



# TEST REPORT

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Bao'an District, Shenzhen, Guangdong, China  
Report Number : SZNS1220207-04026E-RF  
FCC ID: 2A4BH-SW8021

**Test Standard (s)**  
FCC PART 15.247

## Sample Description

Product Type: LoRa Concentrator Module  
Model No.: SW8021-U  
Trade Mark: SEENER  
Date Received: 2022-02-07  
Date of Test: 2022-02-08 to 2022-02-11  
Report Date: 2022-02-11

Test Result:	Pass*
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\* In the configuration tested, the EUT complied with the standards above.

## Prepared and Checked By:

Fan Yang  
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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**GENERAL INFORMATION**

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**Product Description for Equipment under Test (EUT)**

Product	LoRa Concentrator Module
Tested Model	SW8021-U
Frequency Range	923.3-927.5 MHz
Maximum Conducted Peak Output Power	15.90dBm
Modulation Technique	LoRa: Chirp Spread Spectrum
Voltage Range	DC 3.3V from test fixture
Antenna Specification*	Dipole Antenna: 1dBi(provided by the applicant)
Sample serial number	SZNS1220207-04026E-RF-S1 (Assigned by ATC)
Sample/EUT Status	Good condition

**Objective**

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

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

**Test Methodology**

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

And KDB 558074 D01 15.247 Meas Guidance v05r02.

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

**Measurement Uncertainty**

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
Emissions, Radiated	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
Temperature		1°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 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.

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

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

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The system was configured for testing in engineering mode.

#### Channel List

Channel	Freq. (MHz)	Channel	Freq. (MHz)
1	923.3	5	925.7
2	923.9	6	926.3
3	924.5	7	926.9
4	925.1	8	927.5

Channel 1, 4 and 8 were tested.

### Equipment Modifications

No modification was made to the EUT tested.

### EUT Exercise Software

Software “MobaXterm” was used to test and the power level is -pa 1, -pwid 3.

### Duty cycle

Test Result: Compliant. Please refer to the Appendix.

### Support Equipment List and Details

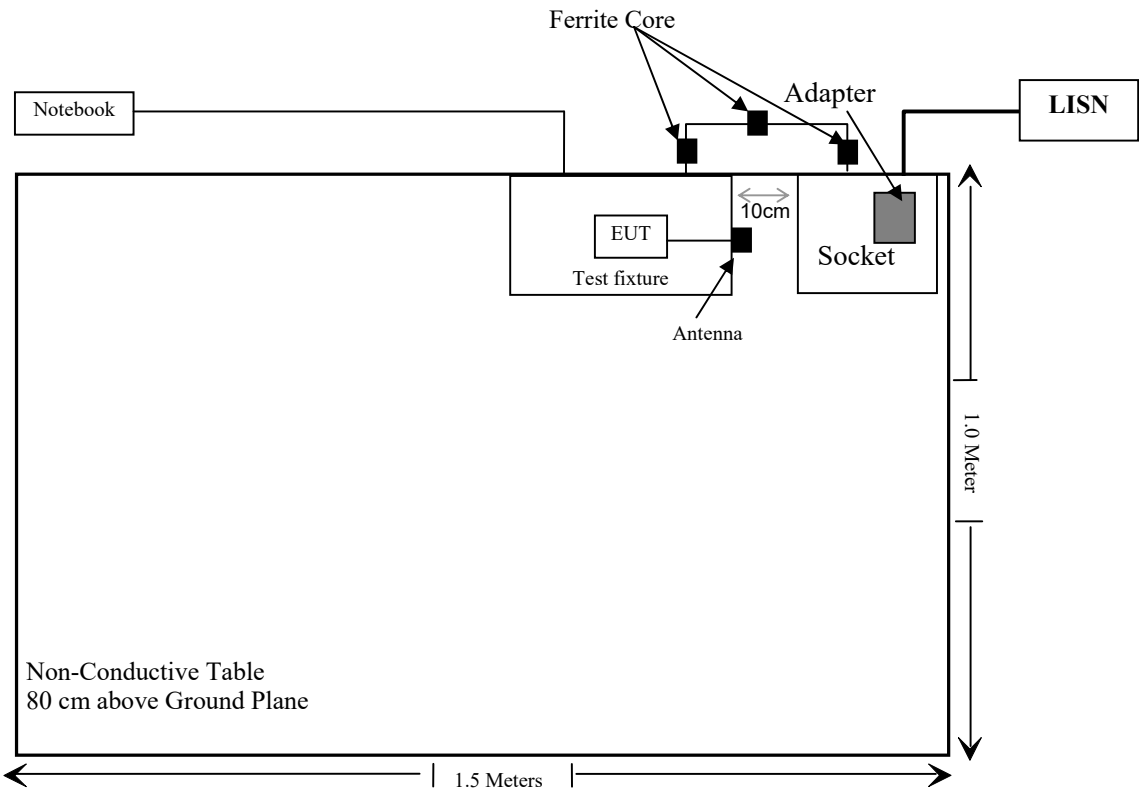
Manufacturer	Description	Model	Serial Number
Unknown	Test Fixture	GL5211-U (SPI)	Unknown
Unknown	Antenna (Used for EUT)	Unknown	Unknown
LENOVO	Notebook	4290-RT8	R9-FW93G 11/08
SCI	Ferrite Core*3	SCUF-70B	Unknown
HUAWEI	Adapter	HW-100400C03	YH59YSM6S01991

### External I/O Cable

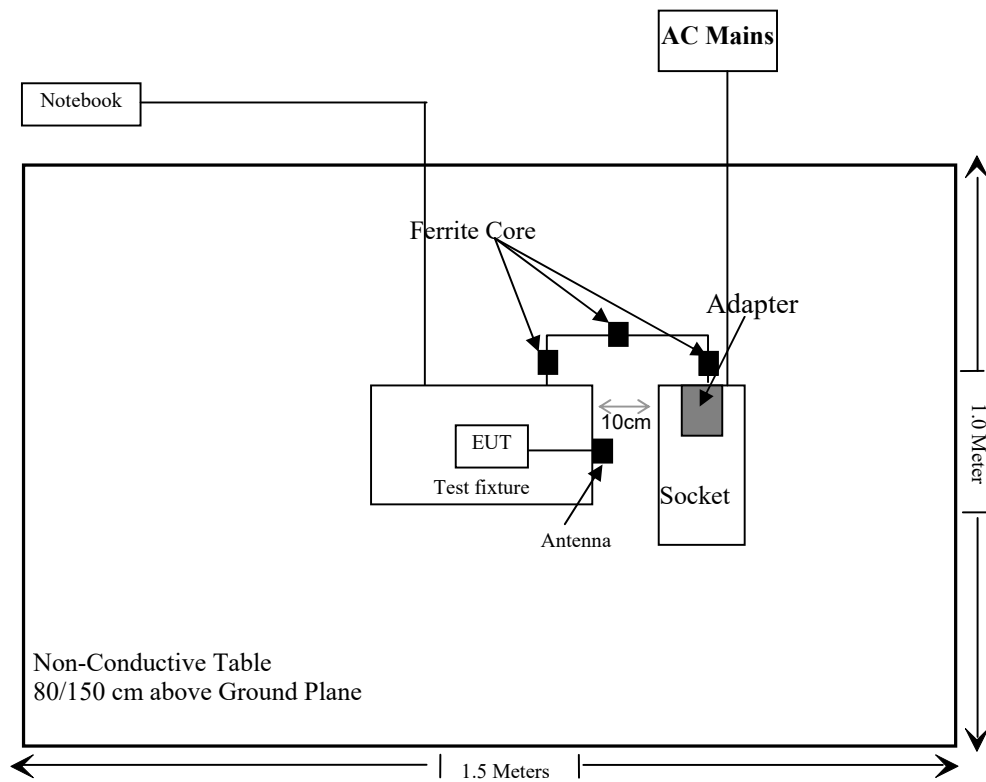
Cable Description	Length (m)	From Port	To
Unshielded un-detachable DC Output Cable With Ferrite Core	0.6	Adapter	Test Fixture
Unshielded detachable RJ45 Cable	10.0	Test Fixture	Notebook

