TEST REPORT

Applicant Name :	Shenzhen LeYun Innovation Technology Co.,Ltd
Address :	C220 Room B Building Western Silicon Valley Baoan District Shenzhen, Guangdong China
Report Number :	RA221123-56370E-RF-00
FCC ID:	2AZ9T-S1PRO

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	S1 Pro
Model No.:	S1 Pro
Multiple Model(s) No.:	N/A
Trade Mark:	N/A
Date Received:	2022/11/23
Report Date:	2023/02/27

Test Result:	Pass*

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

Prepared and Checked By:

Andy Yu
EMC Engineer

Approved By:

Candy Li
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★ ".
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RA221123-56370E-RF-00	Original Report	2023/02/27

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Frequency Range	Wi-Fi: 2412-2472MHz
Maximum Conducted Average Output Power	Wi-Fi: 802.11b: 12.86dBm, 802.11g: 8.53dBm, 802.11n-HT20: 8.91dBm 802.11n-HT40: 7.99dBm
Modulation Technique	Wi-Fi: DSSS, OFDM
Antenna Specification*	1.3dBi (provided by the applicant)
Voltage Range	DC3.7V from battery or DC 5V from USB port
Sample serial number	1RO0-1 for Conducted and Radiated Emissions(below 1GHz) Test 1RO1-2 for Radiated Emissions (above 1GHz) Test 1RO2-3 for RF Conducted Test (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 Frequency		$0.082*10^{-7}$
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.72dB
Emissions, Radiated	9kHz - 30MHz	2.66dB
	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
	26.5GHz - 40GHz	4.72dB
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 Wi-Fi mode, total 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	/	/

802.11b, 802.11g, 802.11n-HT20 mode was tested with Channel 1, 7 and 13.
802.11n-HT40 mode was tested with Channel 3, 7 and 11.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

"Wifi Test Tool v1.6.0 release.exe"* software was used to test and power level as below:

Mode	Data rate	Power Level*		
		Low Channel	Middle Channel	High Channel
802.11b	1Mbps	16	16	16
802.11g	6Mbps	16	16	16
802.11n-HT20	MCS0	16	16	16
802.11n-HT40	MCS0	16	16	16

The software and power level was provided by applicant.

Duty cycle

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

Support Equipment List and Details

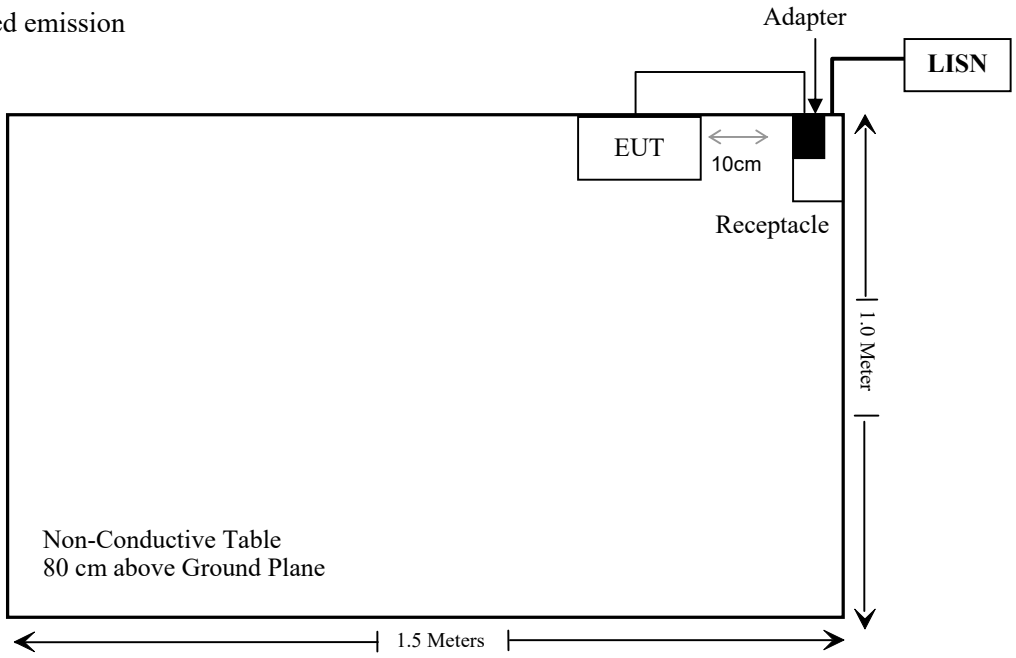
Manufacturer	Description	Model	Serial Number
Bull	Receptacle	902#	Unknown
I.T.E	Adapter	S005AYV0500100	Unknown

External I/O Cable

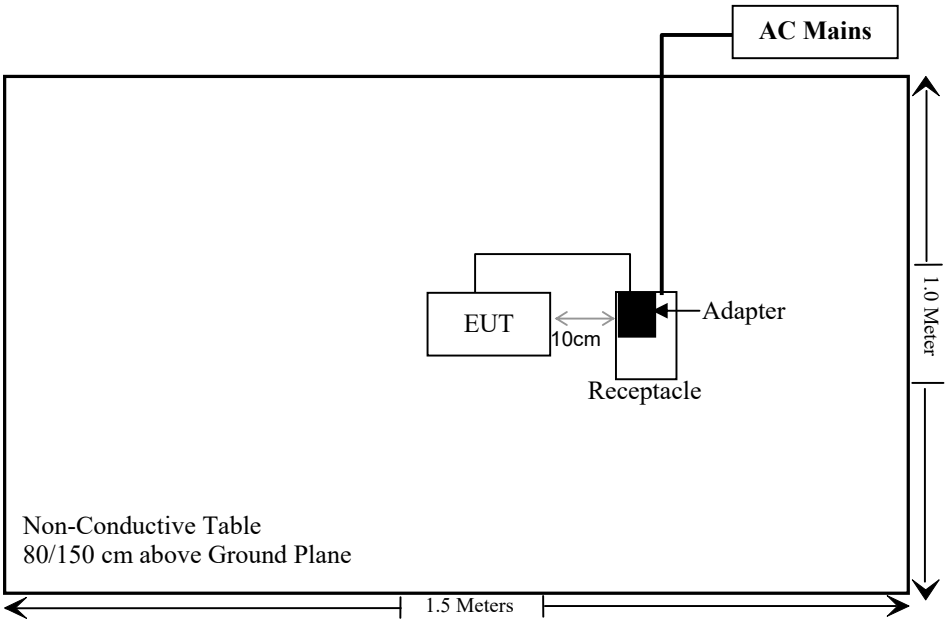
Cable Description	Length (m)	From Port	To
Unshielded Detachable DC Cable	1.0	Adapter	EUT
Unshielded Un-detachable Cable	1.5	Receptacle	LISN/AC Mains

Block Diagram of Test Setup

For conducted emission



For Radiated Emissions:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i) & §1.1307 (b) (3) & §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	2021/12/13	2022/12/12
Rohde & Schwarz	L.I.S.N.	ENV216	101314	2021/12/13	2022/12/12
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2021/12/13	2022/12/12
Unknown	RF Coaxial Cable	No.17	N0350	2021/12/14	2022/12/13
Conducted Emission Test Software: e3 19821b (V9)					
Radiated Emissions Test (30MHz-1GHz)					
Rohde& Schwarz	Test Receiver	ESR	102725	2022/12/13	2023/12/12
SONOMA INSTRUMENT	Amplifier	310 N	186131	2022/11/08	2023/11/07
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Unknown	RF Coaxial Cable	No.12	N040	2022/12/14	2023/12/13
Unknown	RF Coaxial Cable	No.13	N300	2022/12/14	2023/12/13
Unknown	RF Coaxial Cable	No.14	N800	2022/12/14	2023/12/13
Radiated Emission Test Software: e3 19821b (V9)					
Radiated Emissions Test (Above 1GHz)					
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2021/12/13	2022/12/12
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2022/11/08	2023/11/07
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2022/11/08	2023/11/07
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2020/01/05	2023/01/04
Unknown	RF Coaxial Cable	No.10	N050	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.11	N1000	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.15	N600	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.16	N650	2021/12/14	2022/12/13
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2021/12/14	2022/12/13
RF Conducted Test					
Rohde&Schwarz	Spectrum Analyzer	FSV-40	101590	2022/11/25	2023/11/24
Tonscend	RF Control Unit	JS0806-2	19G8060182	2022/10/24	2023/10/23
Agilent	USB wideband power sensor	U2021XA	MY54250003	2022/06/27	2023/06/26
WEINSCHEL	10dB Attenuator	5324	AU 3842	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.31	RF-01	Each time	Each time
Rohde&Schwarz	Spectrum Analyzer	FSV-40	101948	2022/11/25	2023/11/24

*** 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) & §1.1307 (b) (3) & §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.

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power(ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemptionfrom further evaluation from 300 kHz through 100 GHz.

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

Ris the minimum separation distance in meters
f = frequency in MHz

Result

Frequency (MHz)	Antenna Gain		Tune up conducted power	ERP		Evaluation Distance (m)	ERP Limit (W)
	(dBi)	(dBd)	(dBm)	(dBm)	(W)		
2412-2472	1.3	-0.85	13.0	12.15	0.016	0.2	0.768

Note: 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 internal antenna arrangement, which was permanently attached and the antenna gain is 1.3dBi, fulfill the requirement of this section. Please refer to the EUT photos.

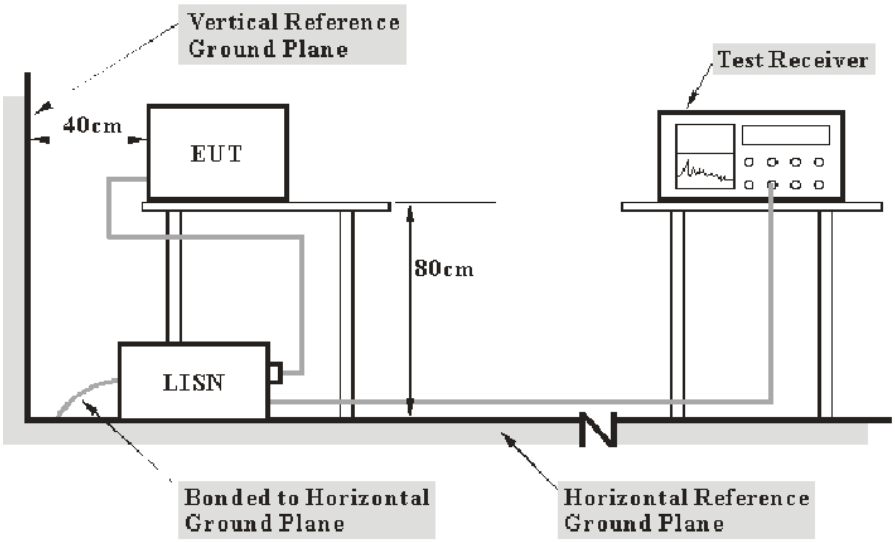
Result: Compliance.

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

During the conducted emission test, the device 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.

Transd Factor & Margin Calculation

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

Transd 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, a over limit of -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Over Limit = level – Limit
Level= reading level+ Transd Factor

Test Data

Environmental Conditions

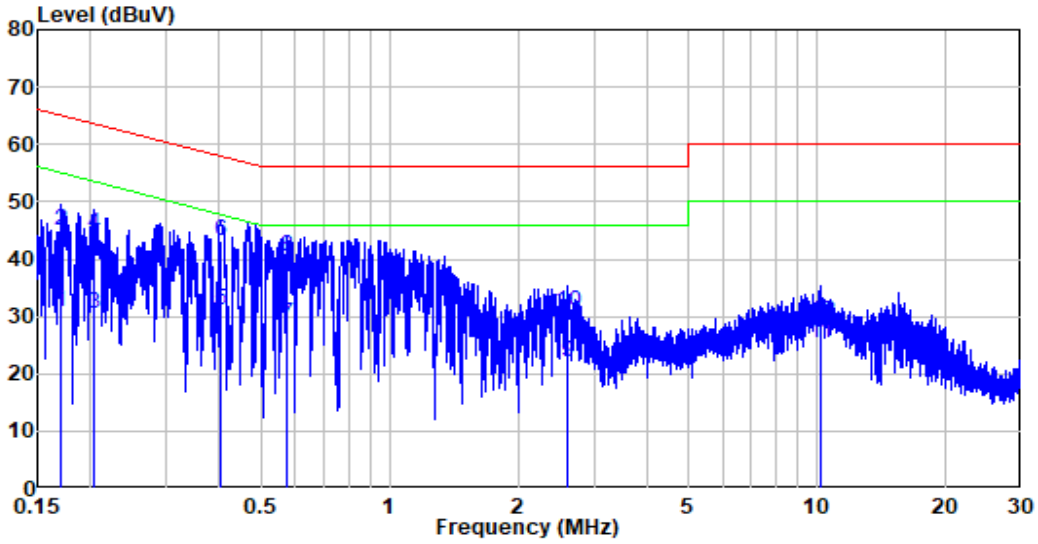
Temperature:	21 °C
Relative Humidity:	42 %
ATM Pressure:	101.0 kPa

The testing was performed by Jie Chen on 2022-12-12.

