

TEST REPORT

Applicant Name : Dragino Technology Co., Limited.
Address : Room 202, BaoChengTai industrial park, No.8 CaiYun,
LongCheng Street, LongGang District, Shenzhen, China
Report Number : RA230409-17769E-RF-00B
FCC ID: ZHZPSLB

Test Standard (s)

FCC PART 15.247

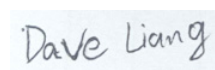
Sample Description

Product Type: LoRaWAN Analog Sensor
Model No.: PS-LB-NA
Multiple Model(s) No.: PS-LB; SDI-12; PS-LB-I5; PS-LB-TN4-A
Trade Mark: DRAGINO
Date Received: 2023/04/09
Report Date: 2023/06/09

Test Result:	Pass*
--------------	-------

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

Prepared and Checked By:



Dave Liang
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 "★".

Shenzhen Accurate Technology Co., Ltd. is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk "★". Customer model name, addresses, names, trademarks etc. are not considered data.

This report cannot be reproduced except in full, without prior written approval of the Company. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested. This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

Shenzhen Accurate Technology Co., Ltd.

1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China
Tel: +86 755-26503290 Tel: +86 755-26503290 Web: www.atc-lab.com

TABLE OF CONTENTS

DOCUMENT REVISION HISTORY	4
GENERAL INFORMATION.....	5
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	5
OBJECTIVE	5
TEST METHODOLOGY	5
MEASUREMENT UNCERTAINTY.....	6
SYSTEM TEST CONFIGURATION	7
DESCRIPTION OF TEST CONFIGURATION	7
EUT EXERCISE SOFTWARE	7
DUTY CYCLE	7
EQUIPMENT MODIFICATIONS	8
BLOCK DIAGRAM OF TEST SETUP	9
SUMMARY OF TEST RESULTS	10
TEST EQUIPMENT LIST	11
FCC §15.247 (I) & §1.1307 (B) (3) & §2.1091- MPE-BASED EXEMPTION	12
FCC §15.203 - ANTENNA REQUIREMENT.....	14
APPLICABLE STANDARD	14
ANTENNA CONNECTOR CONSTRUCTION	14
FCC §15.209, §15.205 & §15.247(D) - SPURIOUS EMISSIONS.....	15
APPLICABLE STANDARD	15
EUT SETUP	15
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP	16
TEST PROCEDURE	16
CORRECTED FACTOR & MARGIN CALCULATION	16
TEST DATA	16
FCC §15.247(A) (1)-CHANNEL SEPARATION TEST	21
APPLICABLE STANDARD	21
TEST PROCEDURE	21
TEST DATA	21
FCC §15.247(A) (1) (I)– 20 DB EMISSION BANDWIDTH.....	23
APPLICABLE STANDARD	23
TEST PROCEDURE	23
TEST DATA	23
FCC §15.247(F) - TIME OF OCCUPANCY (DWELL TIME).....	26
APPLICABLE STANDARD	26
TEST PROCEDURE	26
TEST DATA	26
FCC §15.247(B) (3) - MAXIMUM CONDUCTED OUTPUT POWER	28
APPLICABLE STANDARD	28
TEST PROCEDURE	28
TEST DATA	28

FCC §15.247(D) – 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE31
 APPLICABLE STANDARD31
 TEST PROCEDURE31
 TEST DATA31
FCC §15.247(F) - POWER SPECTRAL DENSITY34
 APPLICABLE STANDARD34
 TEST PROCEDURE34
 TEST DATA34

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RA230409-17769E-RF-00B	Original Report	2023/06/09

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	LoRaWAN Analog Sensor
Tested Model	PS-LB-NA
Multiple Models	PS-LB; SDI-12; PS-LB-I5; PS-LB-TN4-A (model difference see product declaration letter of similarity)
Frequency Range	902.3-914.9MHz
Maximum Conducted Peak Output Power	4.47dBm
Technique	Hybrid System
Antenna Specification*	2.0dBi (provide by applicant)
Voltage Range	DC3.6V from battery
Sample serial number	RF Conducted Test : 24CY-1 Radiated Emission Test : 24CY-2 (Assigned by ATC)
Sample/EUT Status	Good condition

Note: Pre-scan with these models, the worst case is the PS-LB-NA which was recorded in the report.

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, 15.209 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.

Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Harmonic Current		0.512%, k=2
Occupied Channel Bandwidth		5%
RF output power, conducted		0.71dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions	9k-30MHz	2.74dB, k=2
	150kHz-30MHz	2.92dB, k=2
Emissions, Radiated	9kHz - 30MHz	2.06dB
	30MHz - 1GHz	5.08dB
	1GHz - 18GHz	4.96dB
	18GHz - 26.5GHz	5.16dB
	26.5GHz - 40GHz	4.64dB
Temperature		1°C
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 Floor 1, KuMaKe Building, Dongzhou Community, Guangming Street, Guangming District, Shenzhen, Guangdong, 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.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0016. The Registration Number is 30241.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode.

Channel list

Channel	Freq.(MHz)	Channel	Freq.(MHz)	Channel	Freq.(MHz)	Channel	Freq.(MHz)
0	902.3	16	905.5	32	908.7	48	911.9
1	902.5	17	905.7	33	908.9	49	912.1
2	902.7	18	905.9	34	909.1	50	912.3
3	902.9	19	906.1	35	909.3	51	912.5
4	903.1	20	906.3	36	909.5	52	912.7
5	903.3	21	906.5	37	909.7	53	912.9
6	903.5	22	906.7	38	909.9	54	913.1
7	903.7	23	906.9	39	910.1	55	913.3
8	903.9	24	907.1	40	910.3	56	913.5
9	904.1	25	907.3	41	910.5	57	913.7
10	904.3	26	907.5	42	910.7	58	913.9
11	904.5	27	907.7	43	910.9	59	914.1
12	904.7	28	907.9	44	911.1	60	914.3
13	904.9	29	908.1	45	911.3	61	914.5
14	905.1	30	908.3	46	911.5	62	914.7
15	905.3	31	908.5	47	911.7	63	914.9

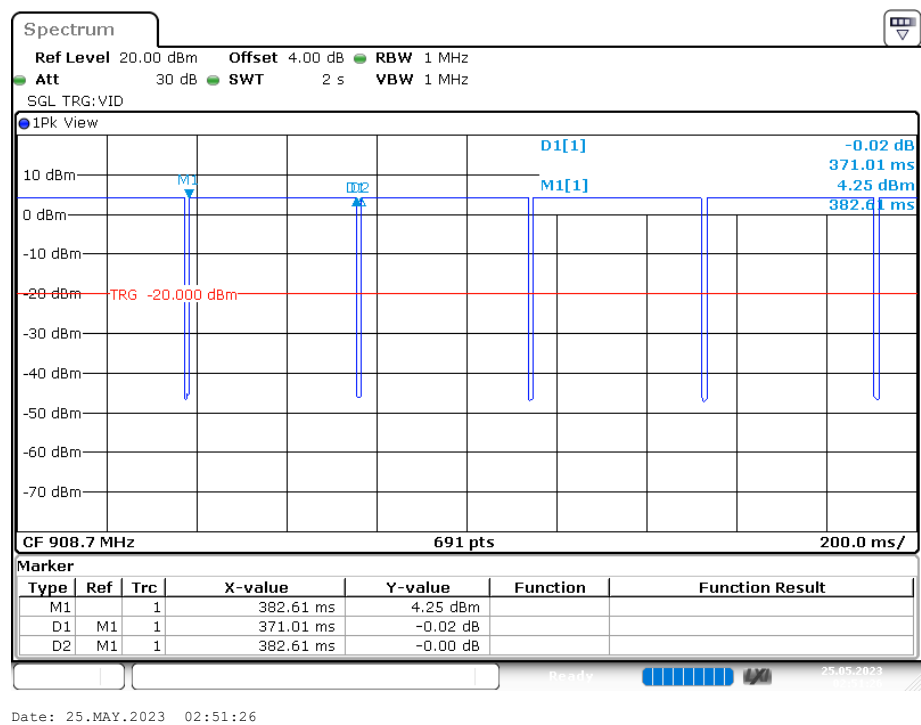
EUT was test with channel 0/32/63

EUT Exercise Software

“SerialPoriling; SmartSnippets Toolbox V5.0.12.exe”* software was used to the EUT tested and power level is 13. The software and power level was provided by the applicant.