Block Diagram of Test Setup

For conducted emission:



For radiated emission:





**SUMMARY OF TEST RESULTS**

FCC Rules	Description of Test	Result
FCC §15.247 (i) & §2.1091	MAXIMUM PERMISSIBLE EXPOSURE (MPE)	Compliant
FCC §15.203	Antenna Requirement	Compliant
FCC §15.207(a)	AC Line Conducted Emissions	Compliant
FCC §15.205, §15.209, §15.247(d)	Spurious Emissions	Compliant
FCC §15.247 (a)(2)	6 dB Emission Bandwidth & Occupied Bandwidth	Compliant
FCC §15.247(b)(3)	Maximum Conducted Output Power	Compliant
FCC §15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §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					
Rohde & Schwarz	Test Receiver	ESR	102725	2021/12/13	2022/12/12
Rohde & Schwarz	Spectrum Analyzer	FSV40	101949	2021/12/13	2022/12/12
SONOMA INSTRUMENT	Amplifier	310 N	186131	2021/11/09	2022/11/08
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2021/11/09	2022/11/08
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	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.12	N040	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.13	N300	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.14	N800	2021/12/14	2022/12/13
Radiated Emission Test Software: e3 19821b (V9)					
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2021/12/13	2022/12/12
WEINSCHL	10dB Attenuator	5324	AU 3842	2021/12/14	2022/12/13

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

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

### Applicable Standard

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

#### Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (Minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	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<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Frequency (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
	(dBi)	(numeric)	(dBm)	(mW)			
923.3-927.5	1.0	1.26	16	39.81	20	0.01	0.61

Note: 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 unique antenna port arrangement for LoRa, which was employed the dipole antenna with maximum gain is 1dBi, fulfill the requirement of this section. Please refer to the EUT photos. If used different type or higher than 1dBi of antenna, that requires the submission of a Class II permissive change or new application.

Type	Antenna Gain	Impedance
Dipole	1dBi	50 $\Omega$

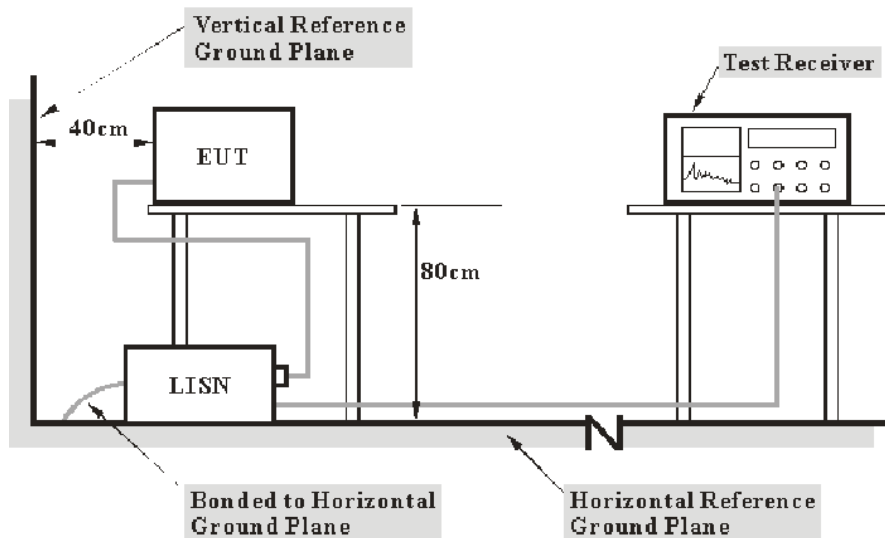
**Result:** Compliant.

## FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

### Applicable Standard

FCC§15.207

### EUT Setup



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

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

The spacing between the peripherals was 10 cm.

### EMI Test Receiver Setup

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

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

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

### Test Procedure

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.

## Transd Factor & Margin Calculation

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

$$\text{Transd Factor} = \text{LISN VDF} + \text{Cable Loss}$$

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

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

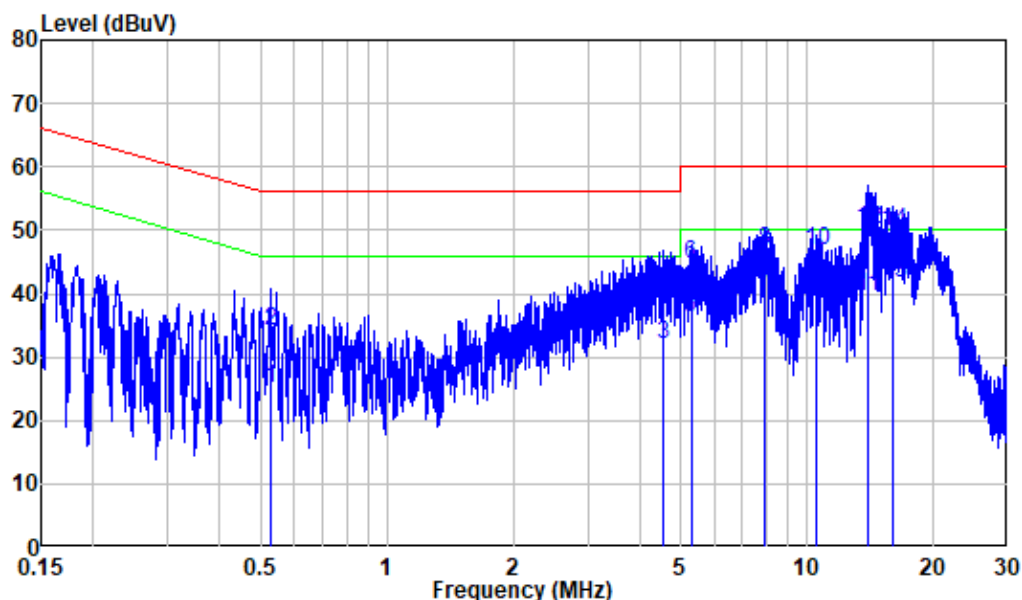
## Test Data

### Environmental Conditions

Temperature:	23 °C
Relative Humidity:	53%
ATM Pressure:	102.0 kPa

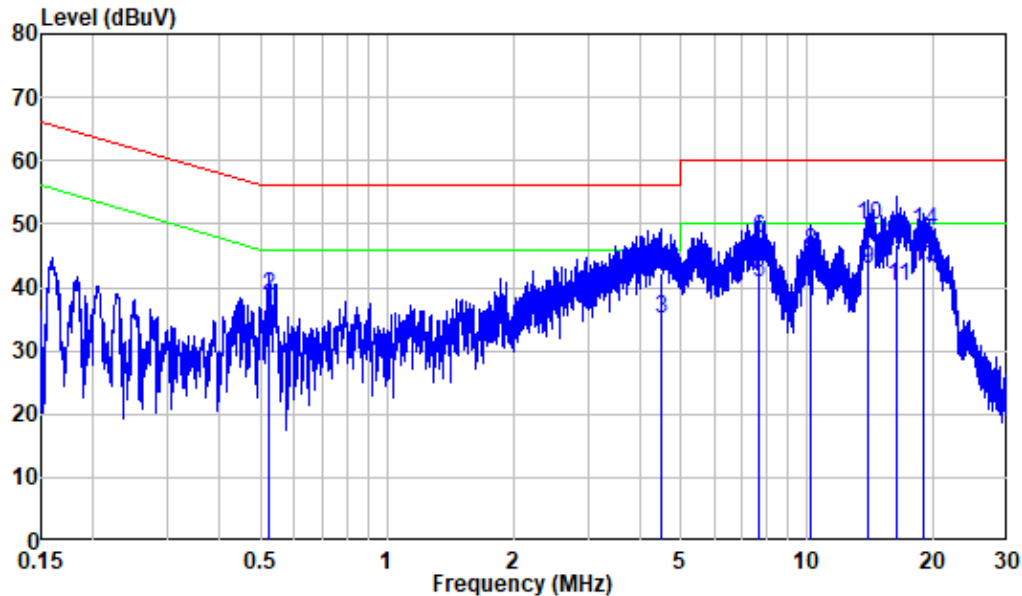
*The testing was performed by Bin Duan on 2022-02-11.*

