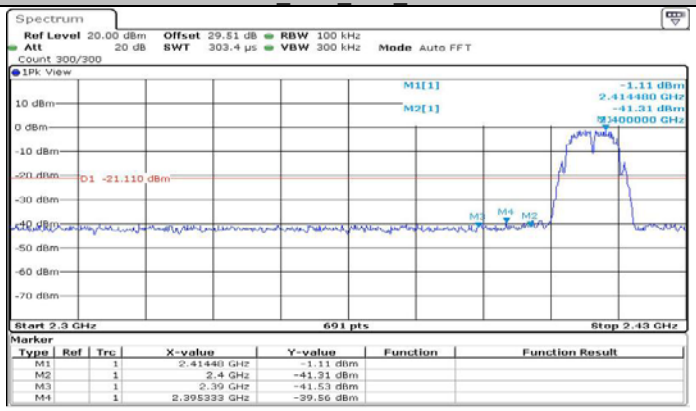


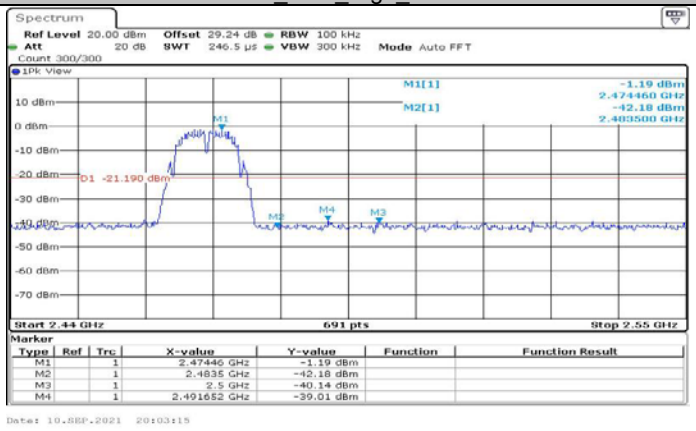
Appendix E: Band edge measurements

Test Graphs

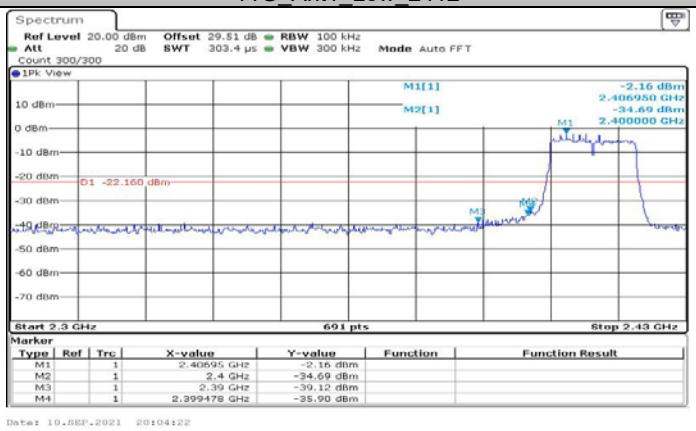
11B_Ant1_Low_2412



11B_Ant1_High_2472



11G_Ant1_Low_2412



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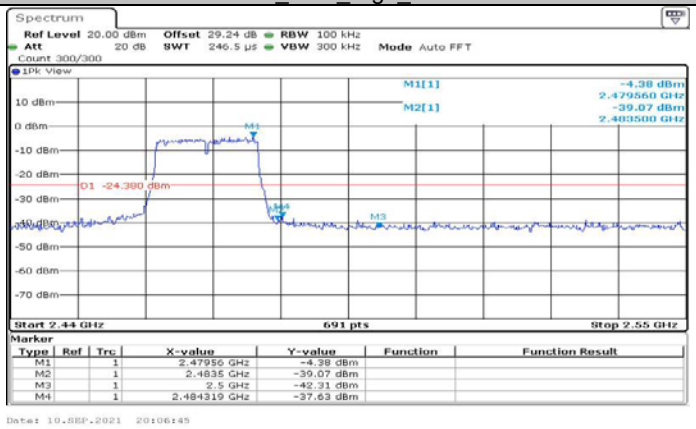