Duty cycle

Mode	T _{on} (ms)	T _{on+off} (ms)	Duty Cycle (%)
Hybrid System	371.01	382.61	96.97



Equipment Modifications

No modification was made to the EUT tested.

Special Accessories

No special accessory.

Support Equipment List and Details

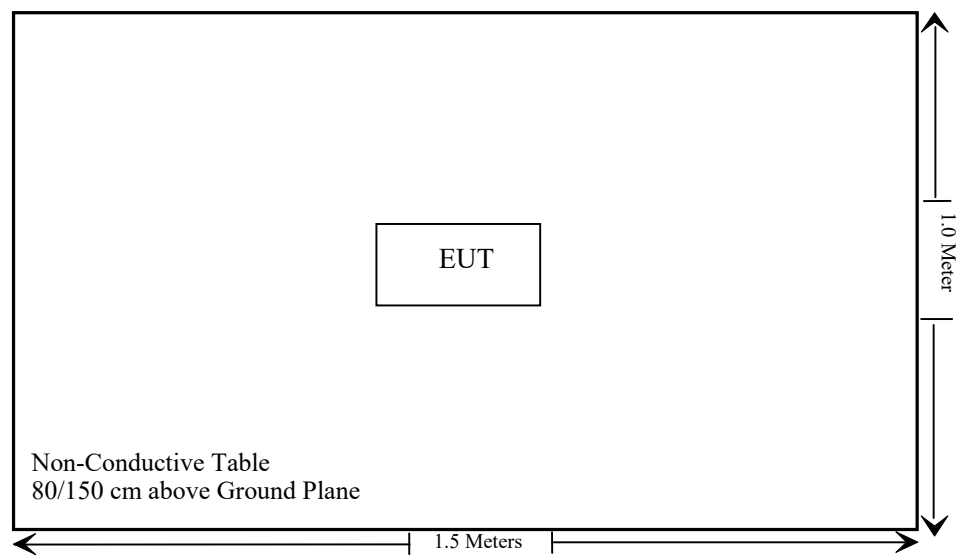
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

Cable Description	Length (m)	From/Port	To
/	/	/	/

Block Diagram of Test Setup

For radiated emission:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.247 (i) & §1.1307 (b) (3) & §2.1091	MPE-Based Exemption	Compliant
§15.203	Antenna Requirement	Compliant
§15.207(a)	AC Line Conducted Emissions	Not Applicable
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliant
§15.247(a)(1)	20 dB Emission Bandwidth	Compliant
§15.247(a)(1)(i)	Channel Separation Test	Compliant
§15.247(f)	Time of Occupancy (Dwell Time)	Compliant
§15.247(b)(3)	Peak Output Power Measurement	Compliant
§15.247(d)	Band edges	Compliant
§15.247(f)	Power Spectral Density	Compliant

Not Applicable: The EUT is powered by battery only.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
Rohde& Schwarz	Test Receiver	ESR	102725	2022/11/25	2023/11/24
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2022/11/25	2023/11/24
SONOMA INSTRUMENT	Amplifier	310 N	186131	2022/11/08	2023/11/07
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2022/11/08	2023/11/07
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2022/11/30	2025/11/29
Radiated Emission Test Software: e3 19821b (V9)					
Unknown	RF Coaxial Cable	No.10	N050	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.11	N1000	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.12	N040	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.13	N300	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.14	N800	2022/11/25	2023/11/24
RF Conducted Test					
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200982	2022/07/04	2023/07/03
WEINSCHTEL	3dB Attenuator	Unknown	F-03-EM121	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.31	RF-01	Each time	

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

FCC §15.247 (i) & §1.1307 (b) (3) & §2.1091- MPE-Based Exemption

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 exemption from 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	$0.0128 R^2 f$.
1,500-100,000	$19.2 R^2$.

R is the minimum separation distance in meters

f = frequency in MHz

Simultaneous Transmission SAR Test Exemption:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1 \quad (C.1)$$

Result

Mode	Frequency (MHz)	Tune up conducted power	Antenna Gain		ERP		Evaluation Distance (m)	ERP Limit (mW)
		(dBm)	(dBi)	(dBd)	(dBm)	(mW)		
BLE	2402-2480	0	2.0	-0.15	-0.15	0.97	0.2	768
LoRa (Hybrid)	902.3-914.9	5	2.0	-0.15	4.85	3.05	0.2	462
LoRa (DTS)	903.0-914.2	14	2.0	-0.15	13.85	24.27	0.2	462

Note: 1.The tune up conducted power and antenna gain was declared by the applicant.
 2. 0dBd=2.15dBi
 3. The BLE can transmit with the LoRa at the same time.

Simultaneous Transmission SAR Test Exemption:

The ratio= $0.97/768+24.27/462=0.054<1$

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

Result: Compliant.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
 - b. Antenna must use a unique type of connector to attach to the EUT.
- Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has a non-standard antenna jack for the LoRa and the maximum antenna gain is 2.0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

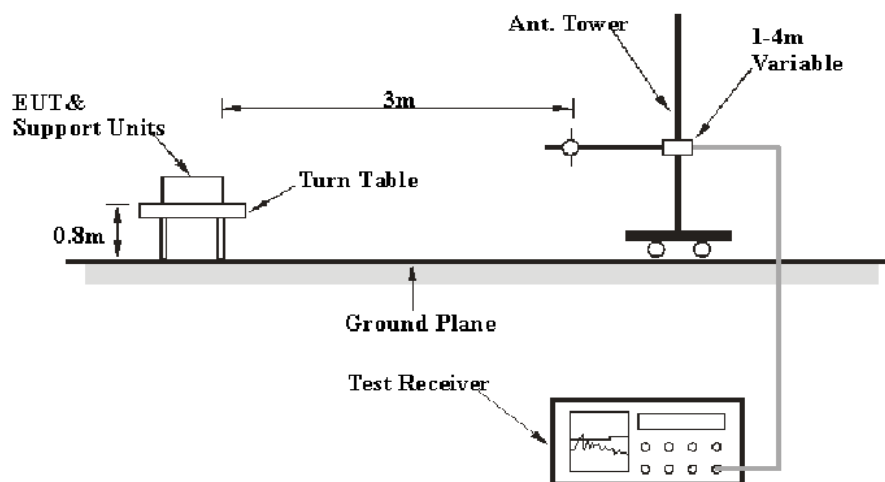
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

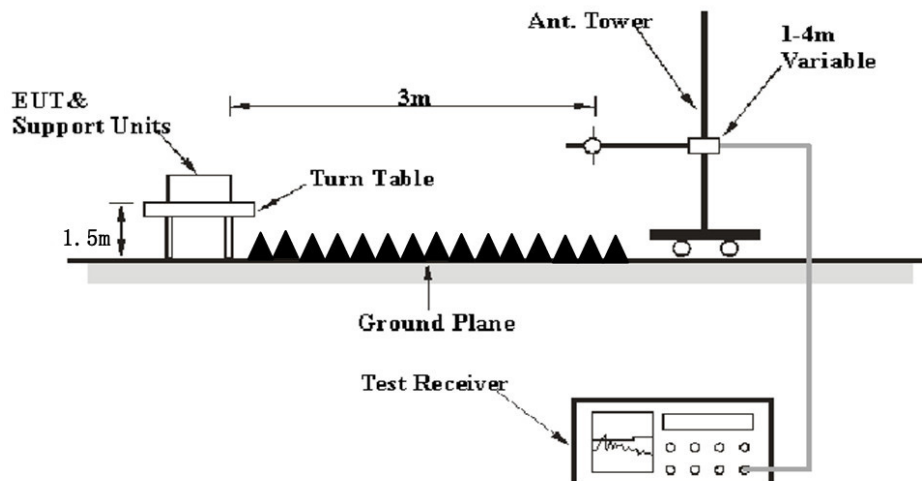
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



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

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 10 GHz.

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	Measurements
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	Ave.

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.