*EUT operation mode: Transmitting (Worst case was low channel)*

**AC 120V/60 Hz, Line**

Site : Shielding Room  
 Condition: Line  
 Mode : Transmission  
 Model : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.527	9.81	15.11	24.92	46.00	-21.08	Average
2	0.527	9.81	24.43	34.24	56.00	-21.76	QP
3	4.534	9.97	22.16	32.13	46.00	-13.87	Average
4	4.534	9.97	30.14	40.11	56.00	-15.89	QP
5	5.287	10.00	26.27	36.27	50.00	-13.73	Average
6	5.287	10.00	34.77	44.77	60.00	-15.23	QP
7	7.946	10.08	30.34	40.42	50.00	-9.58	Average
8	7.946	10.08	36.64	46.72	60.00	-13.28	QP
9	10.466	10.09	30.80	40.89	50.00	-9.11	Average
10	10.466	10.09	36.60	46.69	60.00	-13.31	QP
11	13.933	10.06	29.43	39.49	50.00	-10.51	Average
12	13.933	10.06	40.11	50.17	60.00	-9.83	QP
13	16.044	10.08	31.43	41.51	50.00	-8.49	Average
14	16.044	10.08	39.83	49.91	60.00	-10.09	QP

**AC 120V/60 Hz, Neutral**

Site : Shielding Room  
 Condition: Neutral  
 Mode : Transmission  
 Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.523	9.91	26.96	36.87	46.00	-9.13	Average
2	0.523	9.91	28.66	38.57	56.00	-17.43	QP
3	4.490	10.04	24.97	35.01	46.00	-10.99	Average
4	4.490	10.04	32.13	42.17	56.00	-13.83	QP
5	7.692	10.08	30.70	40.78	50.00	-9.22	Average
6	7.692	10.08	37.50	47.58	60.00	-12.42	QP
7	10.179	10.10	32.88	42.98	50.00	-7.02	Average
8	10.179	10.10	35.58	45.68	60.00	-14.32	QP
9	14.007	10.06	32.77	42.83	50.00	-7.17	Average
10	14.007	10.06	39.87	49.93	60.00	-10.07	QP
11	16.398	10.09	30.08	40.17	50.00	-9.83	Average
12	16.398	10.09	36.80	46.89	60.00	-13.11	QP
13	18.971	10.17	32.92	43.09	50.00	-6.91	Average
14	18.971	10.17	38.72	48.89	60.00	-11.11	QP

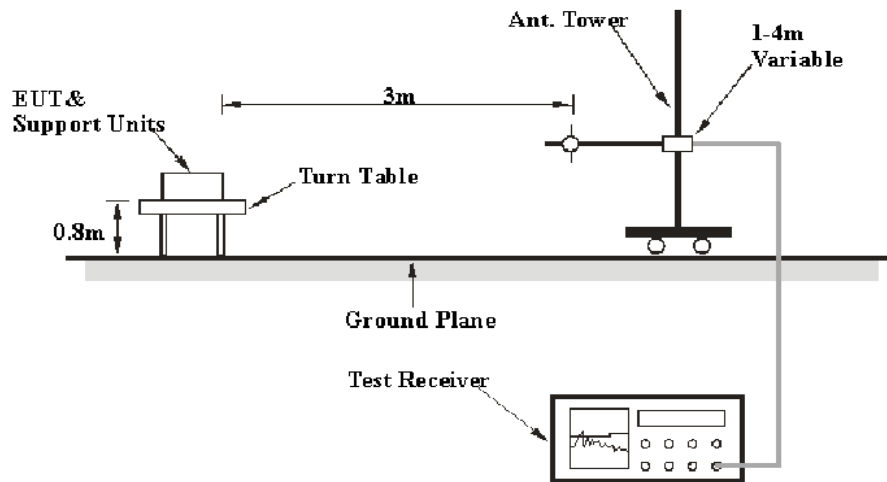


**FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS****Applicable Standard**

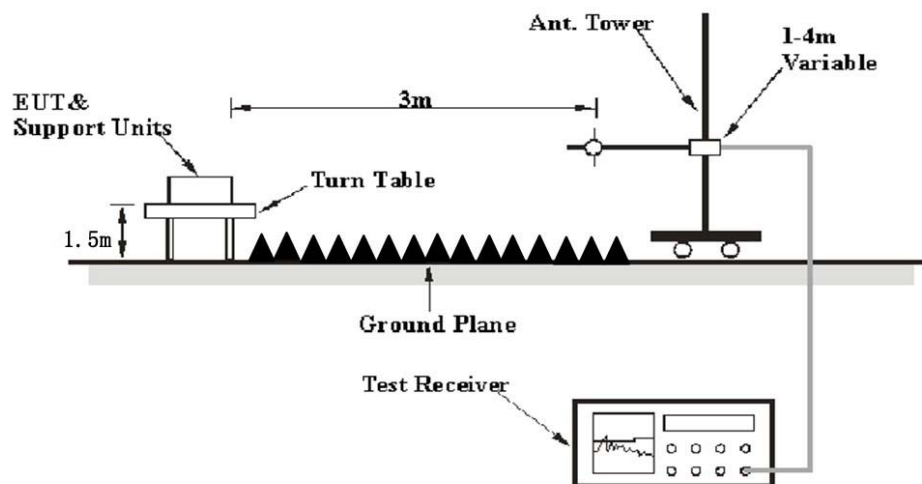
FCC §15.247 (d); §15.209; §15.205;

**EUT Setup**

**Below 1 GHz:**



**Above 1GHz:**



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

## EMI Test Receiver & Spectrum Analyzer Setup

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

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz <sup>Note 1</sup>	/	Average
	1MHz	> 1/T <sup>Note 2</sup>	/	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 Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain. The basic equation is as follows:

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

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

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

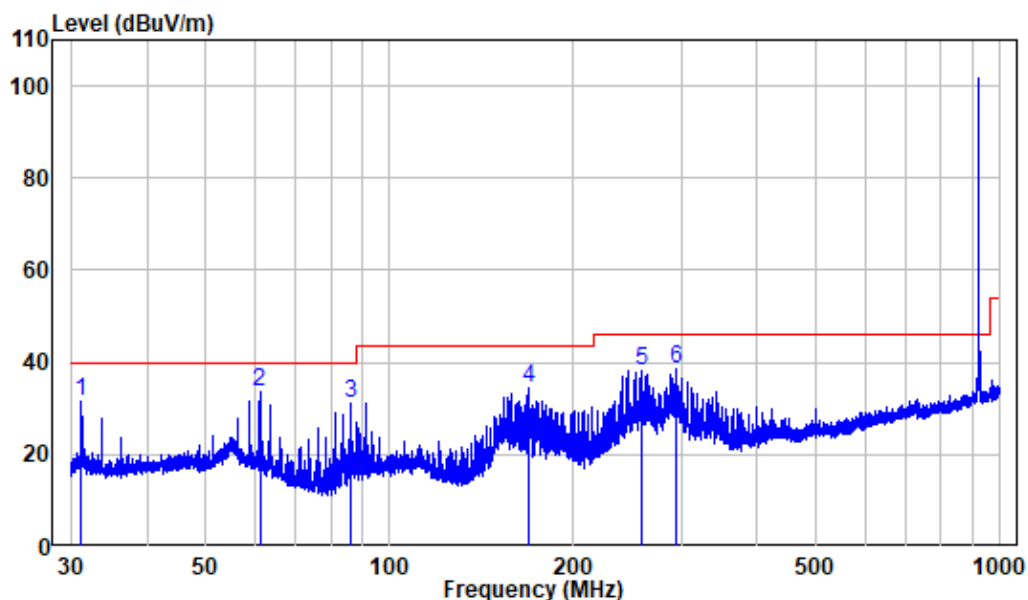
## Test Data

### Environmental Conditions

Temperature:	19-23 °C
Relative Humidity:	55-59 %
ATM Pressure:	102.0 kPa

The testing was performed by Chao Mo on 2022-02-10 for radiated emission, and by Key Pei on 2022-02-08 for conducted emission.