EUT operation mode: Transmitting

Wi-Fi: (Worst case is 802.11G mode, Low Channel)

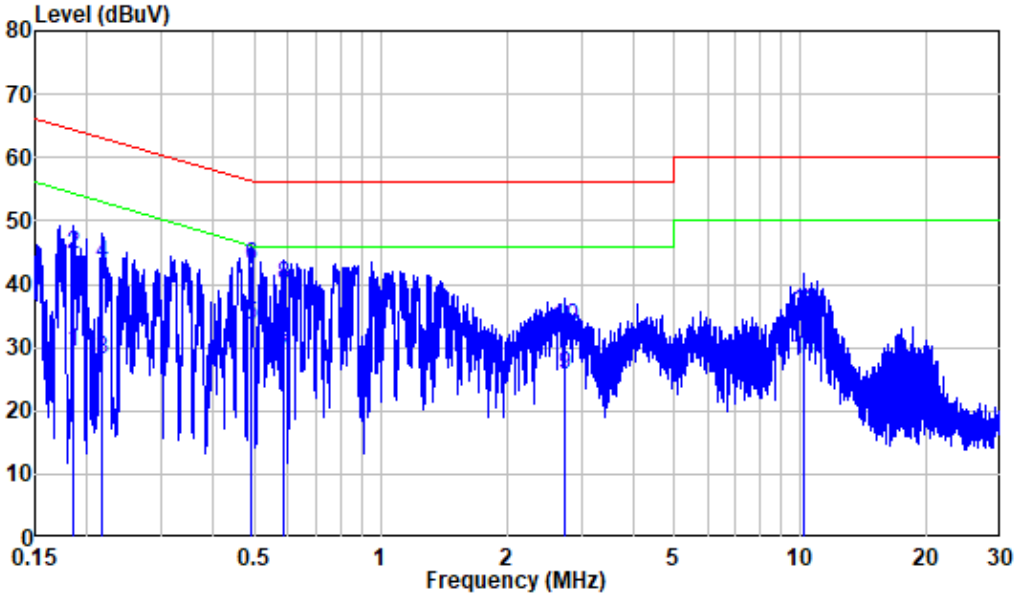
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Job No. : RA221123-56370E-RF
Mode : Charging+2.4G WIFI Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.171	9.80	21.08	30.88	54.93	-24.05	Average
2	0.171	9.80	35.04	44.84	64.93	-20.09	QP
3	0.202	9.80	20.71	30.51	53.51	-23.00	Average
4	0.202	9.80	34.57	44.37	63.51	-19.14	QP
5	0.402	9.80	21.27	31.07	47.82	-16.75	Average
6	0.402	9.80	33.47	43.27	57.82	-14.55	QP
7	0.577	9.81	18.75	28.56	46.00	-17.44	Average
8	0.577	9.81	30.69	40.50	56.00	-15.50	QP
9	2.598	9.83	12.20	22.03	46.00	-23.97	Average
10	2.598	9.83	21.10	30.93	56.00	-25.07	QP
11	10.159	9.90	15.51	25.41	50.00	-24.59	Average
12	10.159	9.90	19.13	29.03	60.00	-30.97	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Job No. : RA221123-56370E-RF
Mode : Charging+2.4G WIFI Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.185	9.80	19.60	29.40	54.27	-24.87	Average
2	0.185	9.80	34.85	44.65	64.27	-19.62	QP
3	0.217	9.80	18.30	28.10	52.91	-24.81	Average
4	0.217	9.80	33.35	43.15	62.91	-19.76	QP
5	0.491	9.80	23.64	33.44	46.16	-12.72	Average
6	0.491	9.80	33.12	42.92	56.16	-13.24	QP
7	0.587	9.81	18.55	28.36	46.00	-17.64	Average
8	0.587	9.81	30.08	39.89	56.00	-16.11	QP
9	2.757	9.83	15.80	25.63	46.00	-20.37	Average
10	2.757	9.83	23.35	33.18	56.00	-22.82	QP
11	10.172	10.00	18.08	28.08	50.00	-21.92	Average
12	10.172	10.00	25.57	35.57	60.00	-24.43	QP

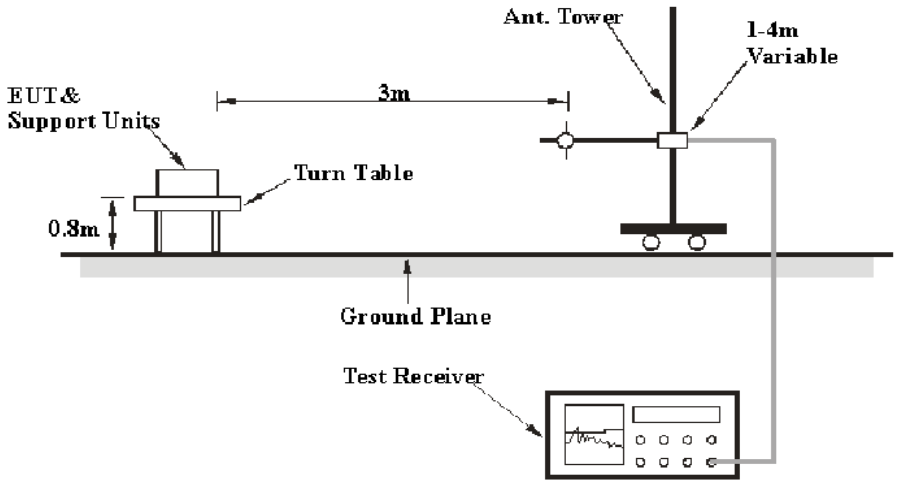
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

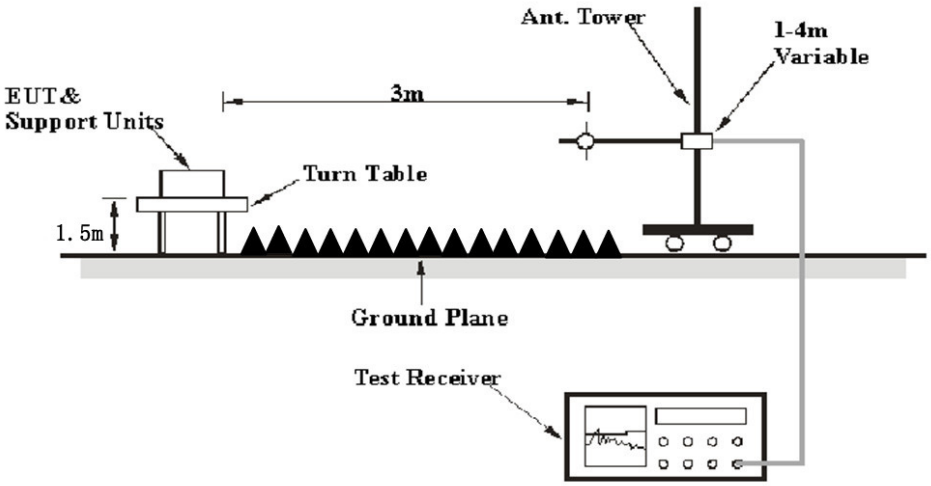
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, FCC 15.247, RSS-247, RSS-Gen 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 from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

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

Margin/Over Limit = Corrected Amplitude/Level-Limit
Corrected Amplitude/Level = Reading + Corrected Factor

Test Data

Environmental Conditions

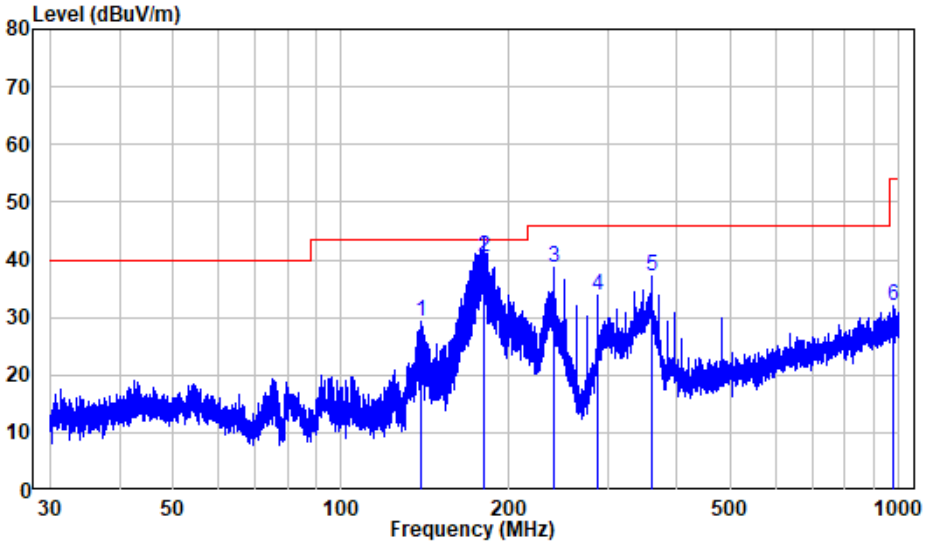
Temperature:	25~25.5 °C
Relative Humidity:	52~57 %
ATM Pressure:	101.0 kPa

The testing was performed by Jason Liu on 2022-12-19 for below 1GHz and Zenos Qiao on 2022-12-05 for above 1GHz.
EUT operation mode: Transmitting (Pre-scan in the X, Y and Z axes of orientation, the worst case X-axis of orientation was recorded)

30MHz-1GHz: (Worst case is 802.11n20 mode, middle Channel)

Note: When the test result of peak was less than the limit of QP more than 6dB, just peak value were recorded.

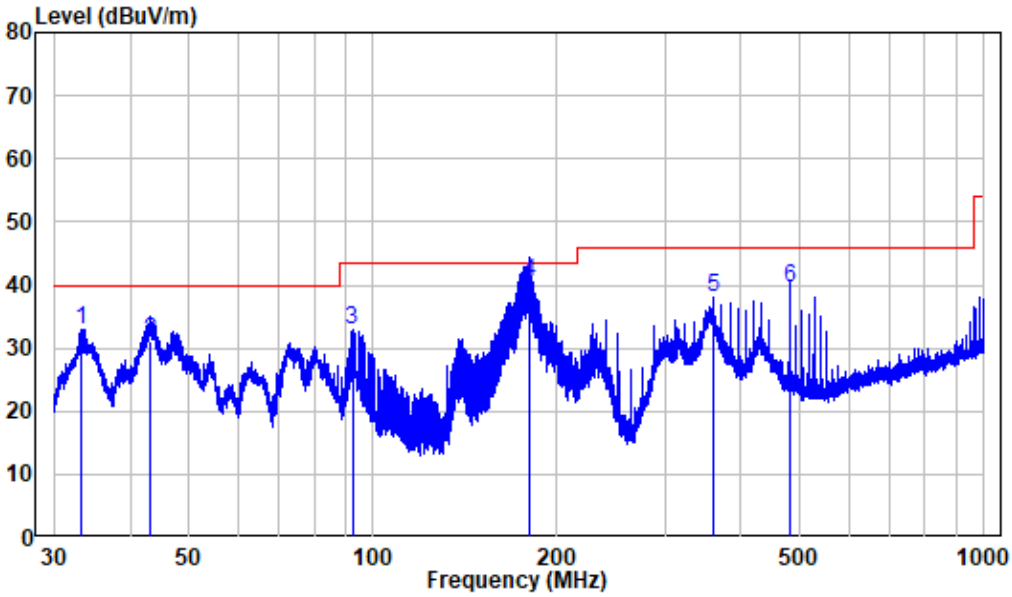
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA221123-56370E-RF
Test Mode: Charging+2.4G WIFI Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	139.117	-15.41	44.82	29.41	43.50	-14.09	Peak
2	180.017	-12.77	53.20	40.43	43.50	-3.07	QP
3	239.987	-10.91	49.63	38.72	46.00	-7.28	Peak
4	287.990	-9.36	43.29	33.93	46.00	-12.07	Peak
5	359.974	-7.68	44.70	37.02	46.00	-8.98	Peak
6	977.894	2.38	29.54	31.92	54.00	-22.08	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA221123-56370E-RF
Test Mode: Charging+2.4G WIFI Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	33.226	-11.98	44.96	32.98	40.00	-7.02	Peak
2	42.994	-9.96	41.10	31.14	40.00	-8.86	QP
3	92.422	-13.17	46.03	32.86	43.50	-10.64	Peak
4	179.938	-12.78	53.10	40.32	43.50	-3.18	QP
5	359.974	-7.68	45.64	37.96	46.00	-8.04	Peak
6	480.107	-5.00	44.60	39.60	46.00	-6.40	QP

1-25 GHz:

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave.		Height (m)	Polar (H/V)				
802.11b									
Low Channel(2412MHz)									
2310	60.83	PK	198	2	H	-7.24	53.59	74	-20.41
2310	47.46	AV	198	2	H	-7.24	40.22	54	-13.78
2310	60.71	PK	342	1.3	V	-7.24	53.47	74	-20.53
2310	47.37	AV	342	1.3	V	-7.24	40.13	54	-13.87
2390	64.61	PK	318	2	H	-7.22	57.39	74	-16.61
2390	48.72	AV	318	2	H	-7.22	41.50	54	-12.50
2390	64.49	PK	159	1.8	V	-7.22	57.27	74	-16.73
2390	48.60	AV	159	1.8	V	-7.22	41.38	54	-12.62
4824	60.79	PK	23	2.3	H	-3.52	57.27	74	-16.73
4824	51.60	AV	23	2.3	H	-3.52	48.08	54	-5.92
4824	62.05	PK	91	1.5	V	-3.52	58.53	74	-15.47
4824	55.32	AV	91	1.5	V	-3.52	51.80	54	-2.20
Middle Channel(2442MHz)									
4884	59.96	PK	133	1.5	H	-3.36	56.6	74	-17.40
4884	48.77	AV	133	1.5	H	-3.36	45.41	54	-8.59
4884	60.68	PK	139	1.7	V	-3.36	57.32	74	-16.68
4884	52.29	AV	139	1.7	V	-3.36	48.93	54	-5.07
High Channel(2472 MHz)									
2483.5	65.92	PK	171	1.8	H	-7.20	58.72	74	-15.28
2483.5	49.61	AV	171	1.8	H	-7.20	42.41	54	-11.59
2483.5	65.79	PK	286	1.9	V	-7.20	58.59	74	-15.41
2483.5	49.50	AV	286	1.9	V	-7.20	42.3	54	-11.70
2500	62.72	PK	98	1.3	H	-7.18	55.54	74	-18.46
2500	49.18	AV	98	1.3	H	-7.18	42	54	-12.00
2500	62.61	PK	291	2.3	V	-7.18	55.43	74	-18.57
2500	49.09	AV	291	2.3	V	-7.18	41.91	54	-12.09
4944	57.66	PK	89	1.7	H	-3.07	54.59	74	-19.41
4944	45.17	AV	89	1.7	H	-3.07	42.10	54	-11.90
4944	59.31	PK	47	1.9	V	-3.07	56.24	74	-17.76
4944	47.10	AV	47	1.9	V	-3.07	44.03	54	-9.97