Corrected Factor & Margin Calculation

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

$$\text{Corrected Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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

$$\begin{aligned}\text{Over Limit/Margin} &= \text{Level/Corrected Amplitude} - \text{Limit} \\ \text{Level/Corrected Amplitude} &= \text{Read Level} + \text{Corrected Factor}\end{aligned}$$

Test Data

Environmental Conditions

Temperature:	24~25.6 °C
Relative Humidity:	50~56 %
ATM Pressure:	101.0 kPa

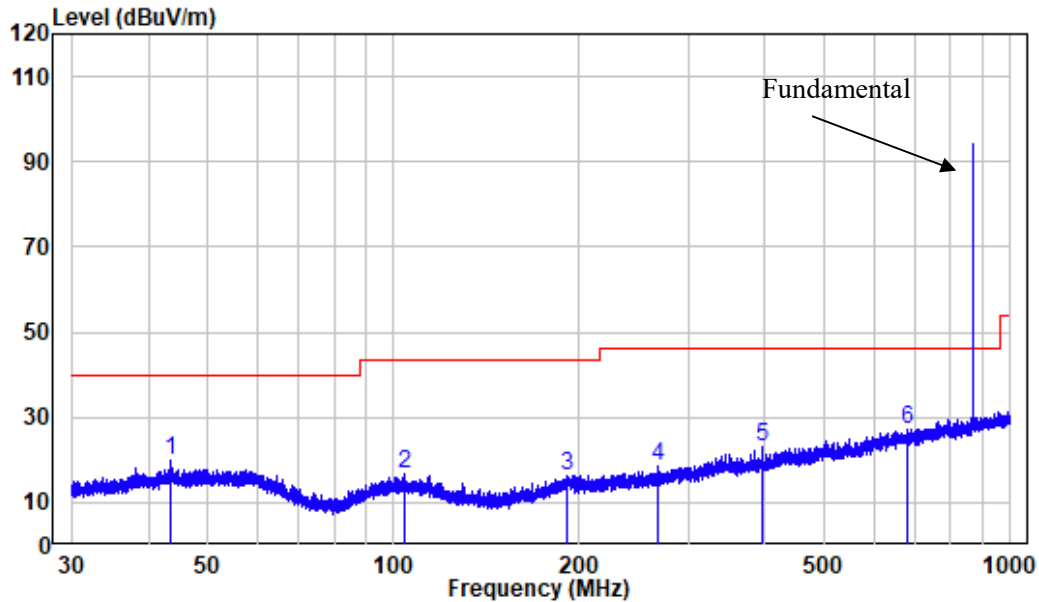
The testing was performed by Jimi Zheng on 2023-04-26 for below 1G and Jason Liu on 2023-05-12 for above 1G.

EUT operation mode: Transmitting (Pre-scan in the X,Y and Z axes of orientation, the worst case of orientation was recorded)

30MHz - 1GHz: (worst case is Middle channel)

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

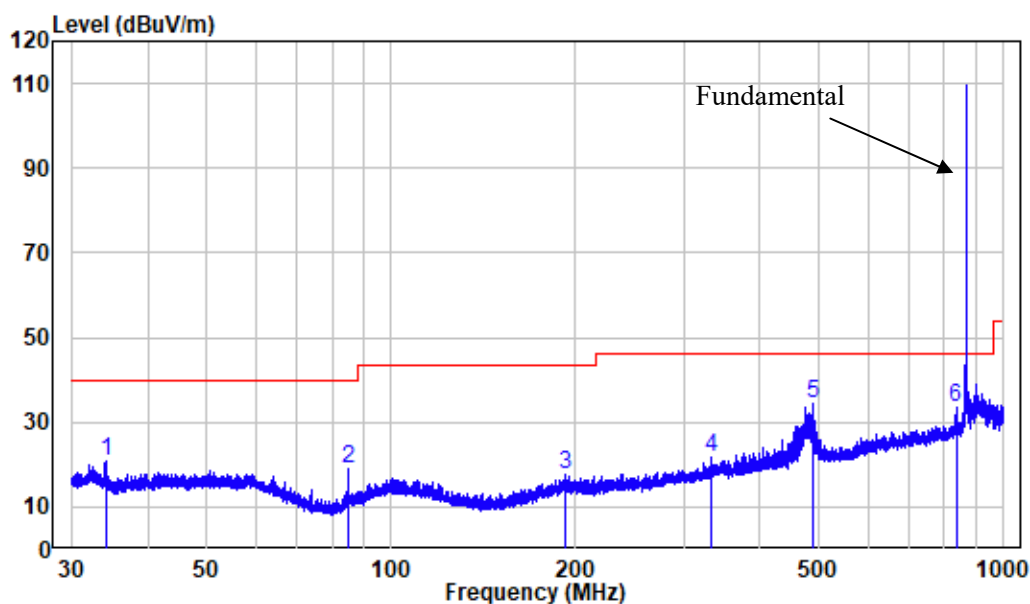
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA230409-17769E-RF
Test Mode: Transmitting

	Freq Factor		Read	Limit	Over	Remark
	MHz	dB/m	Level	Line	Limit	
			dBuV	dBuV/m	dBuV/m	dB
1	43.372	-9.93	29.82	19.89	40.00	-20.11 Peak
2	104.033	-11.74	28.27	16.53	43.50	-26.97 Peak
3	190.489	-11.50	27.91	16.41	43.50	-27.09 Peak
4	268.956	-10.27	28.64	18.37	46.00	-27.63 Peak
5	395.201	-6.81	29.83	23.02	46.00	-22.98 Peak
6	679.066	-1.52	28.76	27.24	46.00	-18.76 Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA230409-17769E-RF
Test Mode: Transmitting

	Freq	Factor	Read Level	Level	Limit	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	34.276	-11.77	32.49	20.72	40.00	-19.28	Peak
2	84.776	-15.72	34.79	19.07	40.00	-20.93	Peak
3	192.841	-11.27	28.87	17.60	43.50	-25.90	Peak
4	332.956	-7.77	29.66	21.89	46.00	-24.11	Peak
5	487.743	-4.78	39.36	34.58	46.00	-11.42	Peak
6	836.244	0.21	33.21	33.42	46.00	-12.58	Peak

Above 1 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)				
Low Channel(902.3MHz)									
1804.6	65.71	PK	243	1.6	H	-13.05	52.66	74	-21.34
1804.6	59.01	PK	167	1.6	V	-13.05	45.96	74	-28.04
2706.9	59.09	PK	2	2.1	H	-9.97	49.12	74	-24.88
2706.9	59.78	PK	94	2.1	V	-9.97	49.81	74	-24.19
3609.2	60.84	PK	184	2.4	H	-9.21	51.63	74	-22.37
3609.2	61.31	PK	320	2.4	V	-9.21	52.10	74	-21.90
Middle Channel(908.7MHz)									
1817.4	60.74	PK	5	1.8	H	-13.22	47.52	74	-26.48
1817.4	58.80	PK	62	1.8	V	-13.22	45.58	74	-28.42
2726.1	61.25	PK	256	1.5	H	-10.64	50.61	74	-23.39
2726.1	59.29	PK	70	1.5	V	-10.64	48.65	74	-25.35
3634.8	60.77	PK	203	1.5	H	-8.94	51.83	74	-22.17
3634.8	58.63	PK	242	1.5	V	-8.94	49.69	74	-24.31
High Channel(914.9MHz)									
1829.8	59.57	PK	29	1.5	H	-13.38	46.19	74	-27.81
1829.8	57.52	PK	92	1.5	V	-13.38	44.14	74	-29.86
2744.7	57.94	PK	49	1.9	H	-10.18	47.76	74	-26.24
2744.7	56.69	PK	13	1.9	V	-10.18	46.51	74	-27.49
3659.6	56.87	PK	155	1.9	H	-8.82	48.05	74	-25.95
3659.6	57.95	PK	179	1.9	V	-8.82	49.13	74	-24.87

Note:

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

Corrected Amplitude = Corrected Factor + Reading

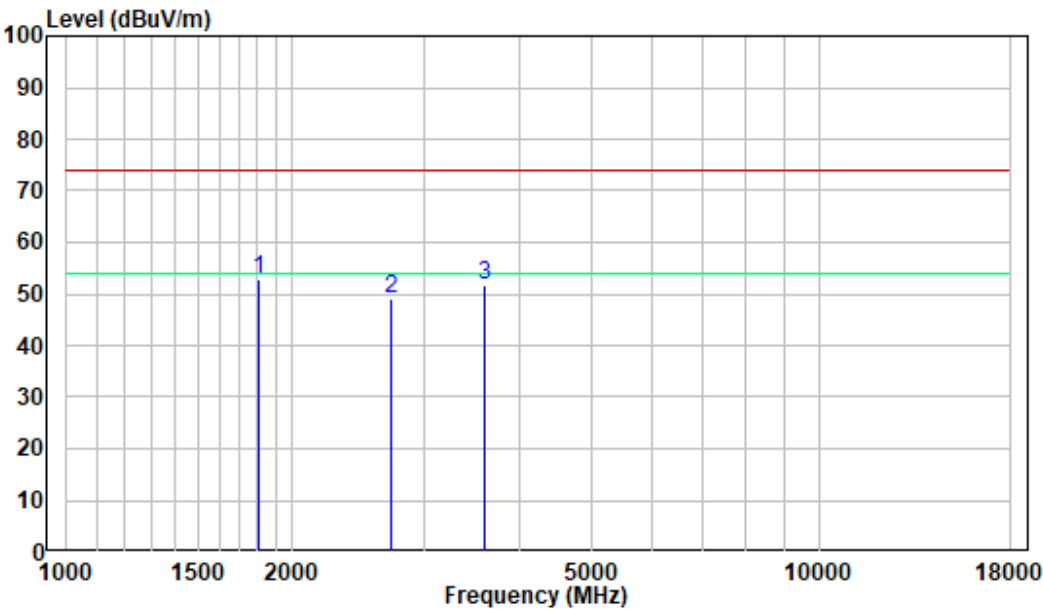
Margin = Corrected. Amplitude - Limit

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

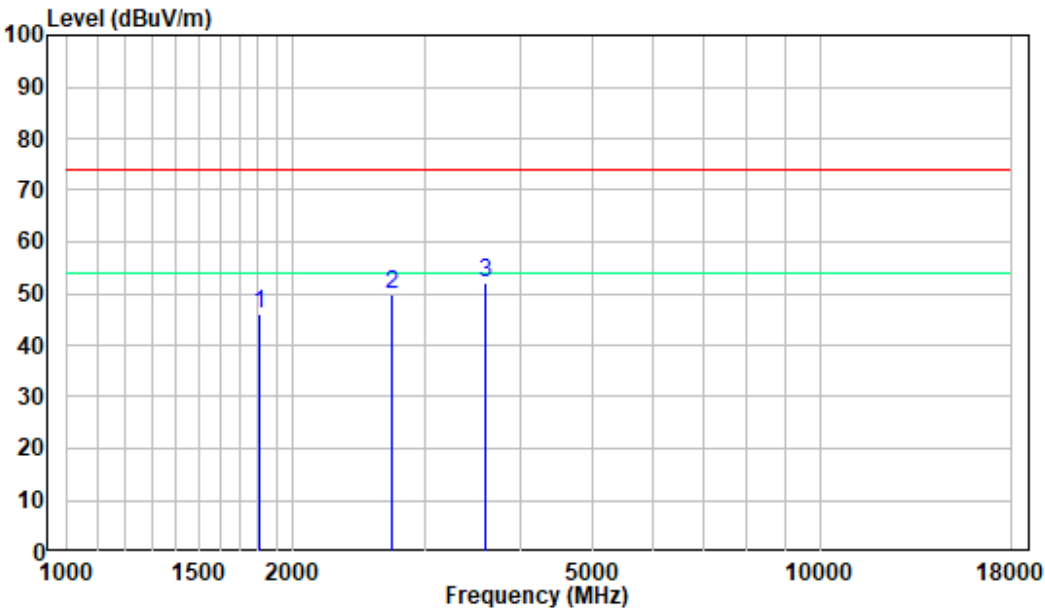
The test result of peak was less than the limit of average, so just peak value were recorded.

Pre-scan with Low channel

Horizontal



Vertical



FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

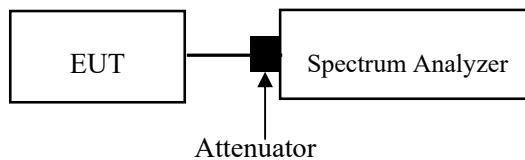
Applicable Standard

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.2

1. Set the EUT in transmitting mode, maxhold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.



Test Data

Environmental Conditions

Temperature:	27.8 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

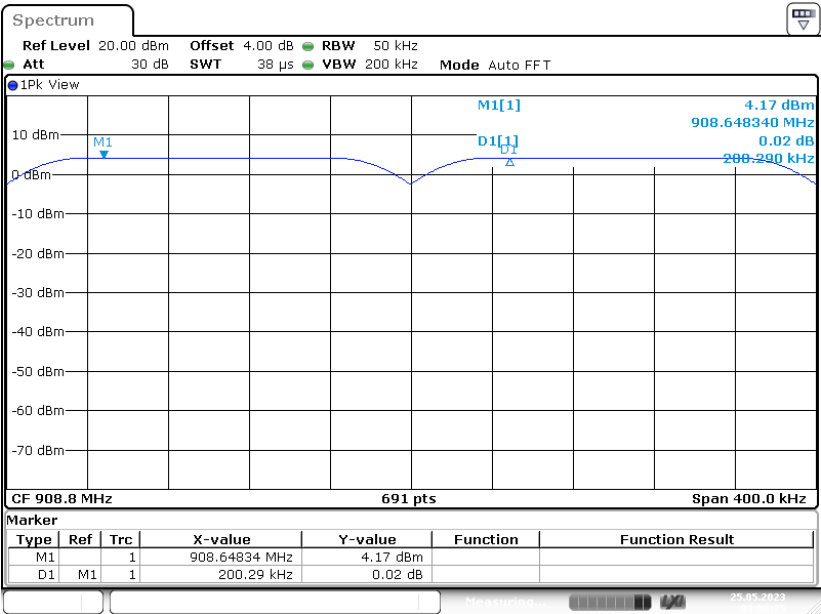
The testing was performed by Jacob Huang on 2023-05-25.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots

Test Mode	Frequency Separation [MHz]	20dB Bandwidth [MHz]	Verdict
Hop	0.200	0.141	Pass

Note: Limit \geq 20 dB bandwidth



Date: 25.MAY.2023 03:02:36

FCC §15.247(a) (1) (i)– 20 dB EMISSION BANDWIDTH

Applicable Standard

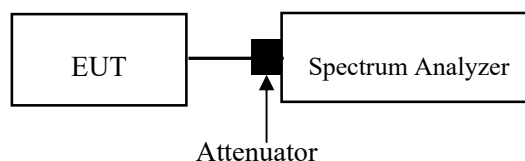
According to §15.247(a) (1) (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.7

The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / 20 dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / 20 dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.