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

**Radiated spurious emissions:****Low Channel****30MHz-1GHz:****Horizontal**

Site : chamber

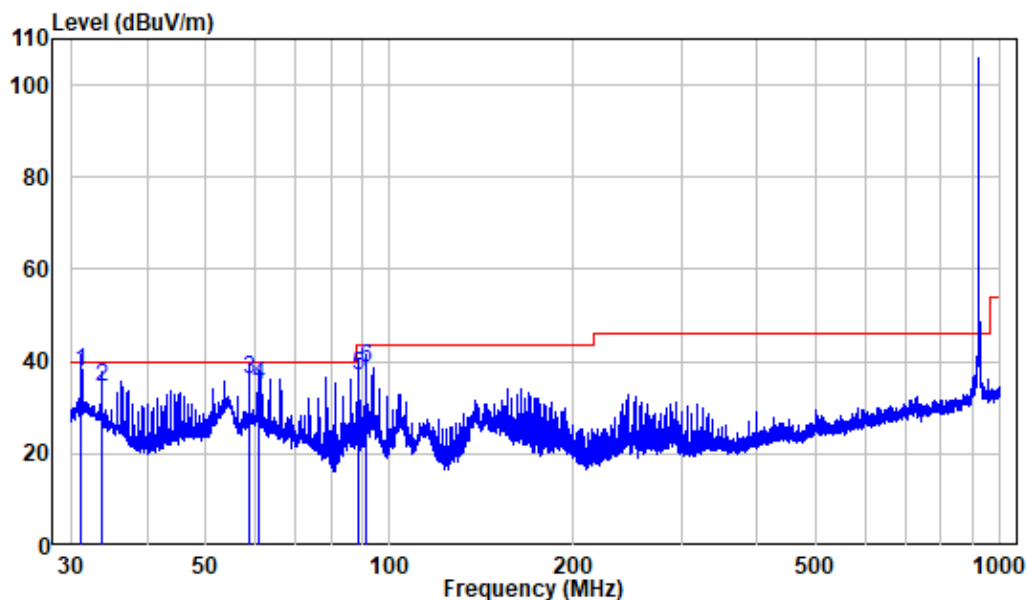
Condition: 3m HORIZONTAL

Job No. : SZNS1220207-04026E-RF

Test Mode: 923.3MHz TX

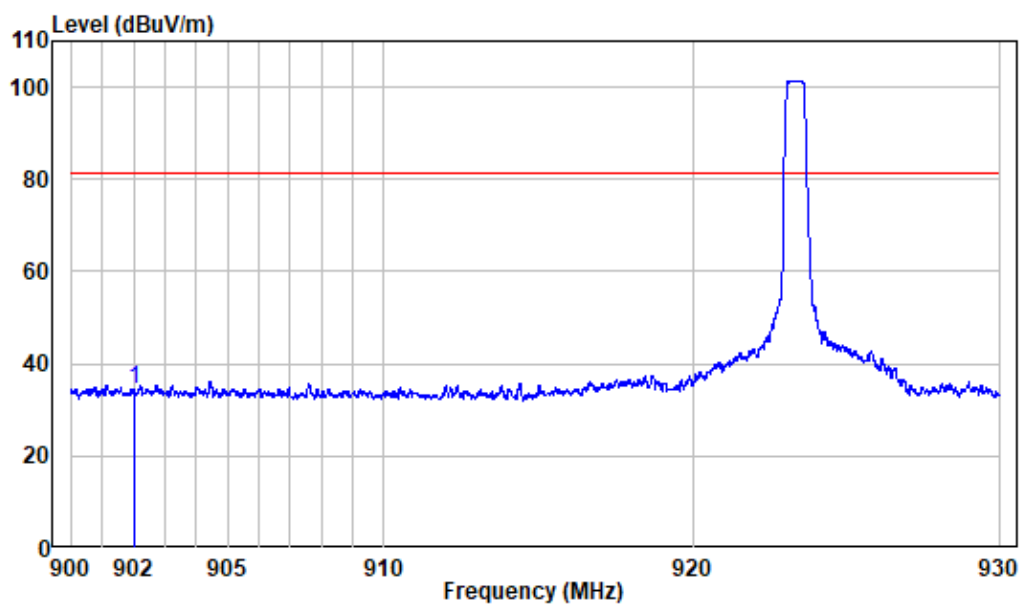
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	31.248	-12.27	43.80	31.53	40.00	-8.47	Peak
2	61.239	-11.13	44.86	33.73	40.00	-6.27	Peak
3	86.238	-15.13	46.37	31.24	40.00	-8.76	Peak
4	169.228	-13.66	48.06	34.40	43.50	-9.10	Peak
5	258.440	-10.59	48.90	38.31	46.00	-7.69	Peak
6	294.759	-9.27	47.85	38.58	46.00	-7.42	Peak

## Vertical



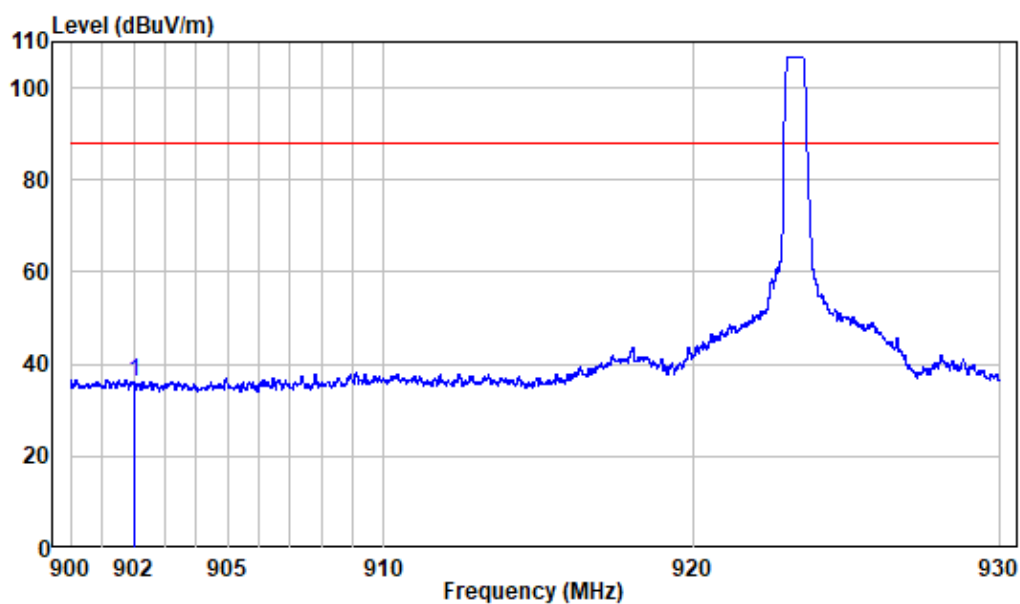
Site : chamber  
 Condition: 3m VERTICAL  
 Job No. : SZNS1220207-04026E-RF  
 Test Mode: 923.3MHz TX