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave.		Height (m)	Polar (H/V)				
802.11g									
Low Channel(2412MHz)									
2310	61.22	PK	254	1	H	-7.24	53.98	74	-20.02
2310	47.58	AV	254	1	H	-7.24	40.34	54	-13.66
2310	61.10	PK	57	2.2	V	-7.24	53.86	74	-20.14
2310	47.47	AV	57	2.2	V	-7.24	40.23	54	-13.77
2390	65.03	PK	159	2.3	H	-7.22	57.81	74	-16.19
2390	48.91	AV	159	2.3	H	-7.22	41.69	54	-12.31
2390	64.90	PK	75	1.1	V	-7.22	57.68	74	-16.32
2390	48.79	AV	75	1.1	V	-7.22	41.57	54	-12.43
4824	58.89	PK	182	1.2	H	-3.52	55.37	74	-18.63
4824	42.67	AV	182	1.2	H	-3.52	39.15	54	-14.85
4824	59.35	PK	133	2	V	-3.52	55.83	74	-18.17
4824	43.00	AV	133	2	V	-3.52	39.48	54	-14.52
Middle Channel(2442MHz)									
4884	58.09	PK	134	1.6	H	-3.36	54.73	74	-19.27
4884	42.13	AV	134	1.6	H	-3.36	38.77	54	-15.23
4884	58.51	PK	190	1.9	V	-3.36	55.15	74	-18.85
4884	42.34	AV	190	1.9	V	-3.36	38.98	54	-15.02
High Channel(2472MHz)									
2483.5	66.29	PK	13	1.7	H	-7.20	59.09	74	-14.91
2483.5	49.73	AV	13	1.7	H	-7.20	42.53	54	-11.47
2483.5	66.16	PK	232	2.5	V	-7.20	58.96	74	-15.04
2483.5	49.61	AV	232	2.5	V	-7.20	42.41	54	-11.59
2500	62.78	PK	177	1.2	H	-7.18	55.6	74	-18.40
2500	49.30	AV	177	1.2	H	-7.18	42.12	54	-11.88
2500	62.67	PK	293	1.8	V	-7.18	55.49	74	-18.51
2500	49.21	AV	293	1.8	V	-7.18	42.03	54	-11.97
4944	56.91	PK	0	1.7	H	-3.07	53.84	74	-20.16
4944	41.36	AV	0	1.7	H	-3.07	38.29	54	-15.71
4944	57.49	PK	142	2	V	-3.07	54.42	74	-19.58
4944	41.65	AV	142	2	V	-3.07	38.58	54	-15.42

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave.		Height (m)	Polar (H/V)				
802.11n20									
Low Channel(2412MHz)									
2310	61.43	PK	52	2	H	-7.24	54.19	74	-19.81
2310	47.64	AV	52	2	H	-7.24	40.40	54	-13.60
2310	61.32	PK	204	2.2	V	-7.24	54.08	74	-19.92
2310	47.51	AV	204	2.2	V	-7.24	40.27	54	-13.73
2390	65.15	PK	168	1.1	H	-7.22	57.93	74	-16.07
2390	49.02	AV	168	1.1	H	-7.22	41.80	54	-12.20
2390	65.01	PK	108	1.8	V	-7.22	57.79	74	-16.21
2390	48.90	AV	108	1.8	V	-7.22	41.68	54	-12.32
4824	59.14	PK	151	2	H	-3.52	55.62	74	-18.38
4824	42.89	AV	151	2	H	-3.52	39.37	54	-14.63
4824	59.63	PK	328	1.4	V	-3.52	56.11	74	-17.89
4824	43.21	AV	328	1.4	V	-3.52	39.69	54	-14.31
Middle Channel(2442MHz)									
4884	58.46	PK	305	2.4	H	-3.36	55.1	74	-18.90
4884	42.35	AV	305	2.4	H	-3.36	38.99	54	-15.01
4884	58.87	PK	337	2.1	V	-3.36	55.51	74	-18.49
4884	42.64	AV	337	2.1	V	-3.36	39.28	54	-14.72
High Channel(2472MHz)									
2483.5	66.60	PK	68	1.4	H	-7.20	59.4	74	-14.60
2483.5	49.94	AV	68	1.4	H	-7.20	42.74	54	-11.26
2483.5	66.48	PK	232	1.1	V	-7.20	59.28	74	-14.72
2483.5	49.81	AV	232	1.1	V	-7.20	42.61	54	-11.39
2500	62.87	PK	305	1.4	H	-7.18	55.69	74	-18.31
2500	49.42	AV	305	1.4	H	-7.18	42.24	54	-11.76
2500	62.75	PK	292	1.7	V	-7.18	55.57	74	-18.43
2500	49.30	AV	292	1.7	V	-7.18	42.12	54	-11.88
4944	57.37	PK	293	1.2	H	-3.07	54.30	74	-19.70
4944	41.70	AV	293	1.2	H	-3.07	38.63	54	-15.37
4944	57.78	PK	140	1.4	V	-3.07	54.71	74	-19.29
4944	41.96	AV	140	1.4	V	-3.07	38.89	54	-15.11

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave.		Height (m)	Polar (H/V)				
802.11n40									
Low Channel(2422MHz)									
2310	61.04	PK	133	1.3	H	-7.24	53.80	74	-20.20
2310	47.63	AV	133	1.3	H	-7.24	40.39	54	-13.61
2310	60.91	PK	123	1.8	V	-7.24	53.67	74	-20.33
2310	47.50	AV	123	1.8	V	-7.24	40.26	54	-13.74
2390	64.64	PK	128	1.7	H	-7.22	57.42	74	-16.58
2390	48.98	AV	128	1.7	H	-7.22	41.76	54	-12.24
2390	64.53	PK	251	1.6	V	-7.22	57.31	74	-16.69
2390	48.89	AV	251	1.6	V	-7.22	41.67	54	-12.33
4844	57.87	PK	235	1.4	H	-3.54	54.33	74	-19.67
4844	42.23	AV	235	1.4	H	-3.54	38.69	54	-15.31
4844	58.32	PK	275	1.8	V	-3.54	54.78	74	-19.22
4844	42.46	AV	275	1.8	V	-3.54	38.92	54	-15.08
Middle Channel(2442MHz)									
4884	57.64	PK	83	2.3	H	-3.36	54.28	74	-19.72
4884	42.13	AV	83	2.3	H	-3.36	38.77	54	-15.23
4884	58.10	PK	11	1.9	V	-3.36	54.74	74	-19.26
4884	42.39	AV	11	1.9	V	-3.36	39.03	54	-14.97
High Channel(2462MHz)									
2483.5	66.04	PK	280	2.3	H	-7.20	58.84	74	-15.16
2483.5	50.19	AV	280	2.3	H	-7.20	42.99	54	-11.01
2483.5	65.90	PK	132	1.7	V	-7.20	58.7	74	-15.30
2483.5	50.06	AV	132	1.7	V	-7.20	42.86	54	-11.14
2500	62.86	PK	328	1	H	-7.18	55.68	74	-18.32
2500	49.41	AV	328	1	H	-7.18	42.23	54	-11.77
2500	62.75	PK	274	2.1	V	-7.18	55.57	74	-18.43
2500	50.29	AV	274	2.1	V	-7.18	43.11	54	-10.89
4924	57.10	PK	220	2.3	H	-3.16	53.94	74	-20.06
4924	41.74	AV	220	2.3	H	-3.16	38.58	54	-15.42
4924	57.49	PK	243	1.1	V	-3.16	54.33	74	-19.67
4924	41.96	AV	243	1.1	V	-3.16	38.80	54	-15.20

Note:

Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Absolute Level (Corrected Amplitude） = Factor + Reading

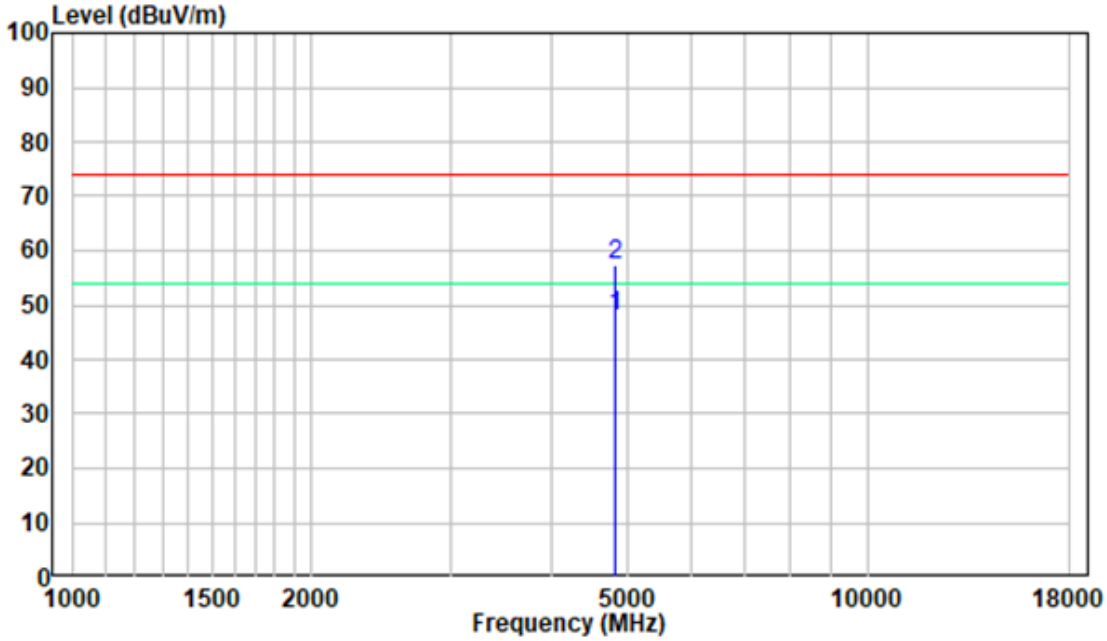
Margin = Absolute Level - Limit

The other spurious emission which is 20dB below to the limit was not recorded.

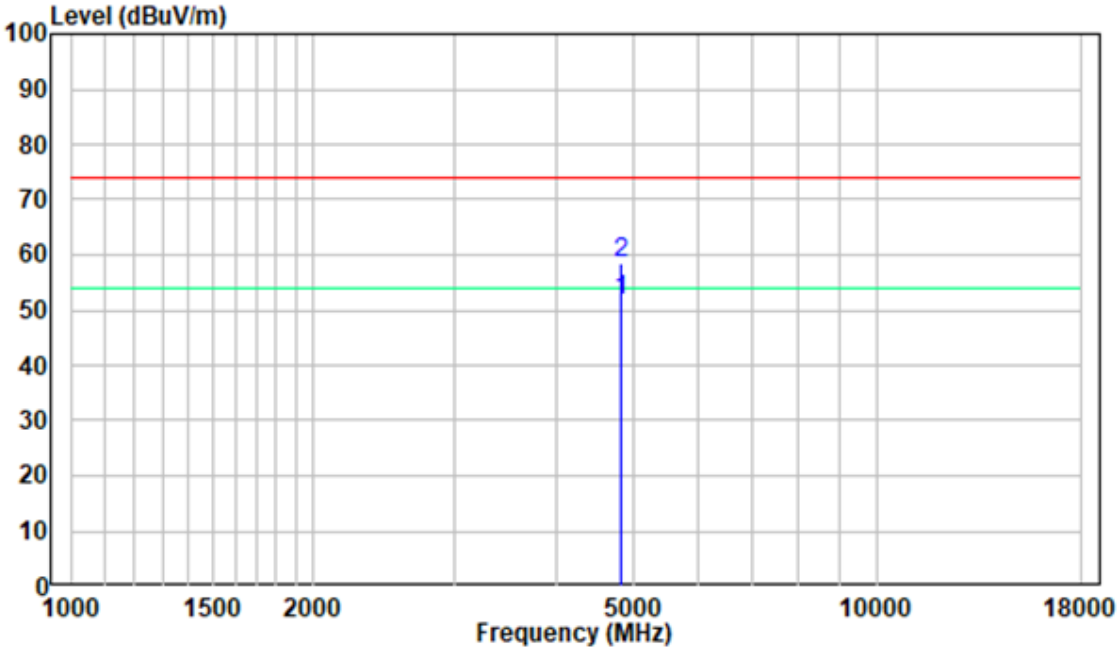
1-18 GHz:

Pre-scan Plots:

802.11 b Low Channel
Horizontal



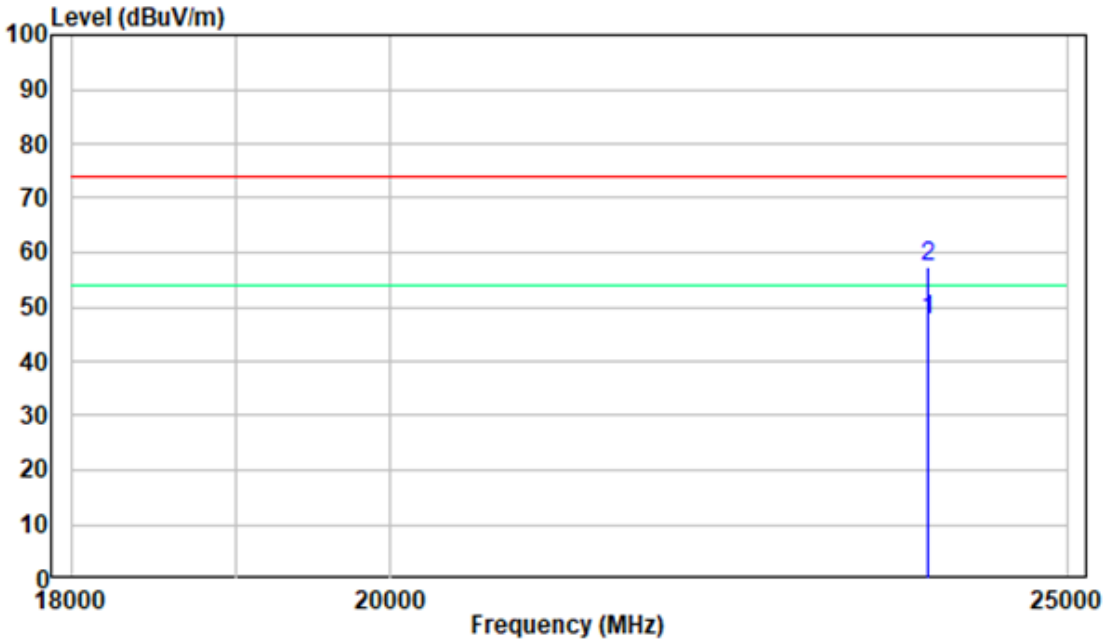
Vertical



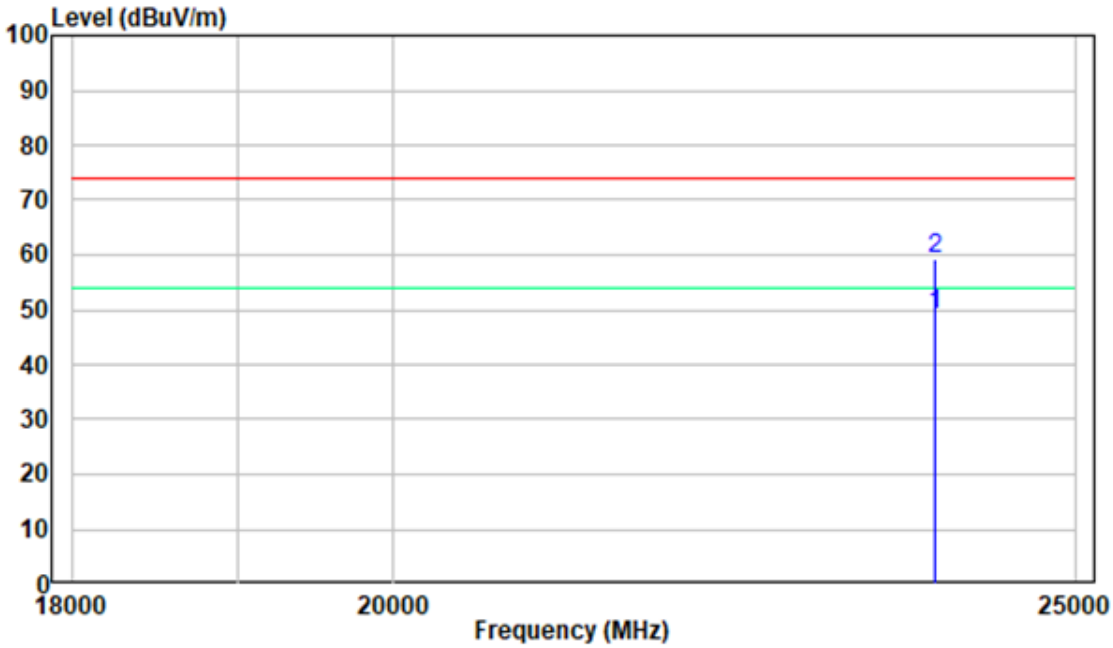
18 -25GHz:

Pre-scan Plots:

802.11 b Low Channel
Horizontal



Vertical



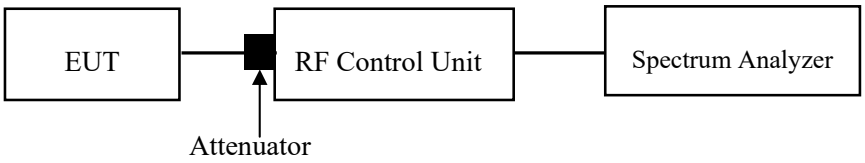
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH & OCCUPIED BANDWIDTH

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 ℃
Relative Humidity:	45 %
ATM Pressure:	101.0 kPa

The testing was performed by Andy Yu on 2022-12-11.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

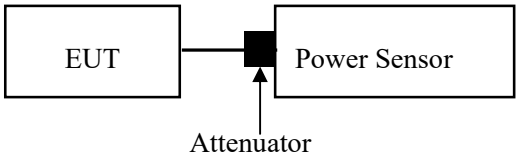
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

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 ℃
Relative Humidity:	45 %
ATM Pressure:	101.0 kPa

The testing was performed by Andy Yu on 2022-12-11.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

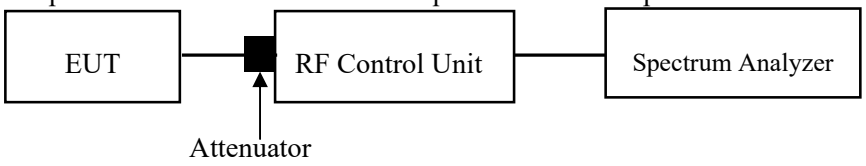
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

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 ℃
Relative Humidity:	45 %
ATM Pressure:	101.0 kPa

The testing was performed by Andy Yu on 2022-12-11.

EUT operation mode: Transmitting

Test Result: Compliant.

Conducted Band Edge Result:

Please refer to the Appendix.

FCC §15.247(e) - POWER SPECTRAL DENSITY

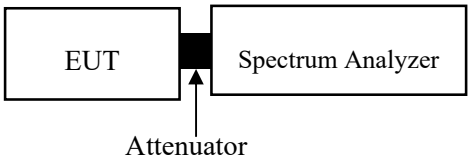
Applicable Standard

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

Use this procedure when the maximum average conducted output power in the fundamental emission is used to demonstrate compliance.

1. Measure the duty cycle (*D*) of the transmitter output signal as described in ANSI C63.10-2013 11.6.
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 = Power Averaging (rms).
6. Ensure that the number of measurement points in the sweep ≥ [2 × span / RBW].
7. Sweep time = auto couple.
8. Trace mode = trace averaging (rms) mode over a minimum of 100 traces.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum amplitude level.
11. When the EUT cannot be configured to transmit continuously (i.e.,D < 98%), when sweep triggering/signal gating cannot be used to measure only when the EUT is transmitting at its maximum power control level, and when the transmission duty cycle is constant (i.e., duty cycle variations are less than ±2%), add [10 log (1 / D)], where D is the duty cycle measured in step 1), to the measured PSD to compute the average PSD during the actual transmission time.
12. When the EUT transmits continuously (or with a $D \geqslant 98\%$), step 11 is not required.
13. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	45 %
ATM Pressure:	101.0 kPa

The testing was performed by Andy Yu on 2023-02-27.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

APPENDIX

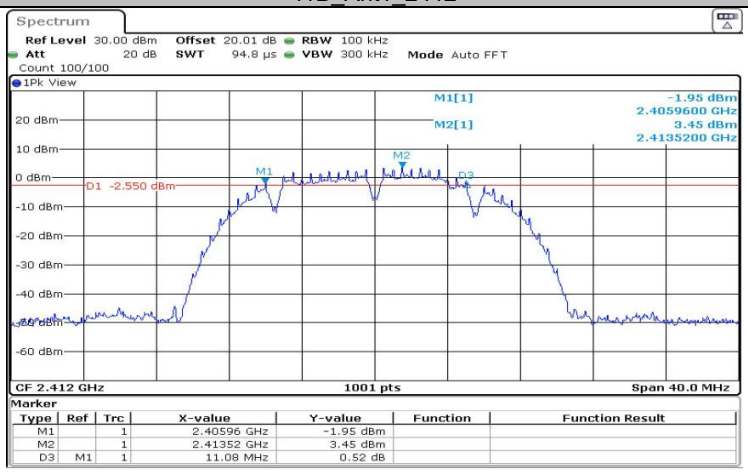
Appendix A: DTS Bandwidth

Test Result

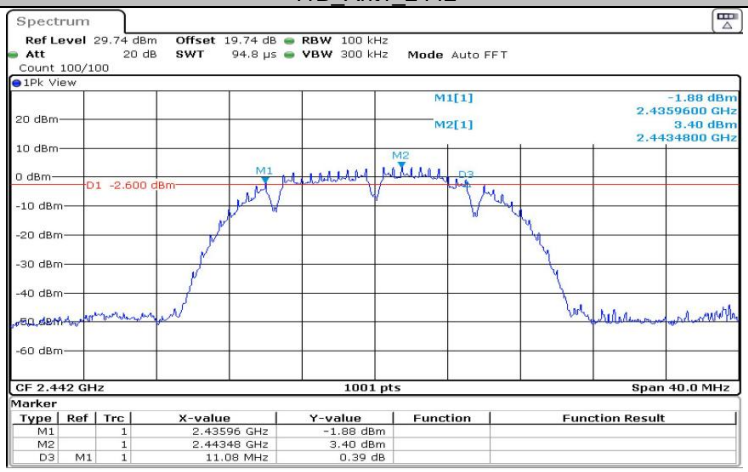
Test Mode	Antenna	Frequency[MHz]	DTS BW [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	11.08	0.5	PASS
		2442	11.08	0.5	PASS
		2472	12.04	0.5	PASS
11G	Ant1	2412	15.12	0.5	PASS
		2442	15.04	0.5	PASS
		2472	15.12	0.5	PASS
11N20SISO	Ant1	2412	11.32	0.5	PASS
		2442	11.32	0.5	PASS
		2472	13.80	0.5	PASS
11N40SISO	Ant1	2422	35.12	0.5	PASS
		2442	35.12	0.5	PASS
		2462	35.12	0.5	PASS

Test Graphs

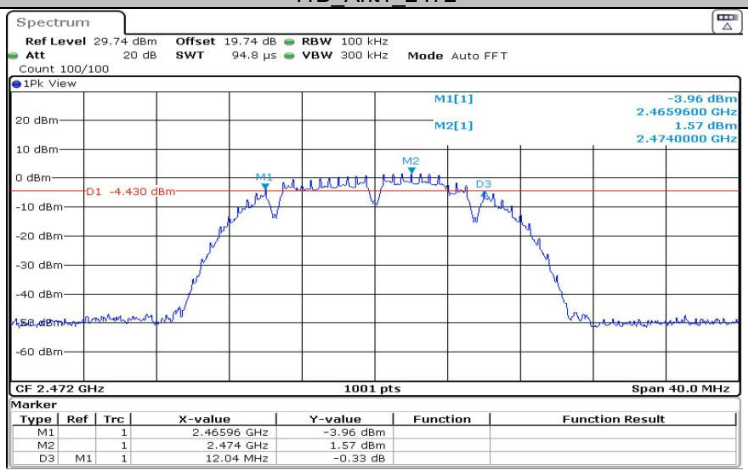
11B_Ant1_2412



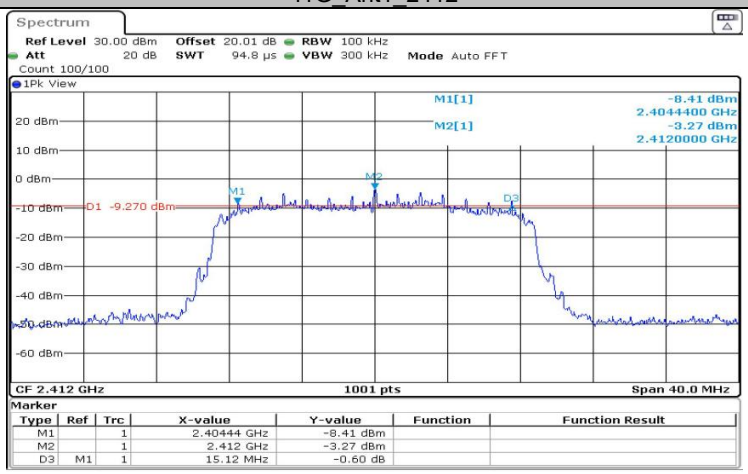
11B_Ant1_2442



11B_Ant1_2472



11G_Ant1_2412

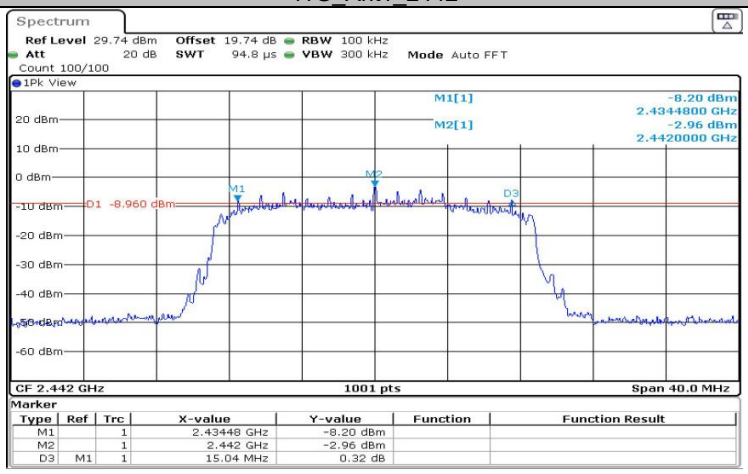


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40444 GHz	-8.41 dBm		
M2		1	2.412 GHz	-3.27 dBm		
D3	M1	1	15.12 MHz	-0.60 dB		