Test Data

Environmental Conditions

Temperature:	27.8 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

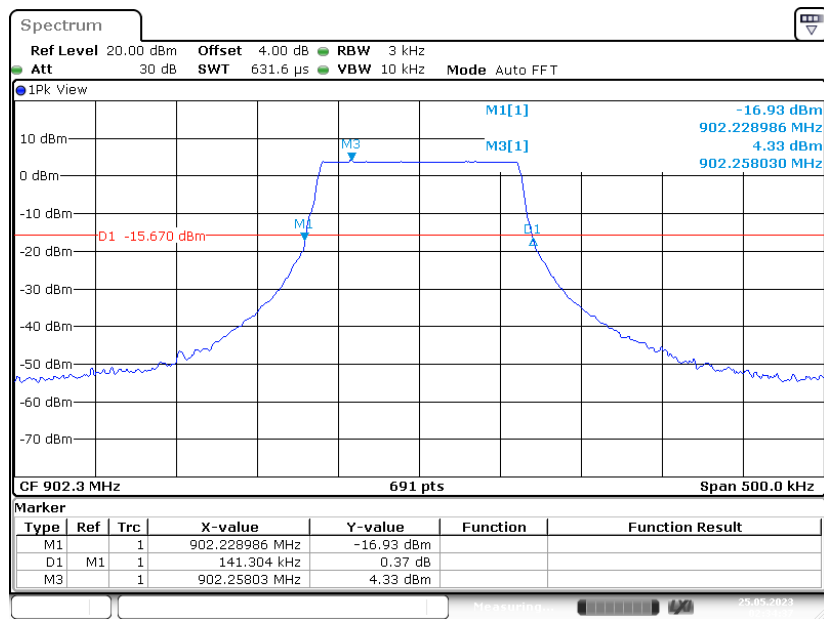
The testing was performed by Jacob Huang on 2023-05-25.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

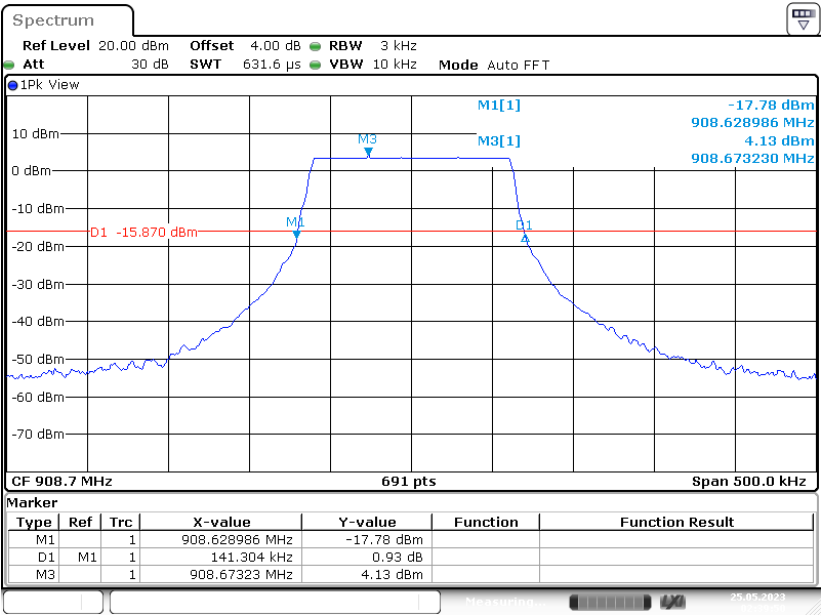
Mode	Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)
Hybrid System	Low	902.3	0.141
	Middle	908.7	0.141
	High	914.9	0.141

Low Channel



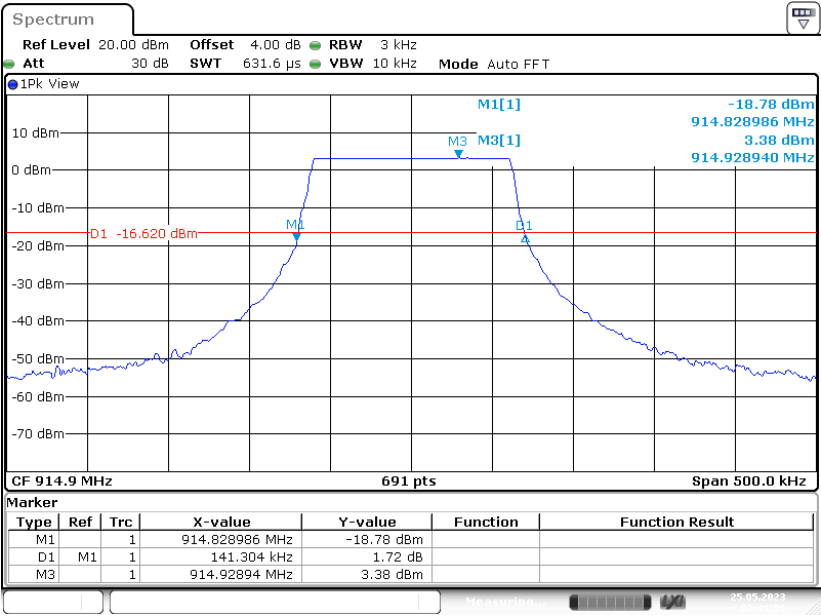
Date: 25.MAY.2023 02:34:37

Middle Channel



Date: 25.MAY.2023 02:39:51

High Channel



Date: 25.MAY.2023 02:41:59

FCC §15.247(f) - TIME OF OCCUPANCY (DWELL TIME)

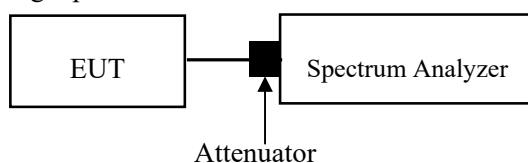
Applicable Standard

(f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.4

1. The EUT was worked in channel hopping.
2. Set the RBW to: 1MHz.
3. Set the VBW $\geq 3 \times$ RBW.
4. Set the span to 0Hz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Recorded the time of single pulses



Test Data

Environmental Conditions

Temperature:	27.8℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-05-25.

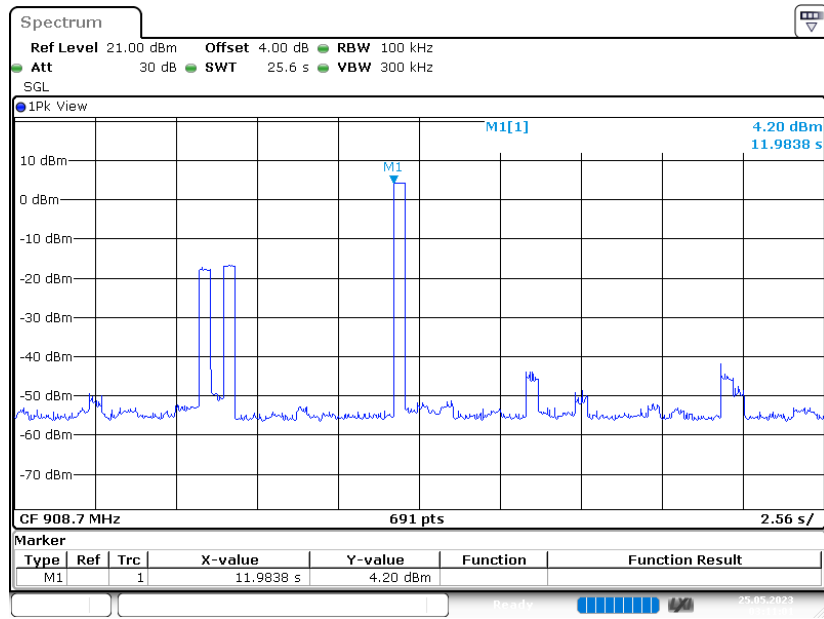
EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

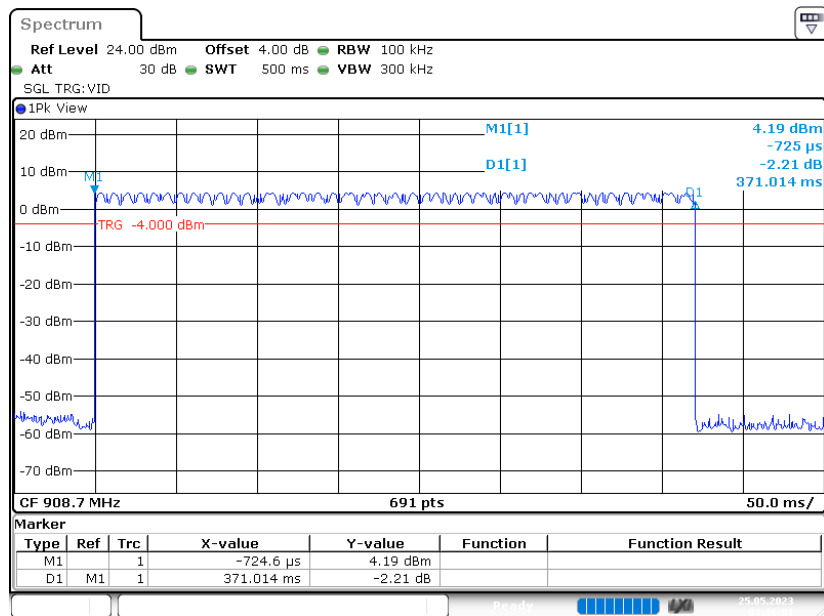
Mode	Pulse Time (ms)	Hopping Number	Period Time (s)	Total of Dwell Time (ms)	Limit (ms)	Result
Hopping	371.01	1	25.6	371.01	400	Pass