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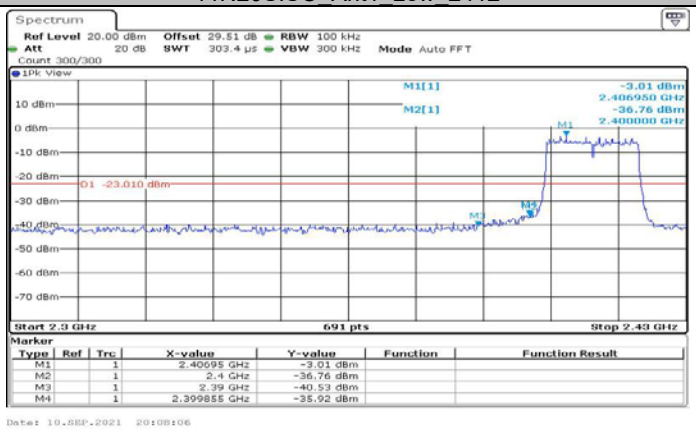
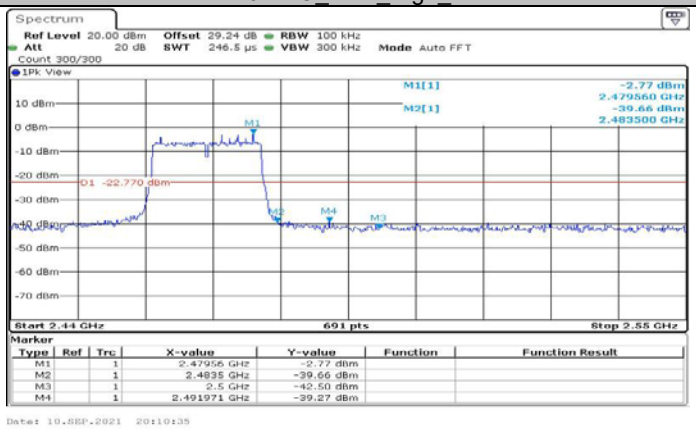


11N20SISO_Ant1_High_2472



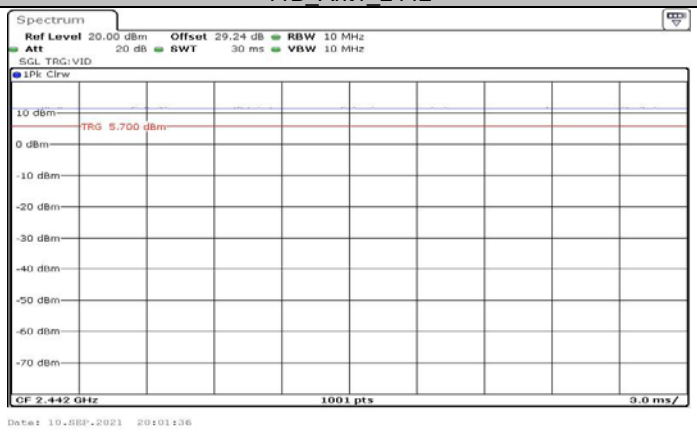
Appendix F: Duty Cycle

Test Result

Test Mode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
11B	Ant1	2442	30.00	30.00	100.00
11G	Ant1	2442	2.73	2.77	98.56
11N20SISO	Ant1	2442	2.54	2.58	98.45

Test Graphs

11B_Ant1_2442



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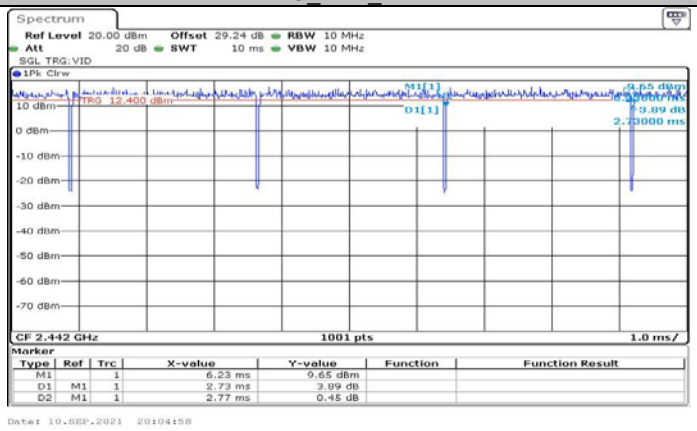
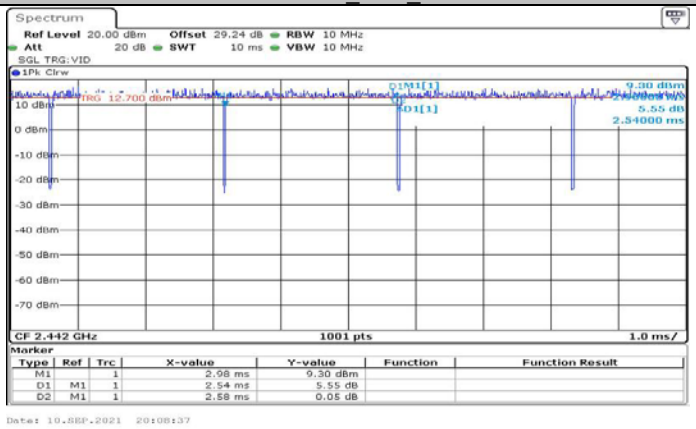


11N20SISO_Ant1_2442



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