Date: 11.DEC.2022 13:17:32

11G_Ant1_2442

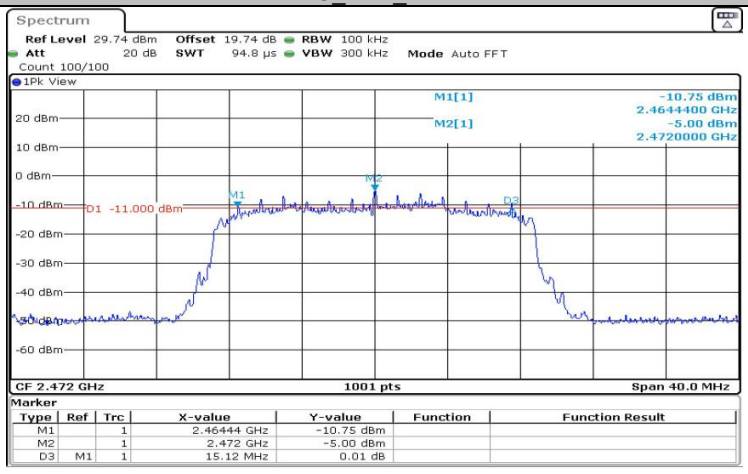


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.43448 GHz	-8.20 dBm		
M2		1	2.442 GHz	-2.96 dBm		
D3	M1	1	15.04 MHz	0.32 dB		

Date: 11.DEC.2022 13:21:03

11G_Ant1_2472

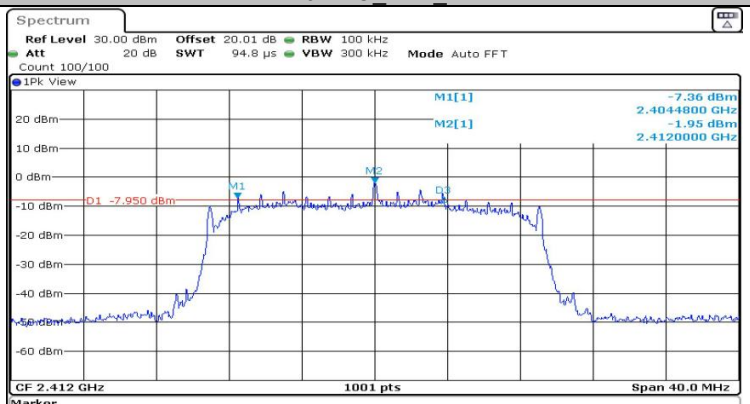


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.46444 GHz	-10.75 dBm		
M2		1	2.472 GHz	-5.00 dBm		
D3	M1	1	15.12 MHz	0.01 dB		

Date: 11.DEC.2022 13:23:10

11N20SISO_Ant1_2412

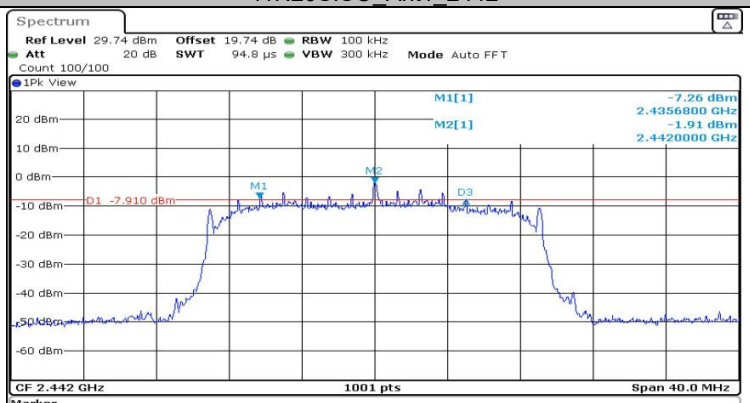


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40448 GHz	-7.36 dBm		
M2		1	2.412 GHz	-1.95 dBm		
D3	M1	1	11.32 MHz	0.51 dB		

Date: 11.DEC.2022 13:24:25

11N20SISO_Ant1_2442

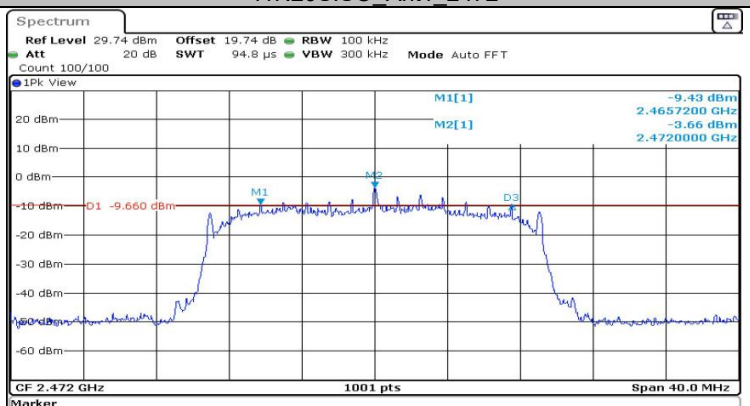


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.43568 GHz	-7.26 dBm		
M2		1	2.442 GHz	-1.91 dBm		
D3	M1	1	11.32 MHz	-0.25 dB		

Date: 11.DEC.2022 13:26:00

11N20SISO_Ant1_2472

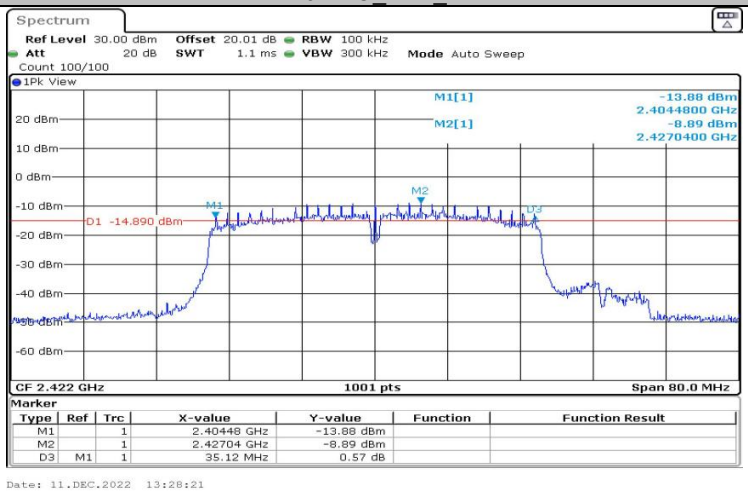


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.46572 GHz	-9.43 dBm		
M2		1	2.472 GHz	-3.66 dBm		
D3	M1	1	13.8 MHz	-0.00 dB		

Date: 11.DEC.2022 13:27:07

11N40SISO_Ant1_2422



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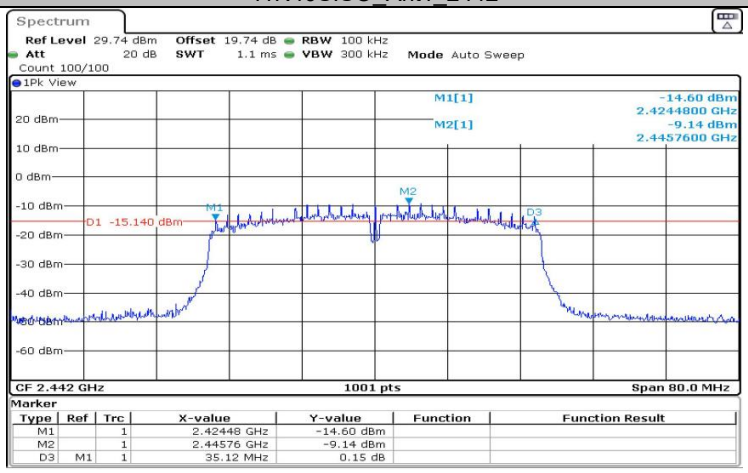
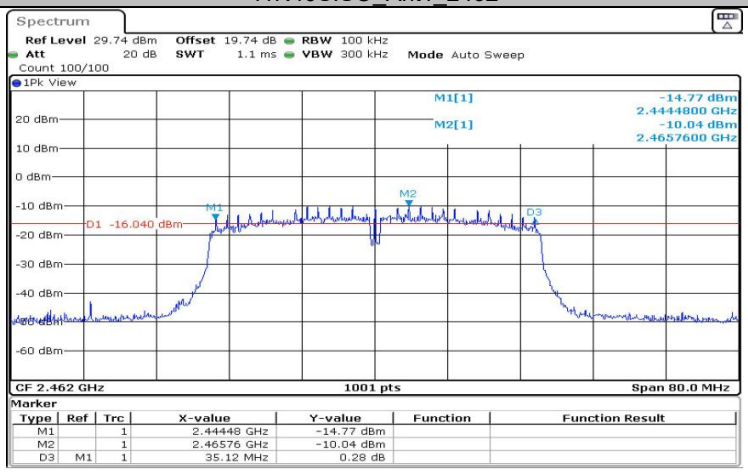


11N40SISO_Ant1_2462



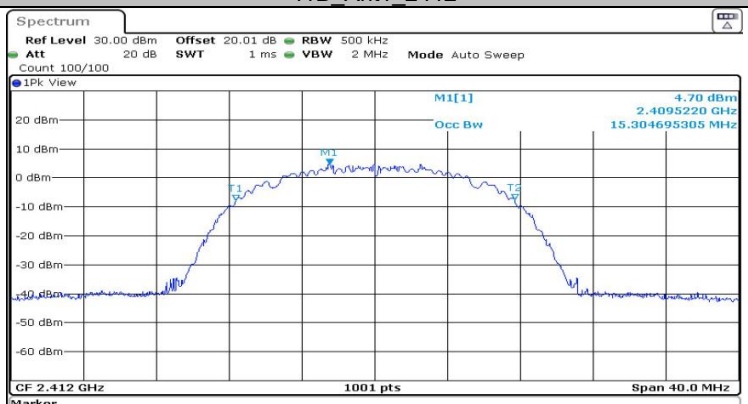
Appendix B: Occupied Channel Bandwidth

Test Result

Test Mode	Antenna	Channel Frequency [MHz]	OCB [MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	15.305	---	---
		2442	15.225	---	---
		2472	15.265	---	---
11G	Ant1	2412	17.542	---	---
		2442	17.542	---	---
		2472	17.582	---	---
11N20SISO	Ant1	2412	18.462	---	---
		2442	18.422	---	---
		2472	18.422	---	---
11N40SISO	Ant1	2422	36.124	---	---
		2442	35.884	---	---
		2462	36.124	---	---

Test Graphs

11B_Ant1_2412

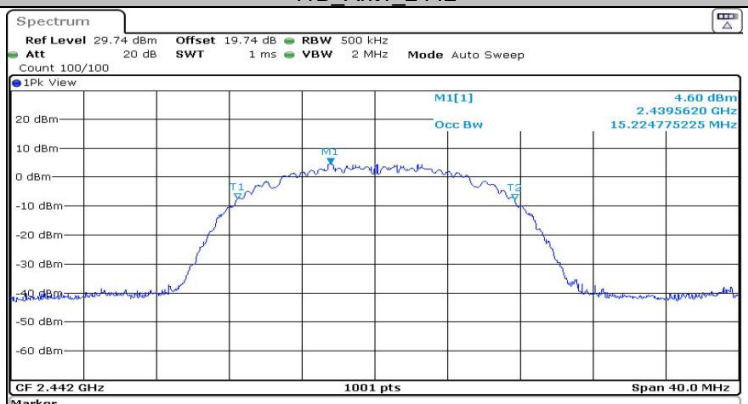


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.409522 GHz	4.70 dBm		
T1		1	2.4043676 GHz	-7.77 dBm	Occ Bw	15.304695305 MHz
T2		1	2.4196723 GHz	-7.63 dBm		

Date: 11.DEC.2022 13:13:24

11B_Ant1_2442

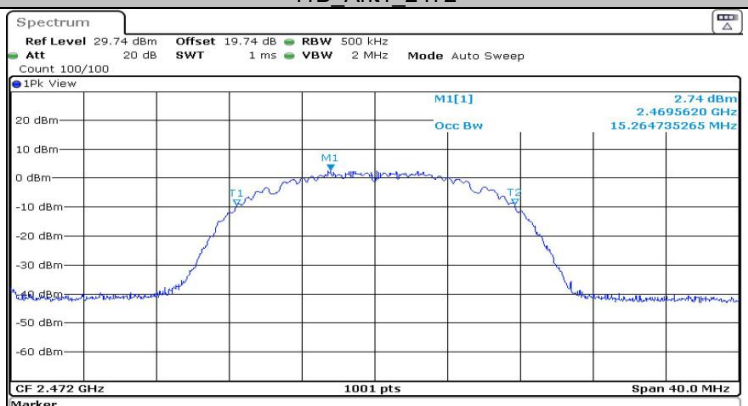


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.439562 GHz	4.60 dBm		
T1		1	2.4344476 GHz	-7.54 dBm	Occ Bw	15.224775225 MHz
T2		1	2.4496723 GHz	-7.78 dBm		