Note: A period time=0.4*64=25.6(s), Total of Dwell Time=Pluse Time*Hopping Number

Hopping Number



Pulse Time



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

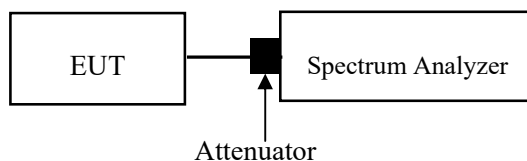
Applicable Standard

(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

Test Method: ANSI C63.10-2013 Clause 7.8.5

1. Place the EUT on a bench and set 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:	27.8 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

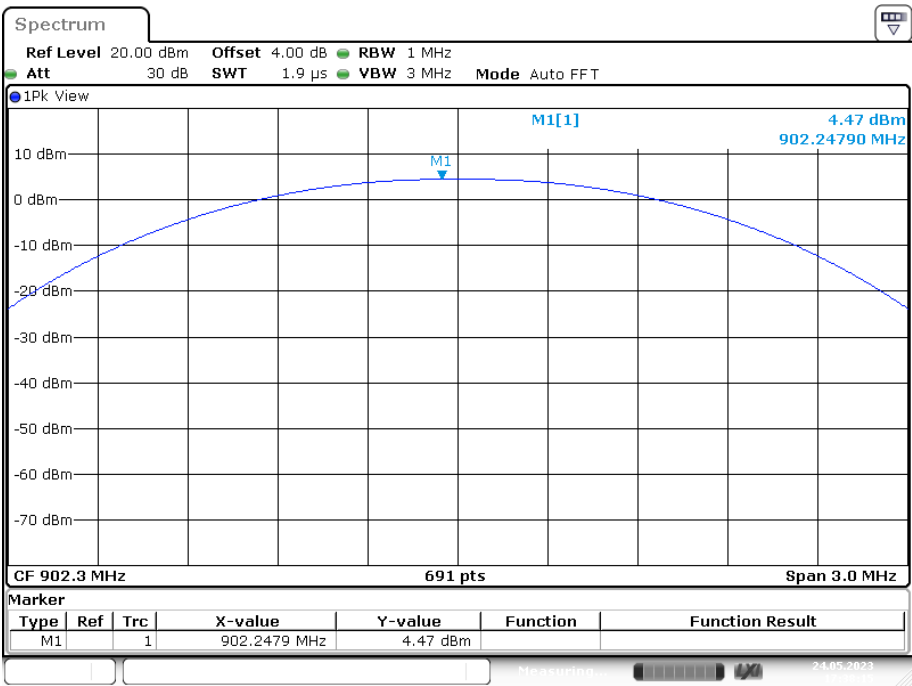
The testing was performed by Jacob Huang on 2023-05-25.

Test Result: Compliance. Please refer to following table.

EUT operation mode: Transmitting

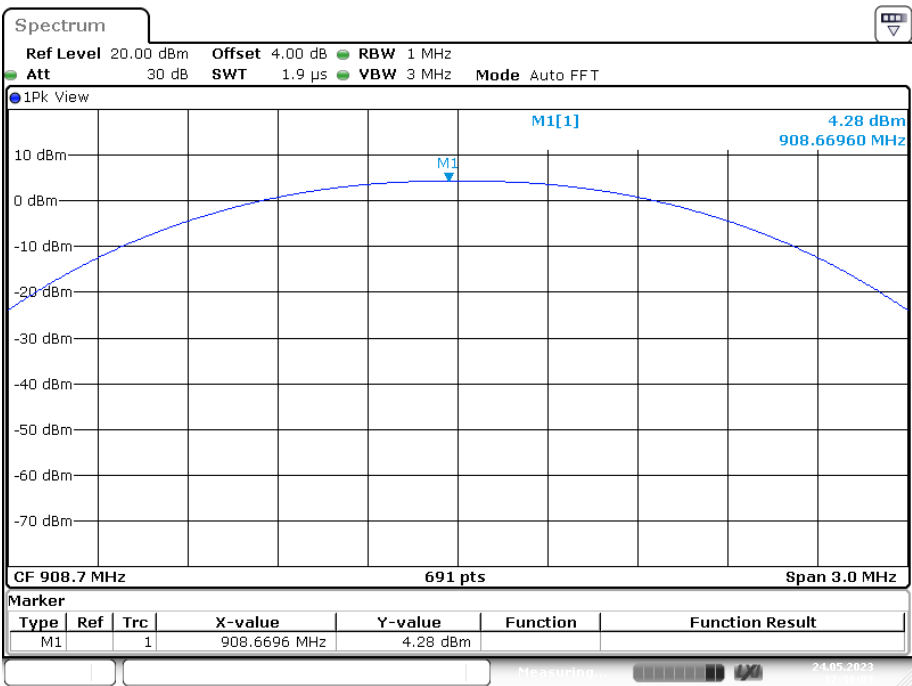
Test Mode	Frequency (MHz)	Maximum Conducted Peak Output Power (dBm)	Limit (dBm)	Verdict
Hybrid System	902.3	4.47	<=30	PASS
	908.7	4.28		PASS
	914.9	4.08		PASS

Low channel



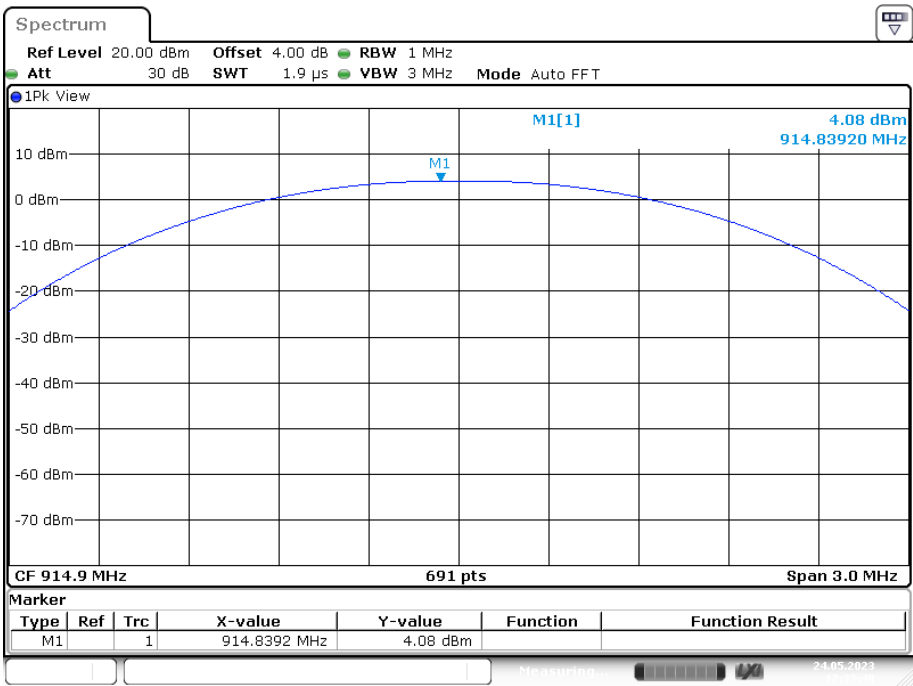
Date: 24.MAY.2023 17:38:16

Middle Channel



Date: 24.MAY.2023 17:36:03

High Channel



Date: 24.MAY.2023 17:33:49

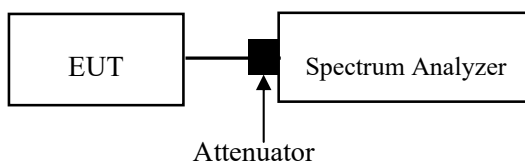
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE**Applicable Standard**

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

Test Method: ANSI C63.10-2013 Clause 7.8.6 & Clause 6.10

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 100 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**