	Freq	Factor	Read Level	Level	Limit	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	31.207	-12.27	50.11	37.84	40.00	-2.16	QP
2	33.769	-11.88	46.19	34.31	40.00	-5.69	QP
3	58.767	-10.18	46.30	36.12	40.00	-3.88	QP
4	61.158	-11.09	46.00	34.91	40.00	-5.09	QP
5	88.769	-14.36	51.31	36.95	43.50	-6.55	QP
6	91.255	-13.57	52.10	38.53	43.50	-4.97	QP

**Horizontal (20dB Down)**

Site : chamber  
Condition: 3m HORIZONTAL  
Job No. : SZNS1220207-04026E-RF  
Test Mode: 923.3MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	902.000	1.49	32.83	34.32	81.43	-47.11	Peak

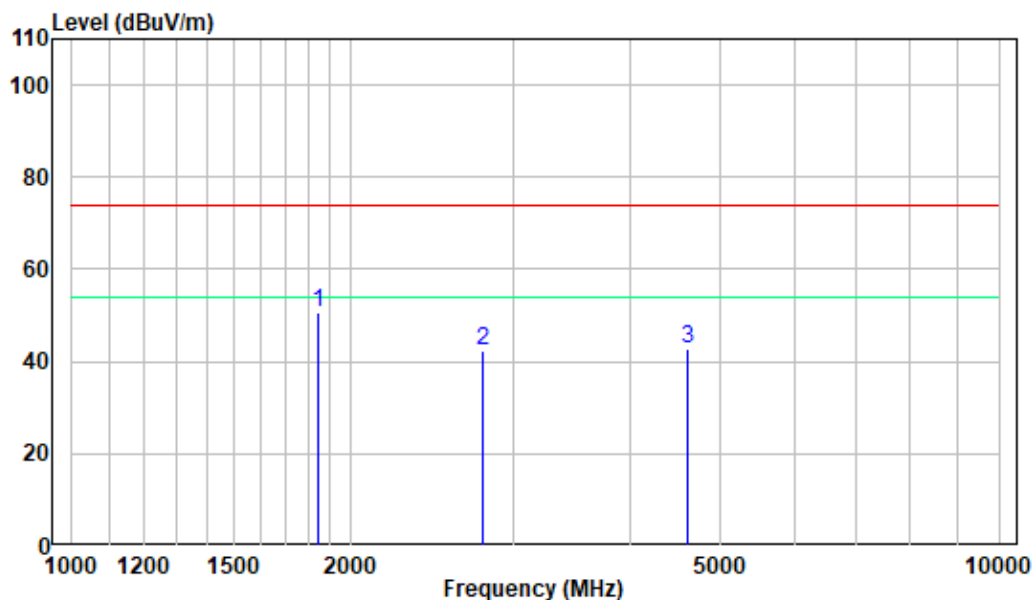
**Vertical (20dB Down)**

Site : chamber  
Condition: 3m VERTICAL  
Job No. : SZNS1220207-04026E-RF  
Test Mode: 923.3MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	902.000	1.49	34.62	36.11	88.12	-52.01	Peak

1-10GHz:

Horizontal



Site : chamber

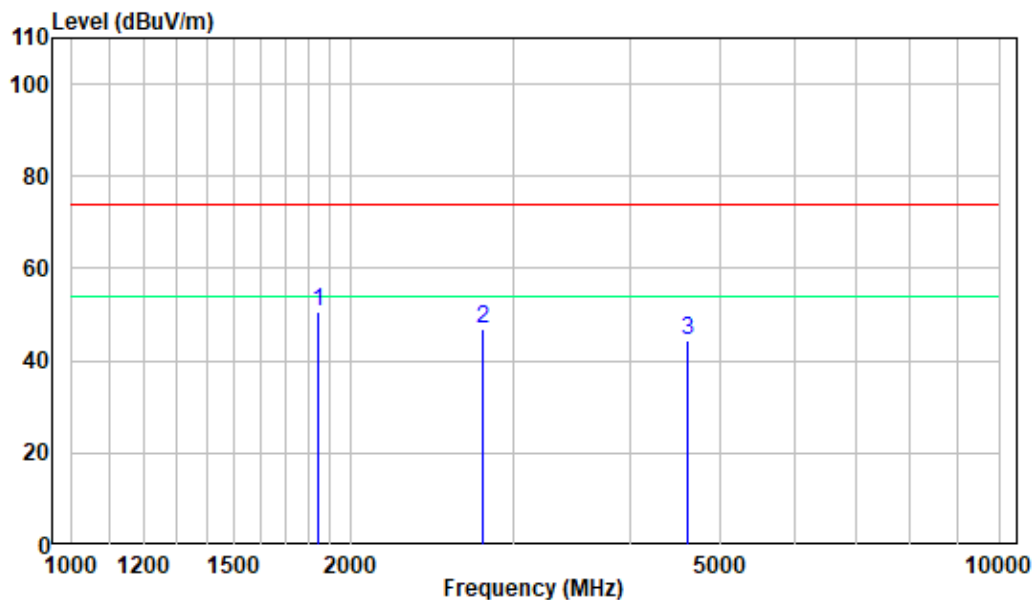
Condition: 3m HORIZONTAL

Job No. : SZNS1220207-04026E-RF

Test Mode: 923.3MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1846.609	-8.39	59.11	50.72	74.00	-23.28	Peak
2	2769.927	-6.47	48.79	42.32	74.00	-31.68	Peak
3	4616.490	-4.28	47.20	42.92	74.00	-31.08	Peak

## Vertical



Site : chamber

Condition: 3m VERTICAL

Job No. : SZNS1220207-04026E-RF

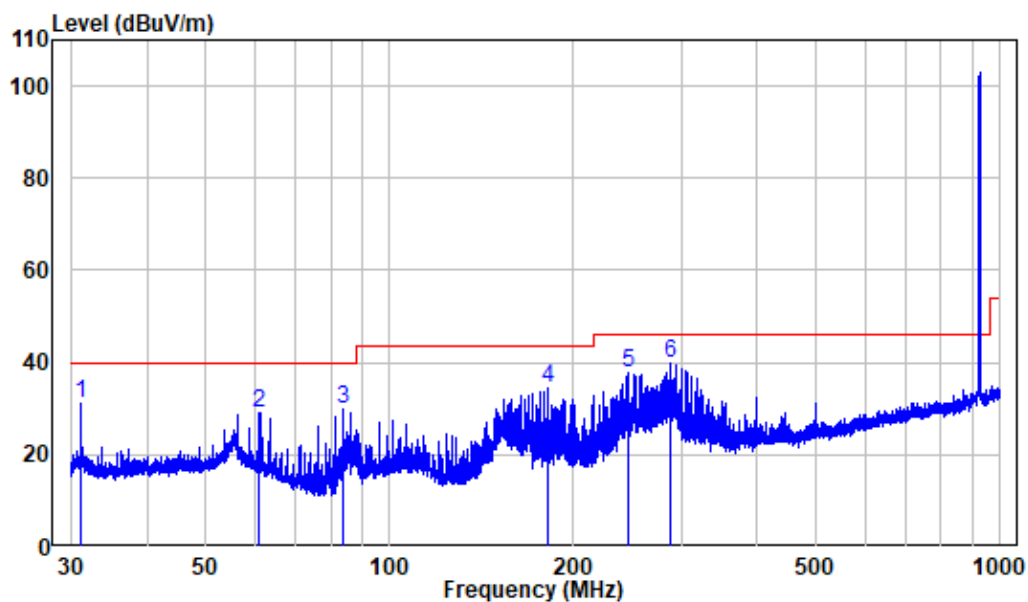
Test Mode: 923.3MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1846.609	-8.39	59.20	50.81	74.00	-23.19	Peak
2	2769.927	-6.47	53.22	46.75	74.00	-27.25	Peak
3	4616.490	-4.28	48.74	44.46	74.00	-29.54	Peak