Date: 11.DEC.2022 13:15:20

11B_Ant1_2472

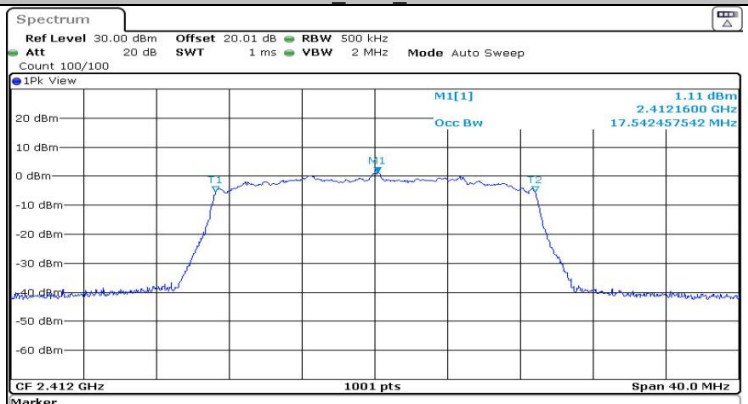


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.469562 GHz	2.74 dBm		
T1		1	2.4644076 GHz	-9.52 dBm	Occ Bw	15.264735265 MHz
T2		1	2.4796723 GHz	-9.27 dBm		

Date: 11.DEC.2022 13:16:23

11G_Ant1_2412

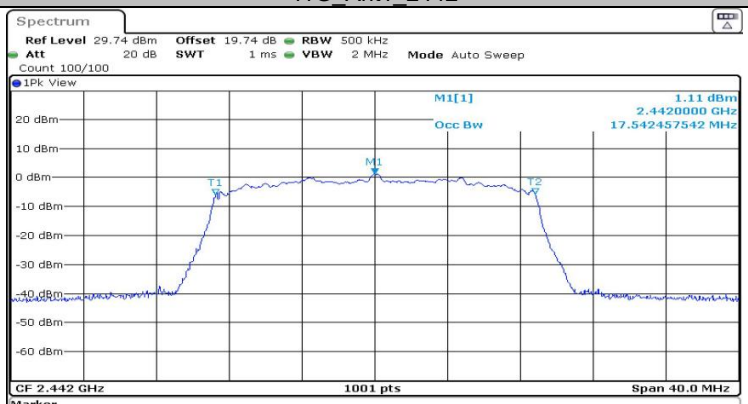


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.41216 GHz	1.11 dBm		
T1		1	2.4032488 GHz	-5.35 dBm	Occ Bw	17.542457542 MHz
T2		1	2.4207912 GHz	-5.46 dBm		

Date: 11.DEC.2022 13:17:43

11G_Ant1_2442

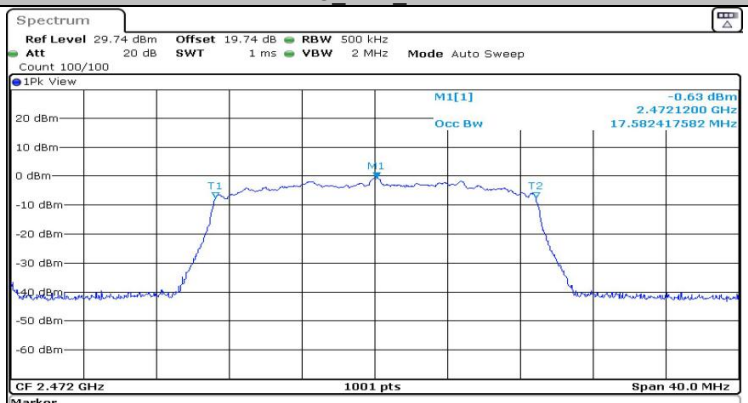


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.442 GHz	1.11 dBm		
T1		1	2.4332488 GHz	-6.07 dBm	Occ Bw	17.542457542 MHz
T2		1	2.4507912 GHz	-5.64 dBm		

Date: 11.DEC.2022 13:21:14

11G_Ant1_2472

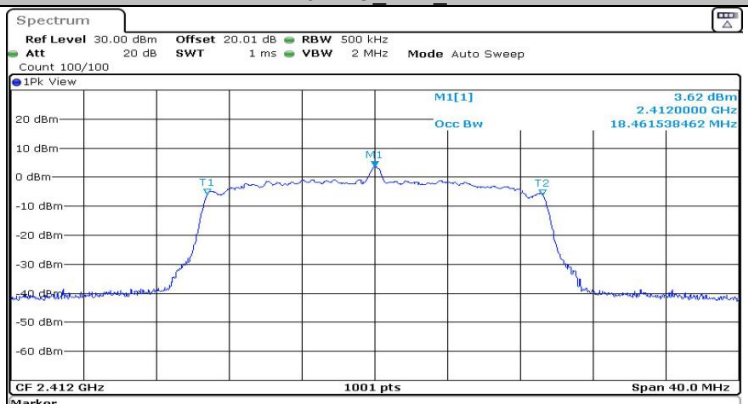


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47212 GHz	-0.63 dBm		
T1		1	2.4632488 GHz	-7.56 dBm	Occ Bw	17.582417582 MHz
T2		1	2.4808312 GHz	-7.54 dBm		

Date: 11.DEC.2022 13:23:21

11N20SISO_Ant1_2412

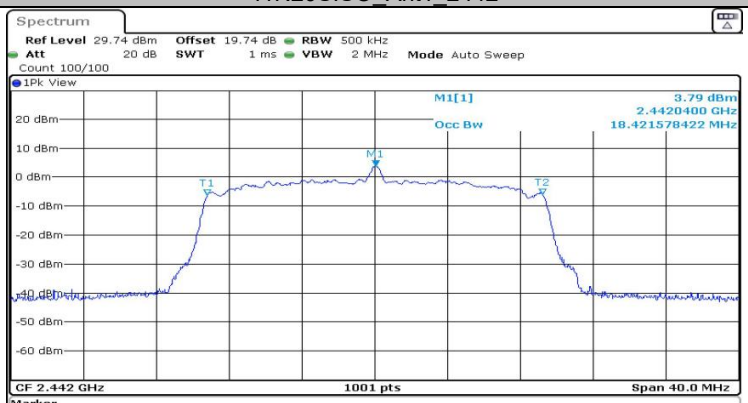


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.412 GHz	3.62 dBm		
T1		1	2.4027692 GHz	-5.99 dBm	Occ Bw	18.461538462 MHz
T2		1	2.4212308 GHz	-6.13 dBm		

Date: 11.DEC.2022 13:24:35

11N20SISO_Ant1_2442

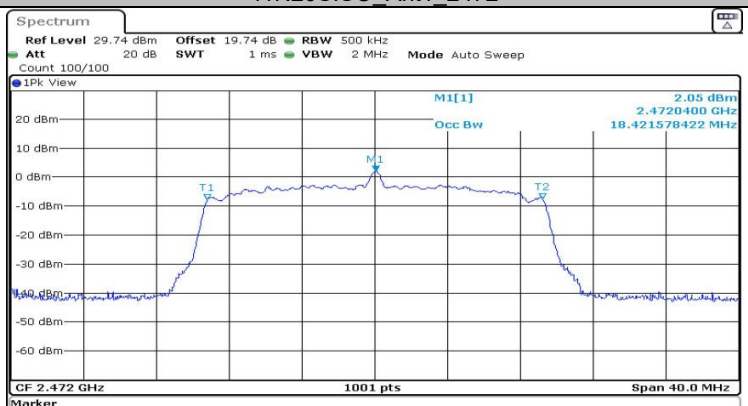


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.44204 GHz	3.79 dBm		
T1		1	2.4328092 GHz	-6.22 dBm	Occ Bw	18.421578422 MHz
T2		1	2.4512308 GHz	-6.09 dBm		

Date: 11.DEC.2022 13:26:11

11N20SISO_Ant1_2472

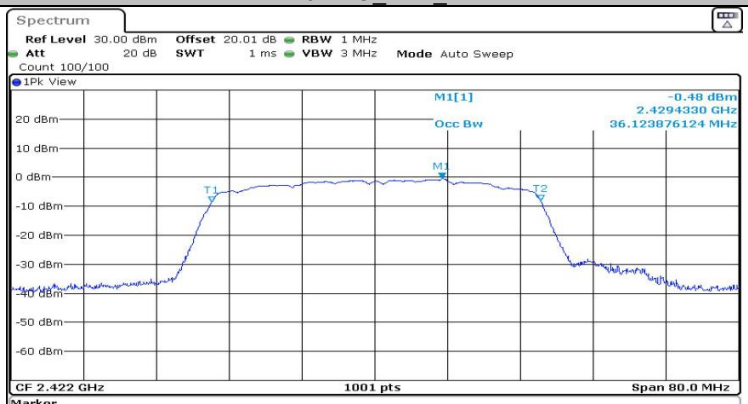


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47204 GHz	2.05 dBm		
T1		1	2.4628092 GHz	-7.76 dBm	Occ Bw	18.421578422 MHz
T2		1	2.4812308 GHz	-7.57 dBm		

Date: 11.DEC.2022 13:27:18

11N40SISO_Ant1_2422

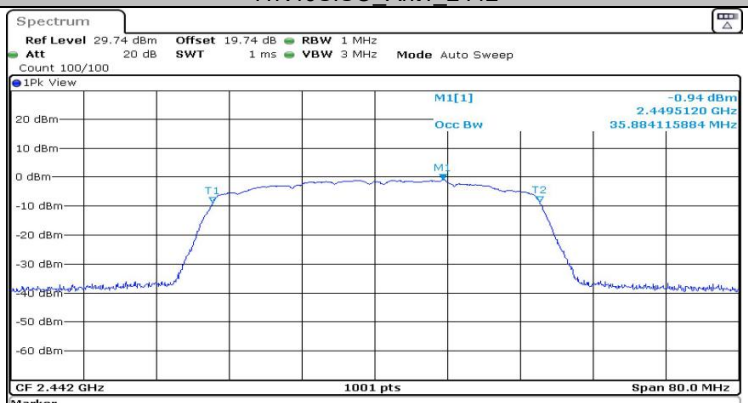


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.429433 GHz	-0.48 dBm		
T1		1	2.4040979 GHz	-8.56 dBm	Occ Bw	36.123876124 MHz
T2		1	2.4402218 GHz	-8.12 dBm		

Date: 11.DEC.2022 13:28:31

11N40SISO_Ant1_2442

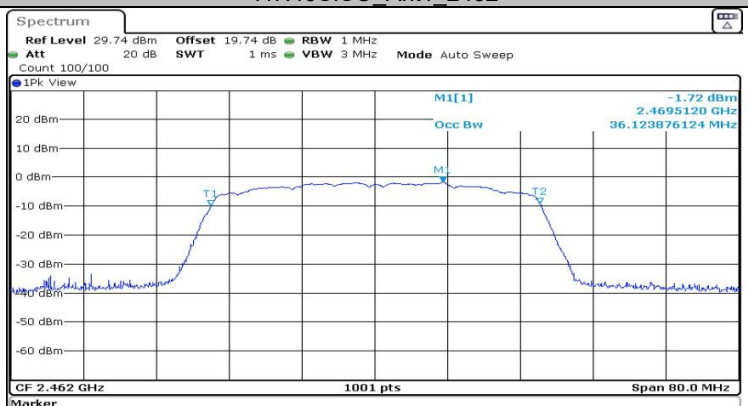


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.449512 GHz	-0.94 dBm		
T1		1	2.4241778 GHz	-8.99 dBm	Occ Bw	35.884115884 MHz
T2		1	2.4600619 GHz	-8.60 dBm		

Date: 11.DEC.2022 13:30:14

11N40SISO_Ant1_2462



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.469512 GHz	-1.72 dBm		
T1		1	2.444018 GHz	-9.91 dBm	Occ Bw	36.123876124 MHz
T2		1	2.4801419 GHz	-9.13 dBm		

Date: 11.DEC.2022 13:31:54

Appendix C: Maximum conducted output power

Test Result

Test Mode	Antenna	Frequency[MHz]	Average Power [dBm]	Conducted Limit[dBm]	Verdict
11B	Ant1	2412	12.35	≤30.00	PASS
		2442	12.86	≤30.00	PASS
		2472	10.83	≤30.00	PASS
11G	Ant1	2412	8.21	≤30.00	PASS
		2442	8.53	≤30.00	PASS
		2472	6.56	≤30.00	PASS
11N20SISO	Ant1	2412	8.45	≤30.00	PASS
		2442	8.91	≤30.00	PASS
		2472	7.07	≤30.00	PASS
11N40SISO	Ant1	2422	7.92	≤30.00	PASS
		2442	7.99	≤30.00	PASS
		2462	7.04	≤30.00	PASS

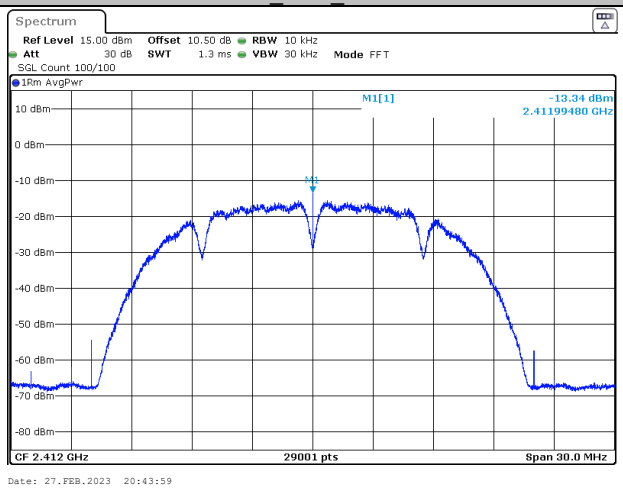
Appendix D: Maximum power spectral density