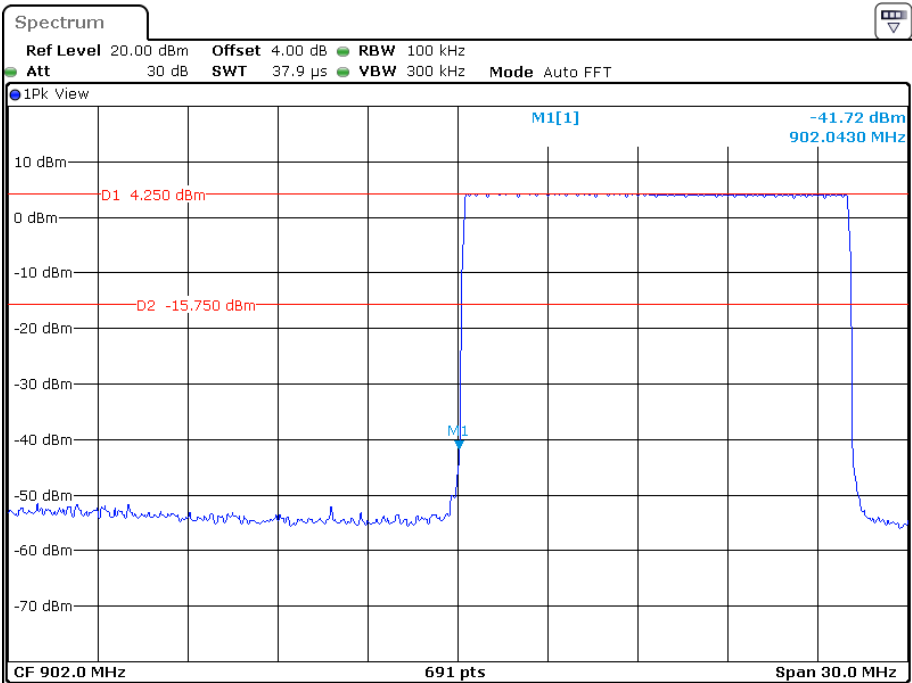
Temperature:	27.8 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang from 2023-05-24 to 2023-06-09.

Test Result: Compliance. Please refer to following plots.