**Middle Channel**  
**30MHz-1GHz:**

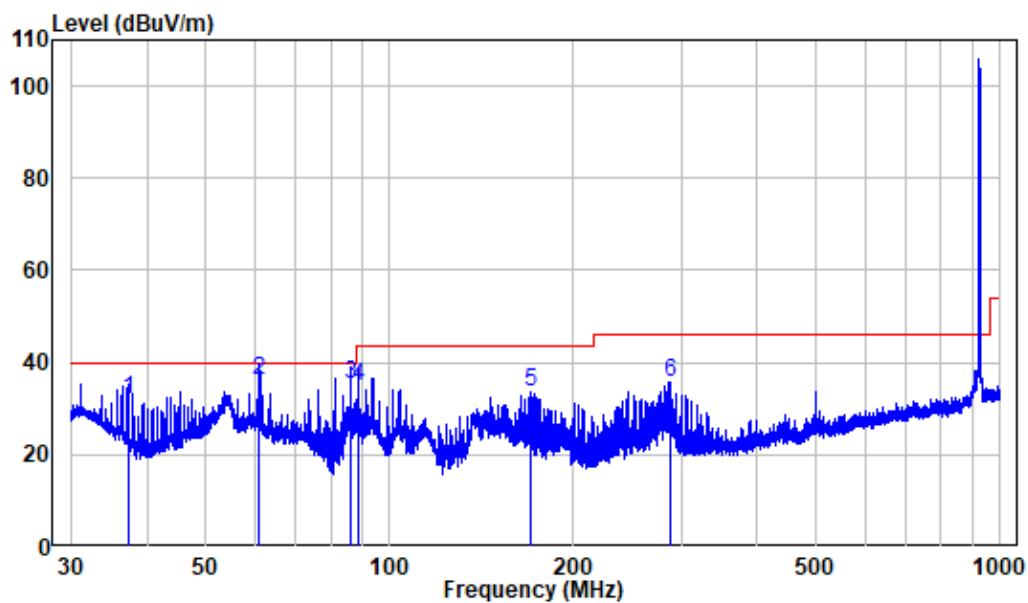
**Horizontal**



Site : chamber  
 Condition: 3m HORIZONTAL  
 Job No. : SZNS1220207-04026E-RF  
 Test Mode: 925.1MHz TX

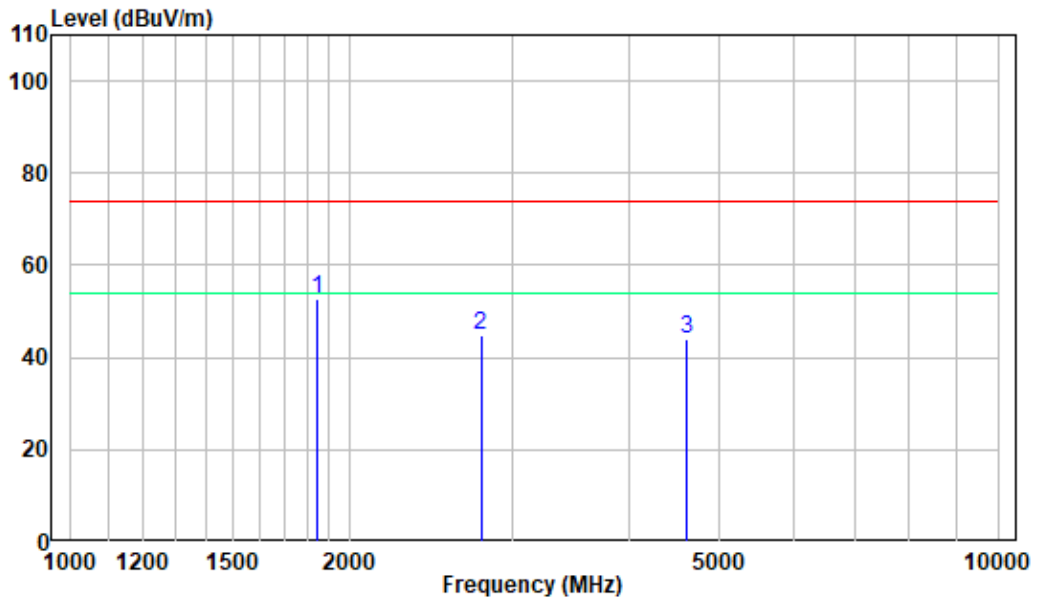
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	31.234	-12.27	43.52	31.25	40.00	-8.75	Peak
2	61.212	-11.11	40.05	28.94	40.00	-11.06	Peak
3	83.742	-16.13	45.98	29.85	40.00	-10.15	Peak
4	181.283	-12.62	46.89	34.27	43.50	-9.23	Peak
5	246.059	-10.62	48.27	37.65	46.00	-8.35	Peak
6	288.369	-9.35	49.30	39.95	46.00	-6.05	Peak

## Vertical



Site : chamber  
 Condition: 3m VERTICAL  
 Job No. : SZNS1220207-04026E-RF  
 Test Mode: 925.1MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	37.220	-10.97	42.90	31.93	40.00	-8.07	QP
2	61.212	-11.11	47.30	36.19	40.00	-3.81	QP
3	86.238	-15.13	50.40	35.27	40.00	-4.73	QP
4	88.769	-14.36	49.31	34.95	43.50	-8.55	QP
5	170.419	-13.54	47.35	33.81	43.50	-9.69	Peak
6	288.243	-9.36	45.14	35.78	46.00	-10.22	Peak

**1-10GHz:****Horizontal**

Site : chamber

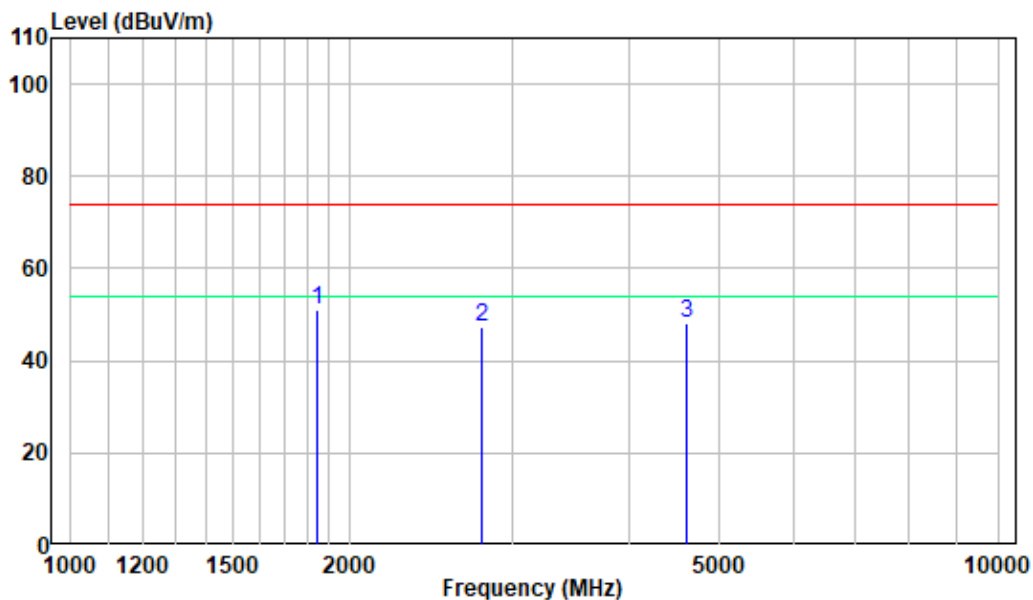
Condition: 3m HORIZONTAL

Job No. : SZNS1220207-04026E-RF

Test Mode: 925.1MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1847.141	-8.39	61.01	52.62	74.00	-21.38	Peak
2	2769.332	-6.47	51.36	44.89	74.00	-29.11	Peak
3	4617.161	-4.28	48.33	44.05	74.00	-29.95	Peak