Test Result

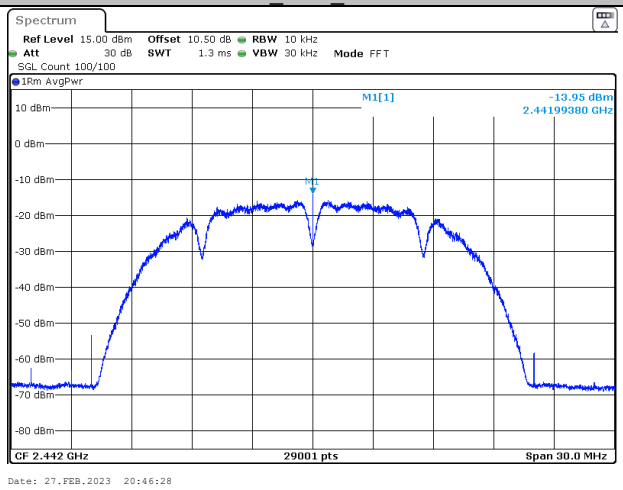
Test Mode	Antenna	Frequency[MHz]	Result[dBm/10kHz]	Limit[dBm/3kHz]	Verdict
11B	Ant1	2412	-13.34	≤8.00	PASS
		2442	-13.95	≤8.00	PASS
		2472	-14.98	≤8.00	PASS
11G	Ant1	2412	-15.42	≤8.00	PASS
		2442	-15.18	≤8.00	PASS
		2472	-16.81	≤8.00	PASS
11N20SISO	Ant1	2412	-15.32	≤8.00	PASS
		2442	-15.11	≤8.00	PASS
		2472	-16.46	≤8.00	PASS
11N40SISO	Ant1	2422	-15.68	≤8.00	PASS
		2442	-15.65	≤8.00	PASS
		2462	-16.38	≤8.00	PASS

Test Graphs

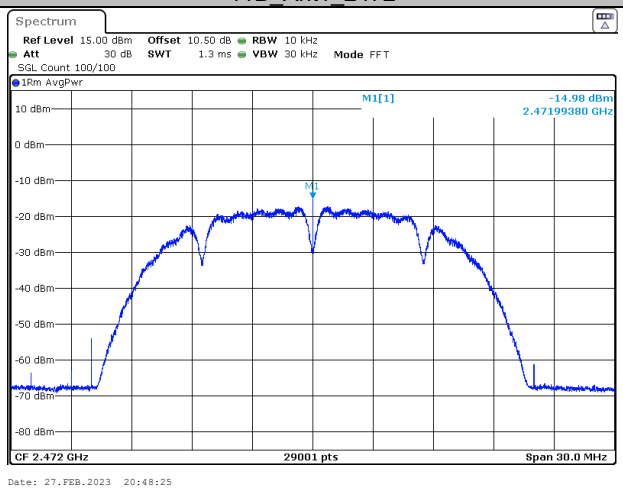
11B_Ant1_2412



11B_Ant1_2442



11B_Ant1_2472



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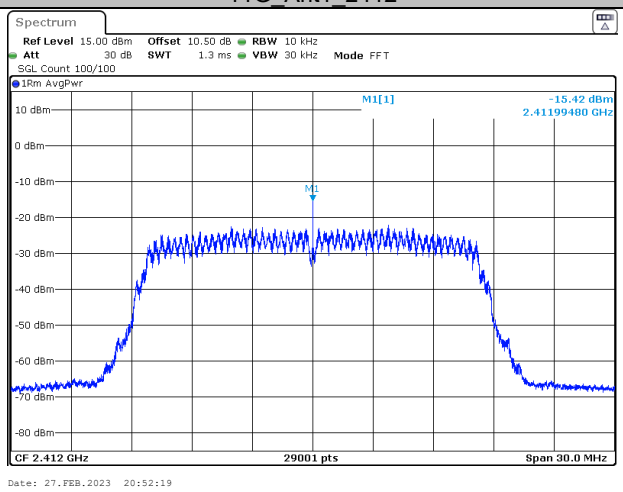

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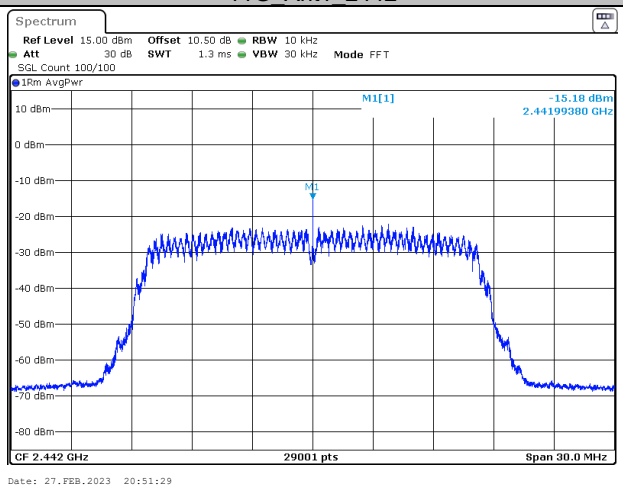

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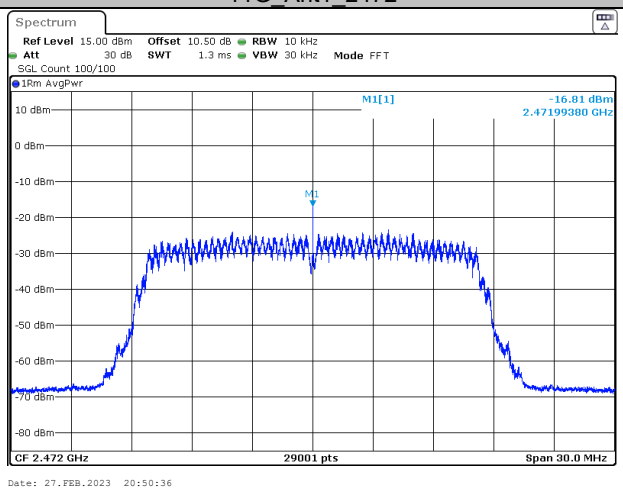

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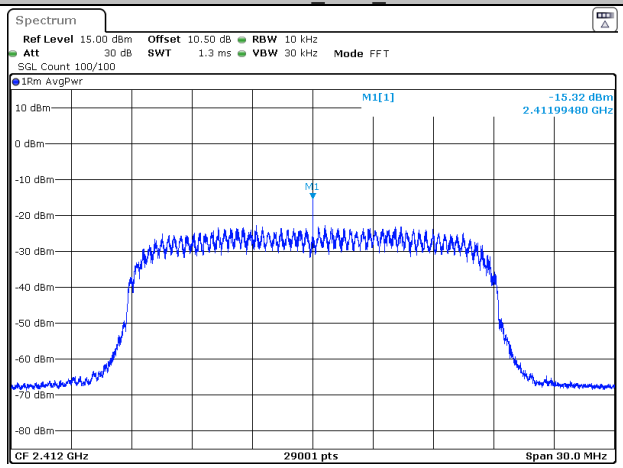

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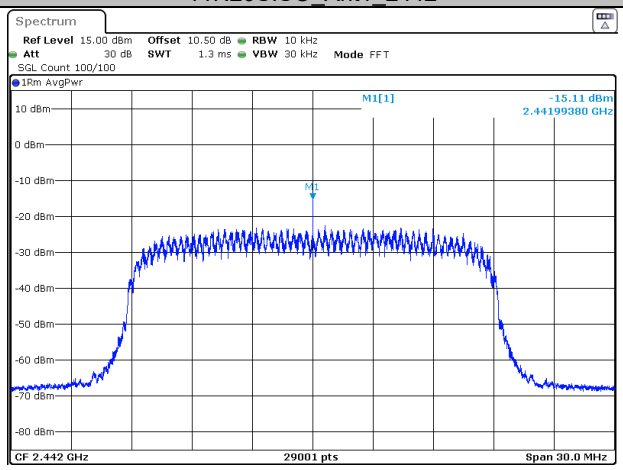

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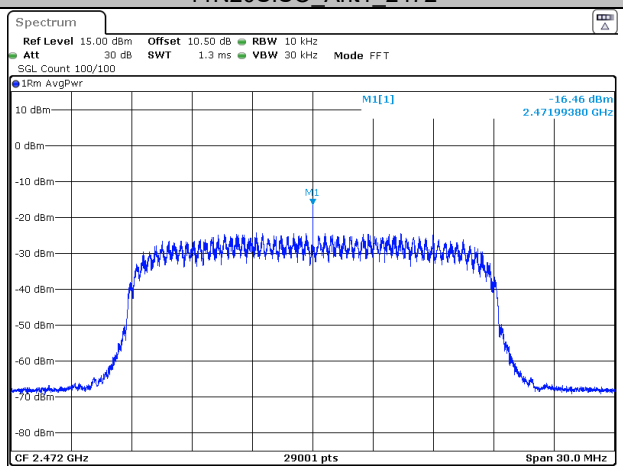
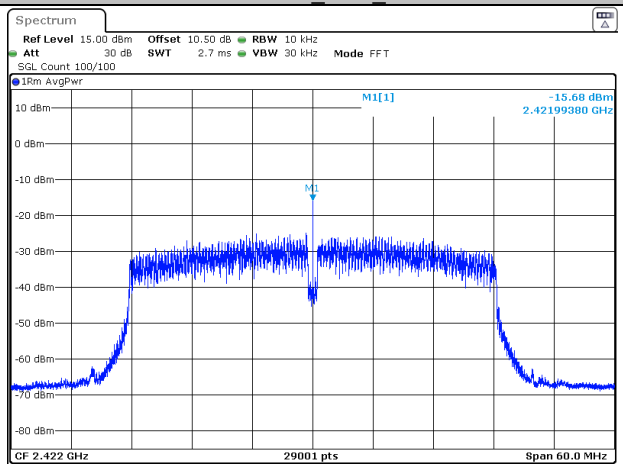


11N40SISO_Ant1_2422



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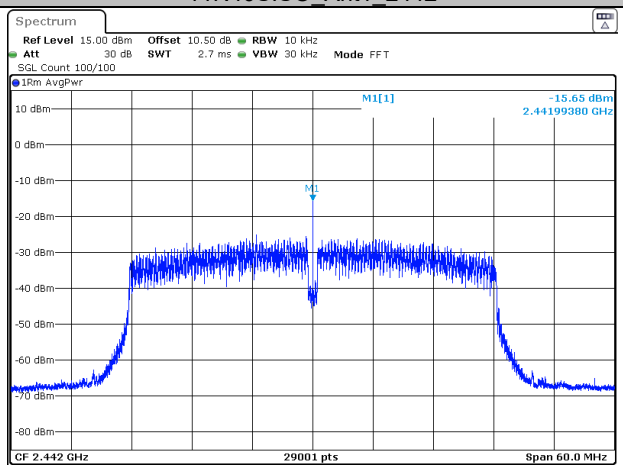
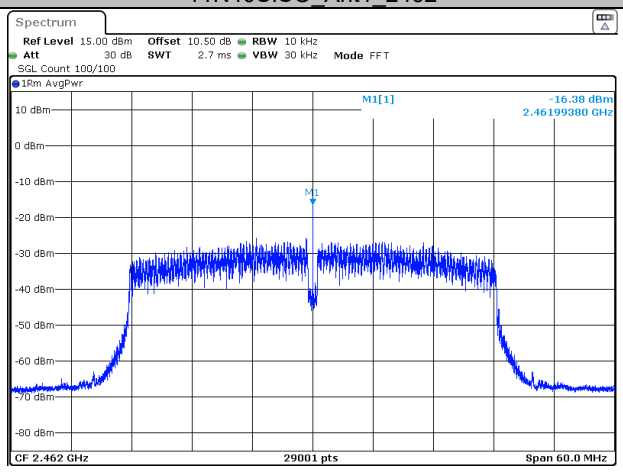


11N40SISO_Ant1_2462

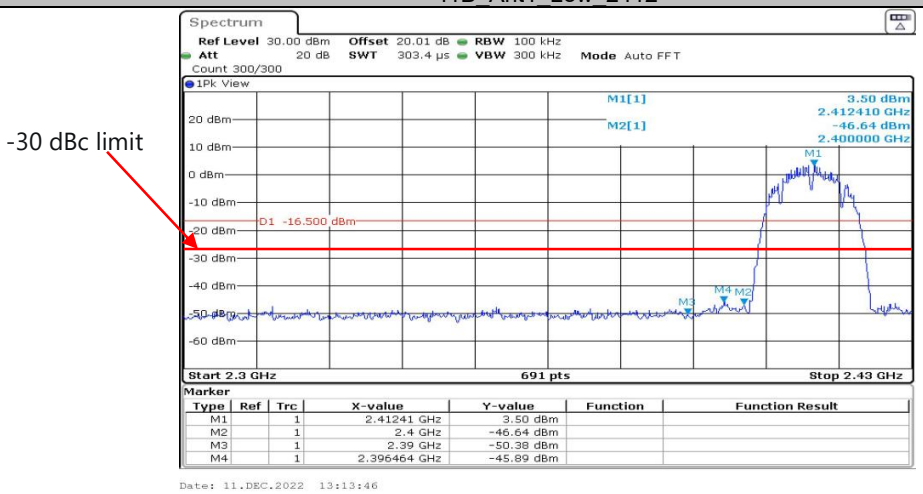


Appendix E: Band edge measurements

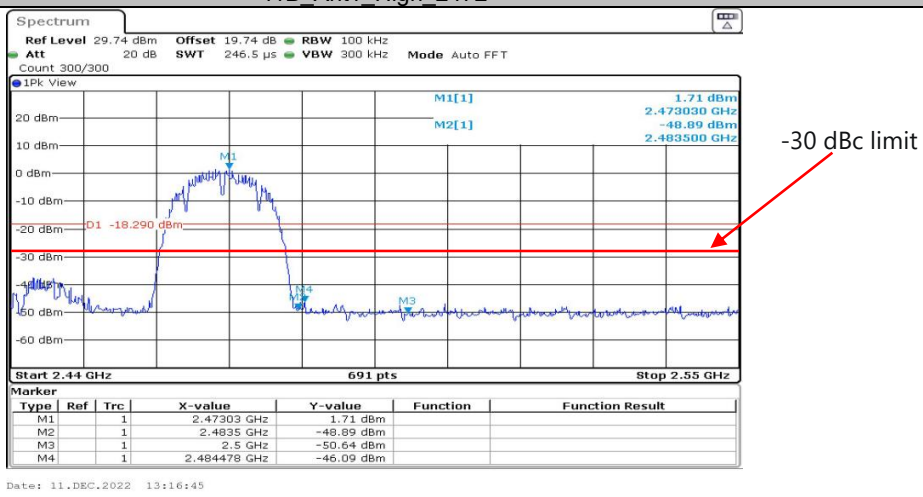
Test Graphs

Note: As shown in the test pltos below, the spurious meets the -30 dBc limit.