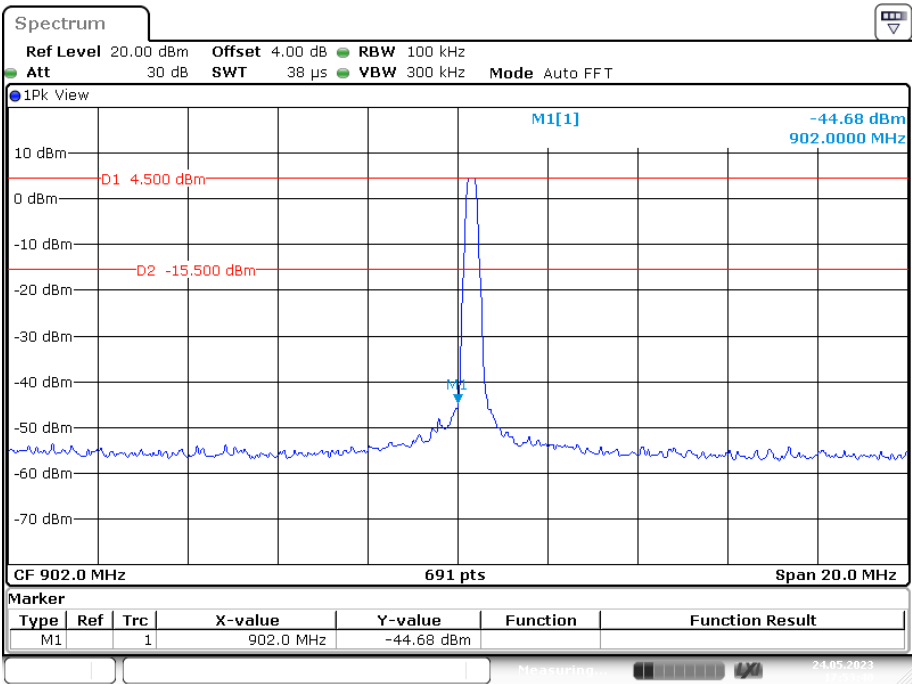
EUT operation mode: Transmitting

Left side
Hopping



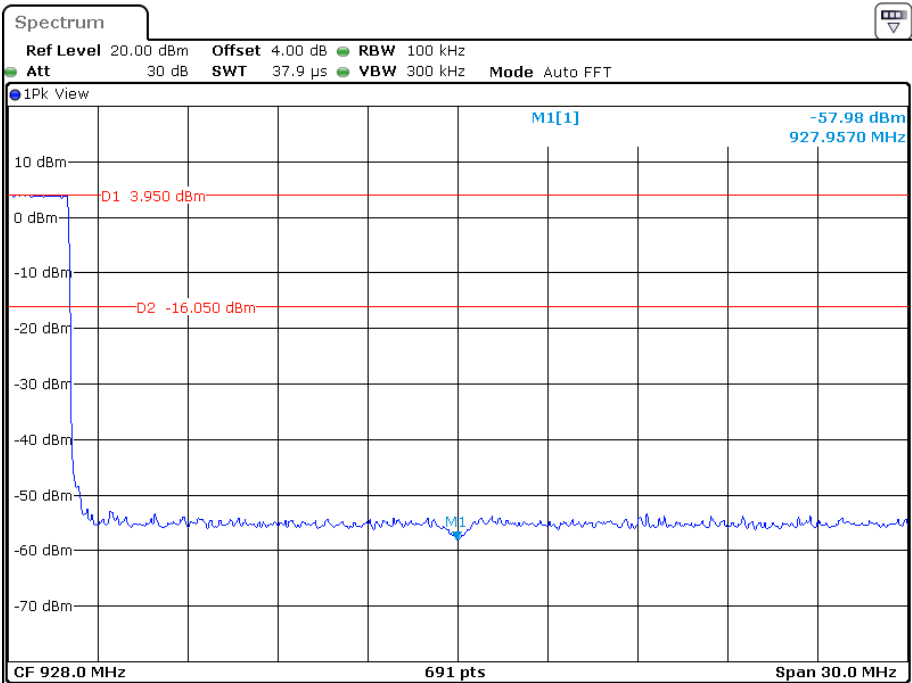
Date: 9.JUN.2023 18:07:59

Single



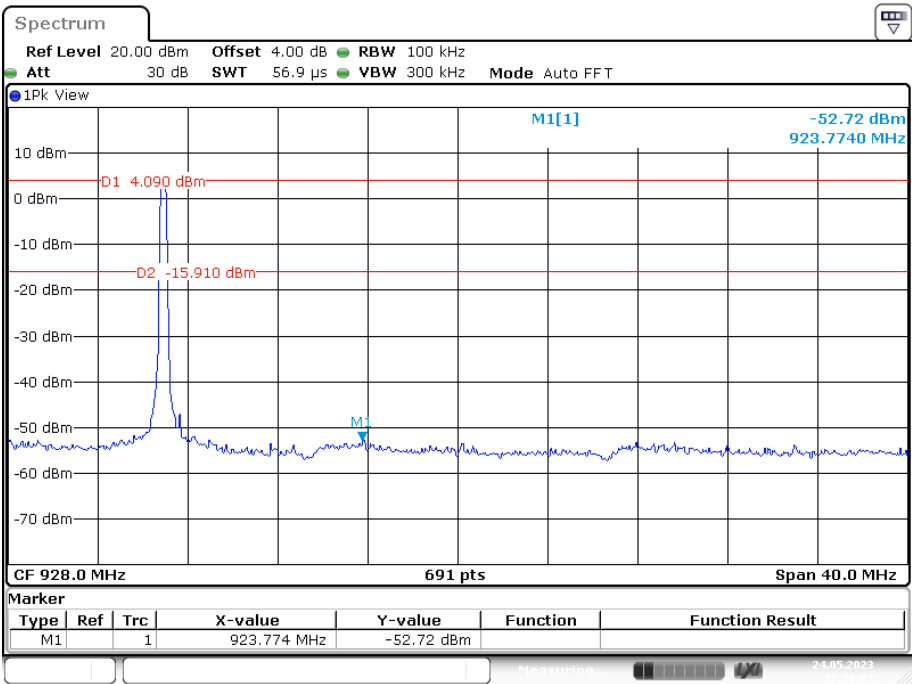
Date: 24.MAY.2023 17:53:41

Right side
Hopping



Date: 9.JUN.2023 18:13:48

Single



Date: 24.MAY.2023 17:50:03

FCC §15.247(f) - POWER SPECTRAL DENSITY

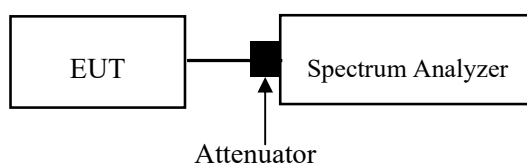
Applicable Standard

(f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.10.2

10. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
11. Set the RBW to: $3\text{kHz} \leq \text{RBW} \leq 100\text{ kHz}$.
12. Set the VBW $\geq 3 \times \text{RBW}$.
13. Set the span to 1.5 times the DTS bandwidth.
14. Detector = peak.
15. Sweep time = auto couple.
16. Trace mode = max hold.
17. Allow trace to fully stabilize.
18. Use the peak marker function to determine the maximum amplitude level within the RBW.
19. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test Data

Environmental Conditions

Temperature:	27.8 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

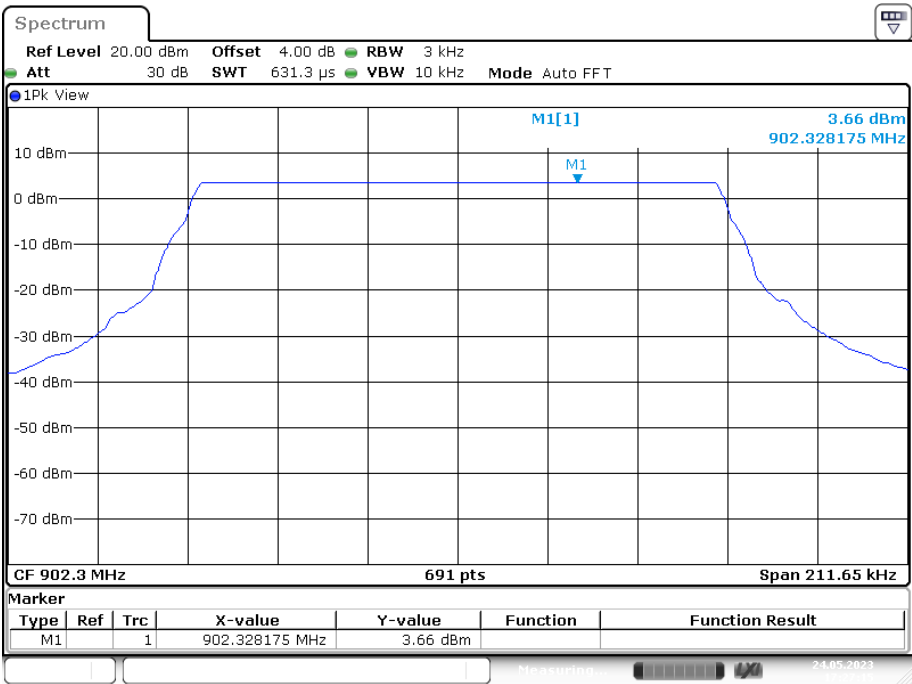
The testing was performed by Jacob Huang on 2023-05-24.

EUT operation mode: Transmitting

Test Result: Pass

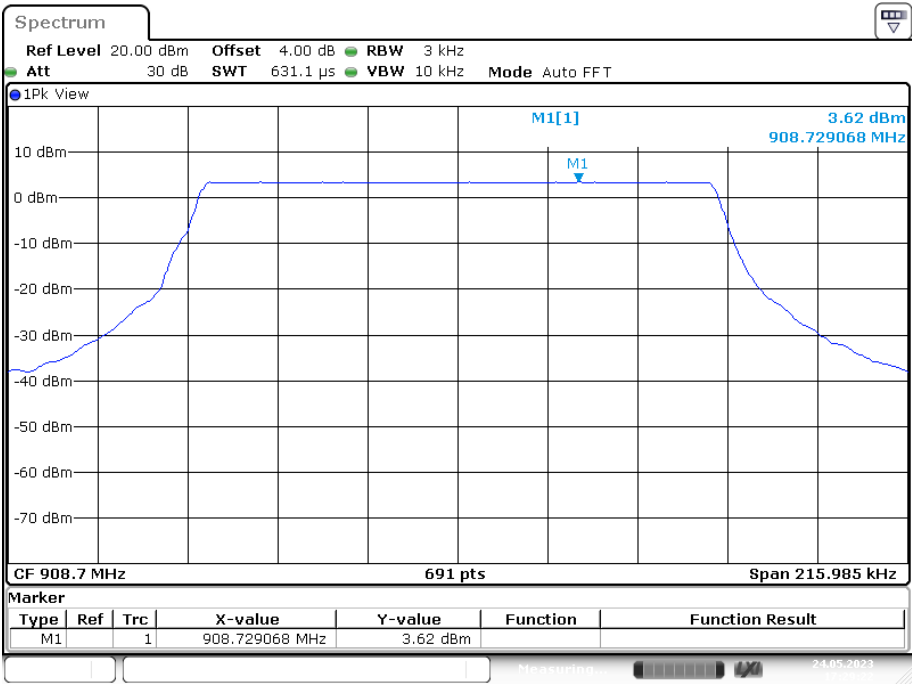
Test Mode	Frequency (MHz)	Result [dBm/3kHz]	Limit [dBm/3kHz]	Verdict
Hybrid System	902.3	3.66	<=8	PASS
	908.7	3.62		PASS
	914.9	3.46		PASS

Power Spectral Density, Low Channel



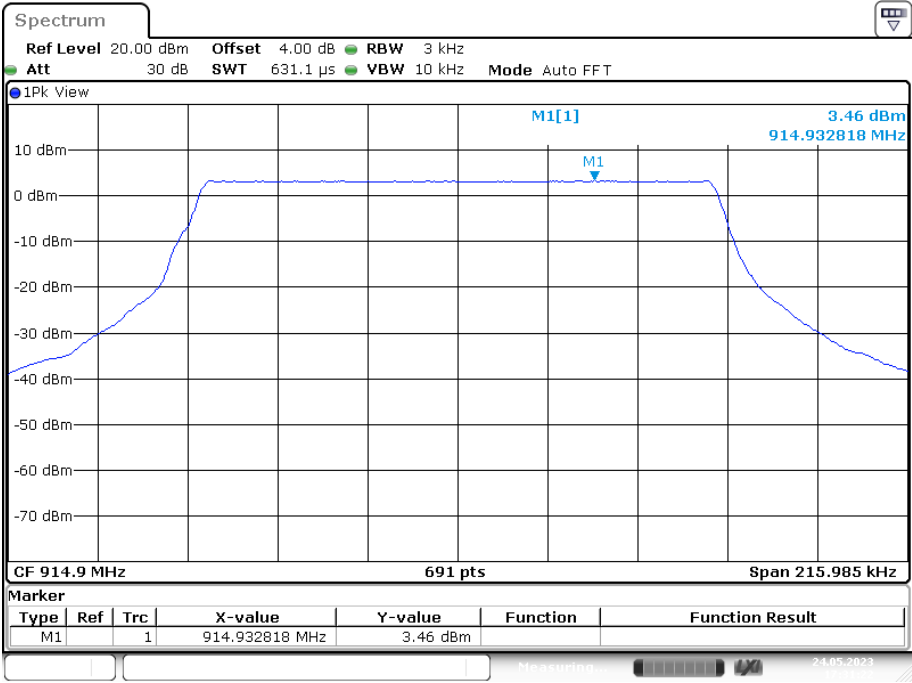
Date: 24.MAY.2023 17:27:16

Power Spectral Density, Middle Channel



Date: 24.MAY.2023 17:29:23

Power Spectral Density, High Channel



Date: 24.MAY.2023 17:31:22

***** END OF REPORT ***