## Vertical

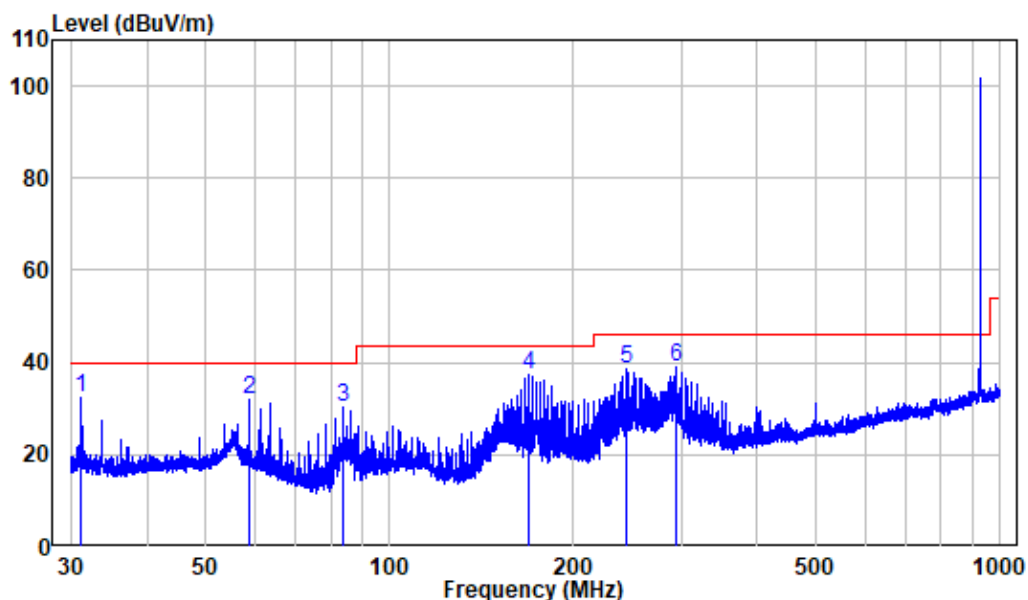


Site : chamber  
Condition: 3m VERTICAL  
Job No. : SZNS1220207-04026E-RF  
Test Mode: 925.1MHz TX

Freq Factor		Read Level	Level	Limit Line	Over Limit	Remark
MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1846.609	-8.39	59.32	50.93	74.00	-23.07 Peak
2	2770.129	-6.47	53.85	47.38	74.00	-26.62 Peak
3	4615.832	-4.29	52.36	48.07	74.00	-25.93 Peak

# High Channel 30MHz-1GHz:

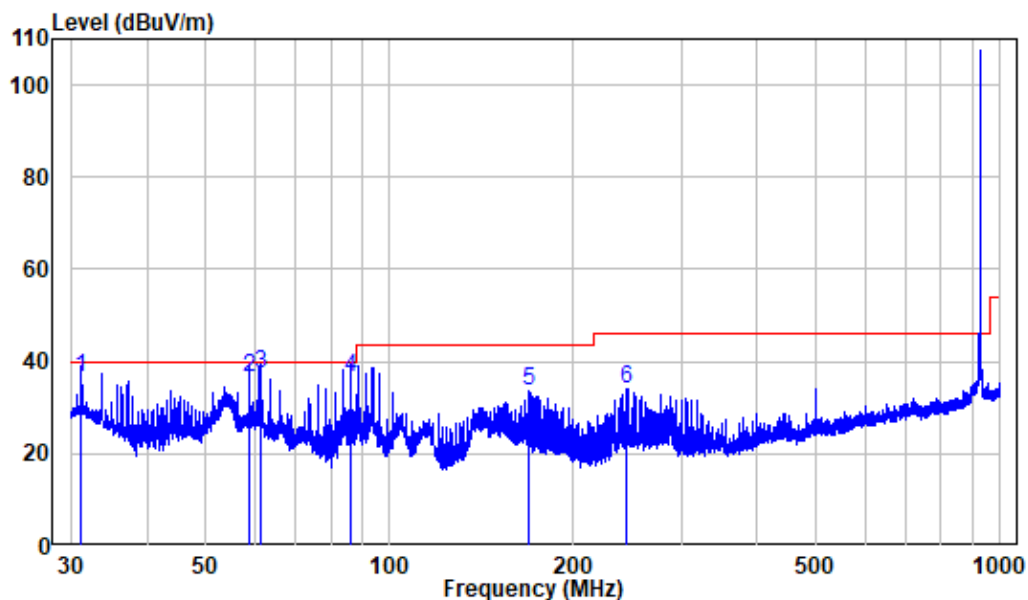
## Horizontal



Site : chamber  
Condition: 3m HORIZONTAL  
Job No. : SZNS1220207-04026E-RF  
Test Mode: 927.5MHz TX

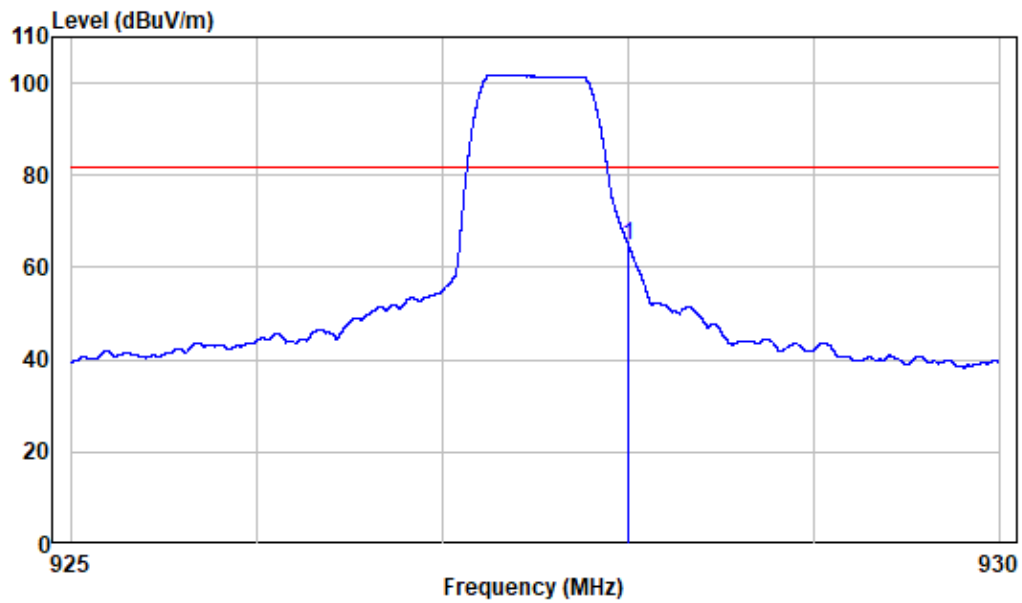
	Freq Factor		Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	31.234	-12.27	44.75	32.48	40.00	-7.52	Peak
2	58.741	-10.18	42.18	32.00	40.00	-8.00	Peak
3	83.742	-16.13	46.32	30.19	40.00	-9.81	Peak
4	168.783	-13.70	51.19	37.49	43.50	-6.01	Peak
5	244.446	-10.61	49.03	38.42	46.00	-7.58	Peak
6	294.243	-9.27	48.21	38.94	46.00	-7.06	Peak

## Vertical



Site : chamber  
 Condition: 3m VERTICAL  
 Job No. : SZNS1220207-04026E-RF  
 Test Mode: 927.5MHz TX