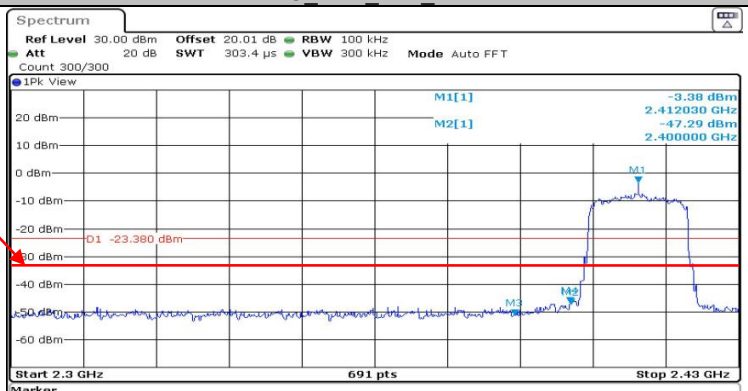
11B_Ant1_Low_2412



11B_Ant1_High_2472



11G_Ant1_Low_2412



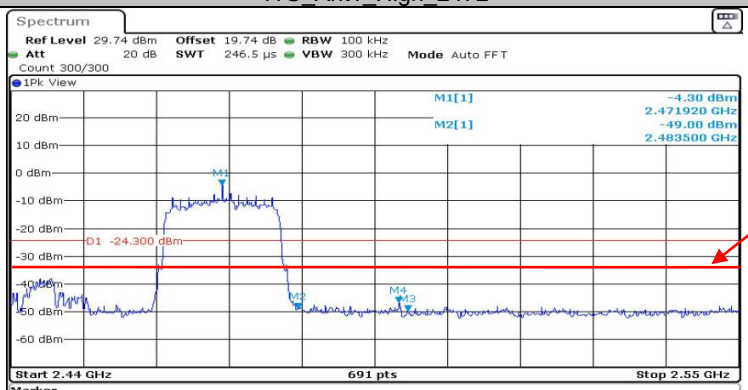
-30 dBc limit

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.41203 GHz	-3.38 dBm		
M2		1	2.4 GHz	-47.29 dBm		
M3		1	2.39 GHz	-51.29 dBm		
M4		1	2.399855 GHz	-46.73 dBm		

Date: 11.DEC.2022 13:18:05

11G_Ant1_High_2472



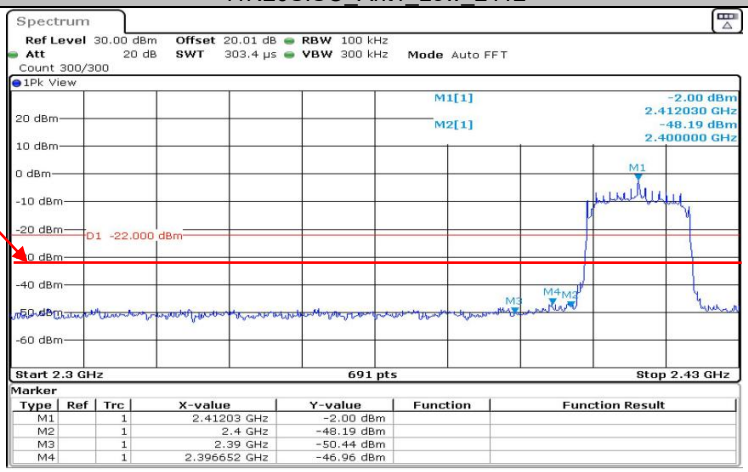
-30 dBc limit

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47192 GHz	-4.30 dBm		
M2		1	2.4835 GHz	-49.00 dBm		
M3		1	2.5 GHz	-49.72 dBm		
M4		1	2.498667 GHz	-46.76 dBm		

Date: 11.DEC.2022 13:23:43

11N20SISO_Ant1_Low_2412



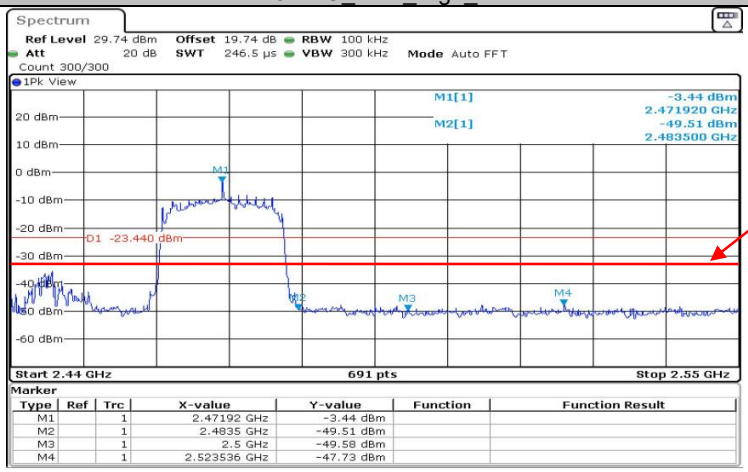
-30 dBc limit

Marker

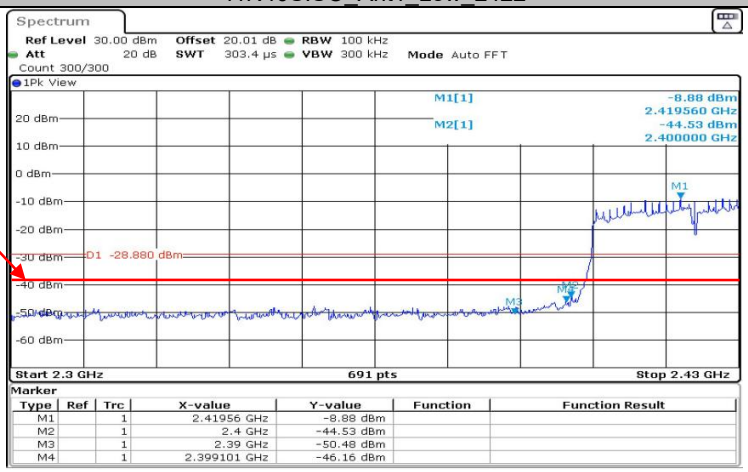
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.41203 GHz	-2.00 dBm		
M2		1	2.4 GHz	-48.19 dBm		
M3		1	2.39 GHz	-50.44 dBm		
M4		1	2.396652 GHz	-46.96 dBm		

Date: 11.DEC.2022 13:24:57

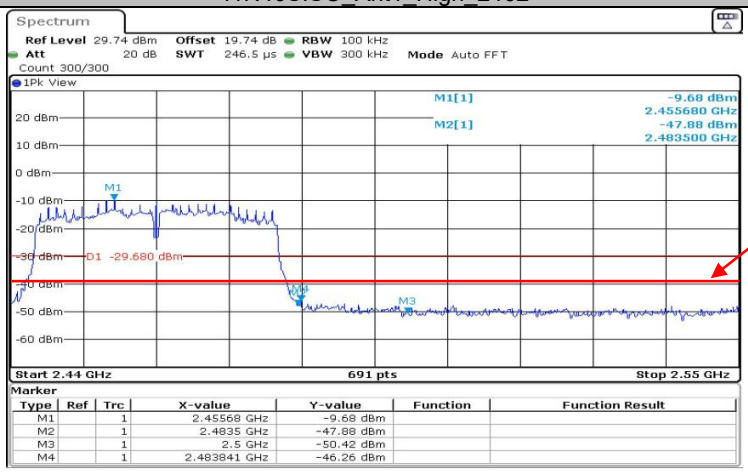
11N20SISO_Ant1_High_2472



11N40SISO_Ant1_Low_2422



11N40SISO_Ant1_High_2462



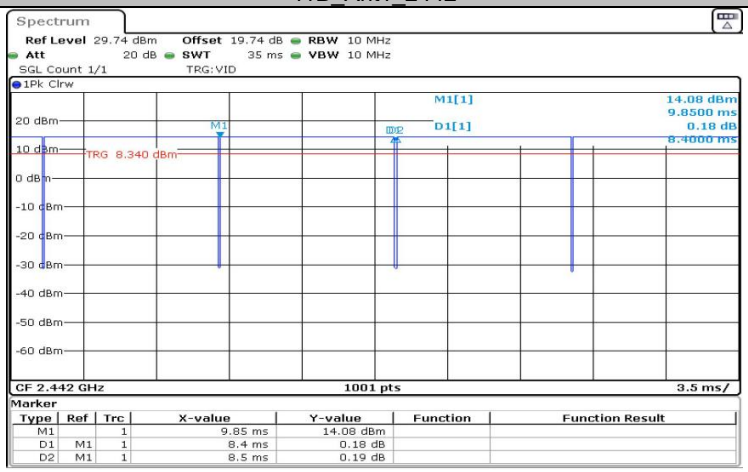
Appendix F: Duty Cycle

Test Result

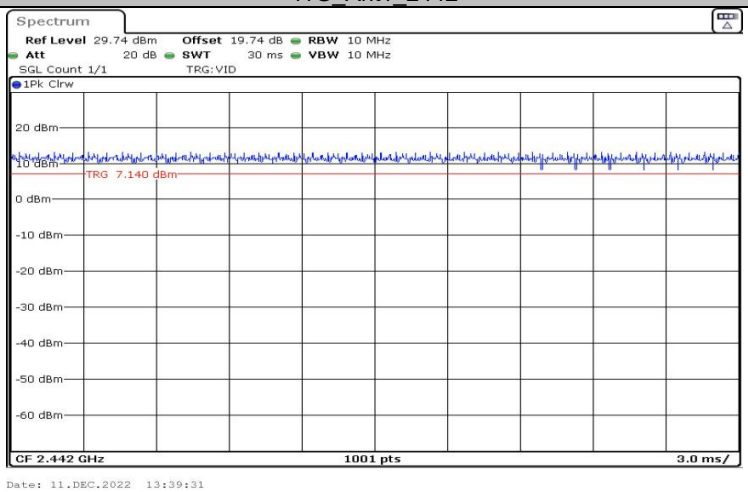
Test Mode	Antenna	Frequency[MHz]	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
11B	Ant1	2442	8.40	8.50	98.82
11G	Ant1	2442	30.00	30.00	100.00
11N20SISO	Ant1	2442	30.00	30.00	100.00
11N40SISO	Ant1	2442	30.00	30.00	100.00

Test Graphs

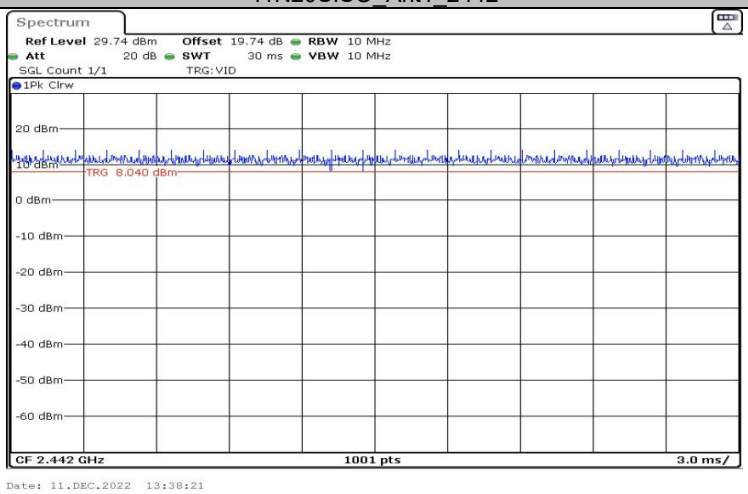
11B_Ant1_2442

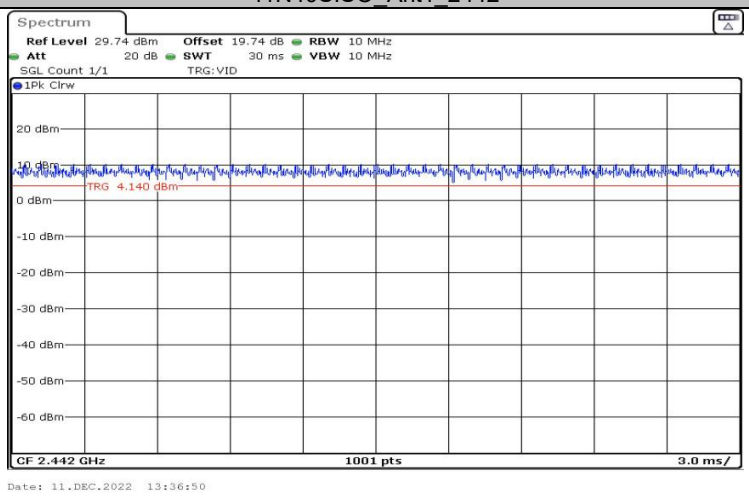


11G_Ant1_2442



11N20SISO_Ant1_2442



11N40SISO_Ant1_2442


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