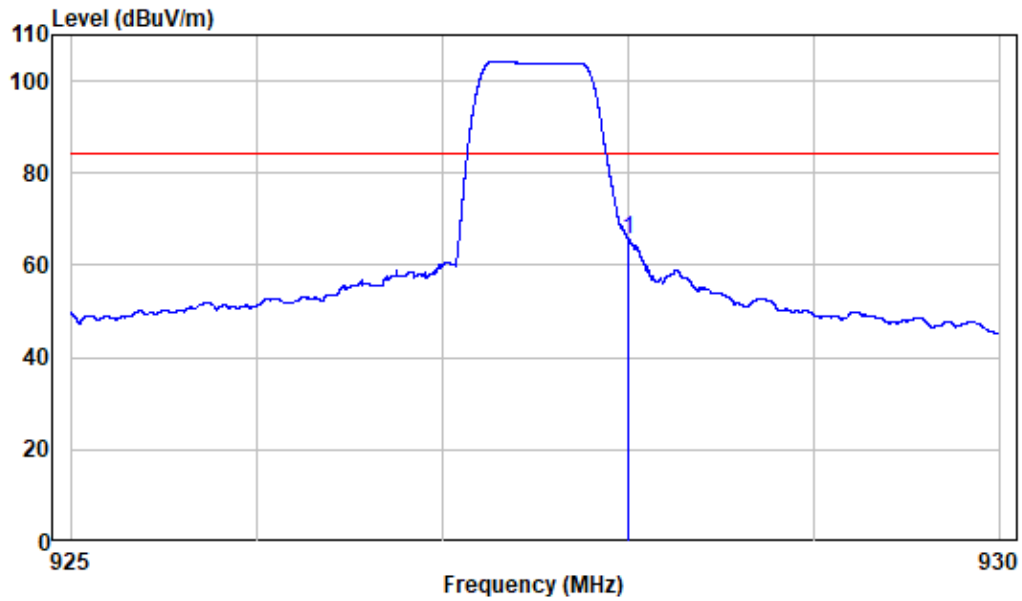
	Freq	Factor	Read Level	Level	Limit	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	31.221	-12.27	48.71	36.44	40.00	-3.56	QP
2	58.767	-10.18	46.70	36.52	40.00	-3.48	QP
3	61.266	-11.14	48.30	37.16	40.00	-2.84	QP
4	86.238	-15.13	51.80	36.67	40.00	-3.33	QP
5	168.783	-13.70	47.30	33.60	43.50	-9.90	Peak
6	244.446	-10.61	44.55	33.94	46.00	-12.06	Peak

**Horizontal (20dB Down)**

Site : chamber  
Condition: 3m HORIZONTAL  
Job No. : SZNS1220207-04026E-RF  
Test Mode: 927.5MHz TX

Freq Factor		Read Level	Level	Limit Line	Over Limit	Remark
MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	928.000	1.77	62.82	64.59	81.81	-17.22 Peak

## Vertical (20dB Down)



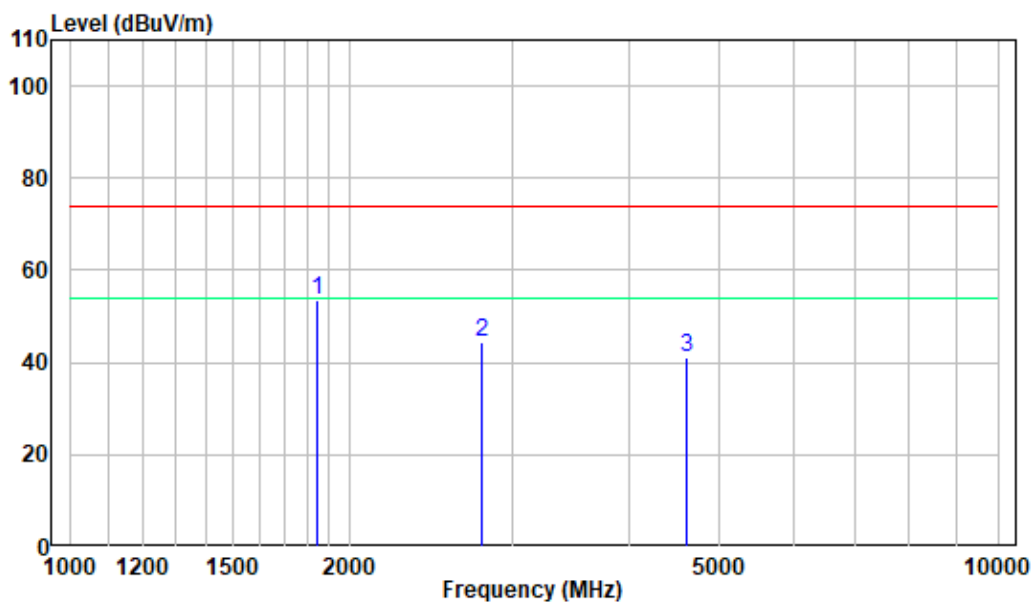
Site : chamber  
Condition: 3m VERTICAL  
Job No. : SZNS1220207-04026E-RF  
Test Mode: 927.5MHz TX

		Read		Limit	Over	Remark
Freq	Factor	Level	Level	Line	Limit	
MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1 928.000	1.77	63.83	65.60	84.19	-18.59	Peak



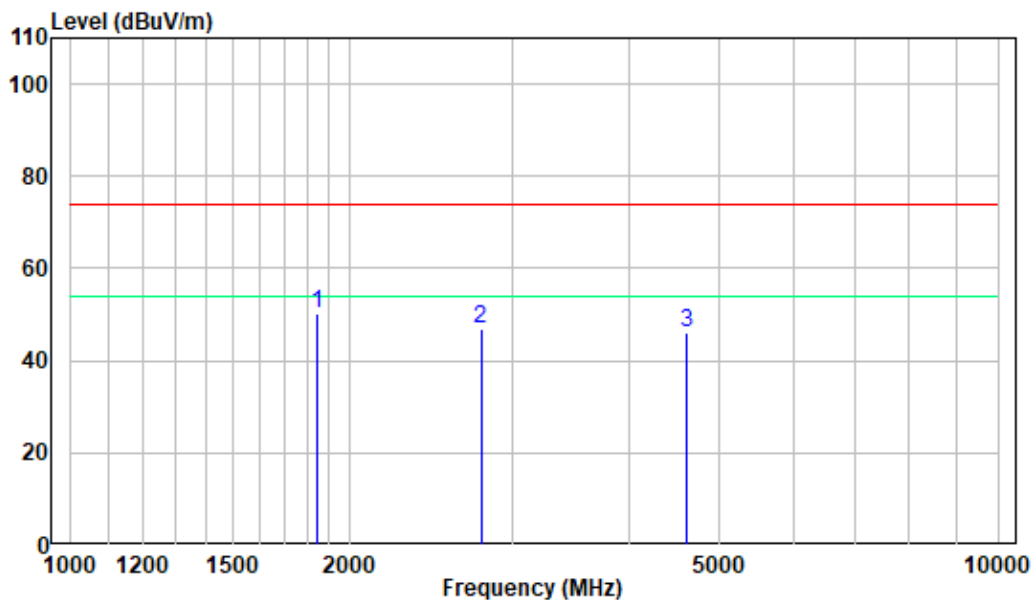
1-10GHz:

Horizontal



Site : chamber  
Condition: 3m HORIZONTAL  
Job No. : SZNS1220207-04026E-RF  
Test Mode: 927.5MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1846.609	-8.39	61.86	53.47	74.00	-20.53	Peak
2	2770.927	-6.46	50.89	44.43	74.00	-29.57	Peak
3	4618.490	-4.28	45.37	41.09	74.00	-32.91	Peak

**Vertical**

Site : chamber  
 Condition: 3m VERTICAL  
 Job No. : SZNS1220207-04026E-RF  
 Test Mode: 927.5MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1846.609	-8.39	58.45	50.06	74.00	-23.94	Peak
2	2769.332	-6.47	53.25	46.78	74.00	-27.22	Peak
3	4618.490	-4.28	50.46	46.18	74.00	-27.82	Peak

**Note:**

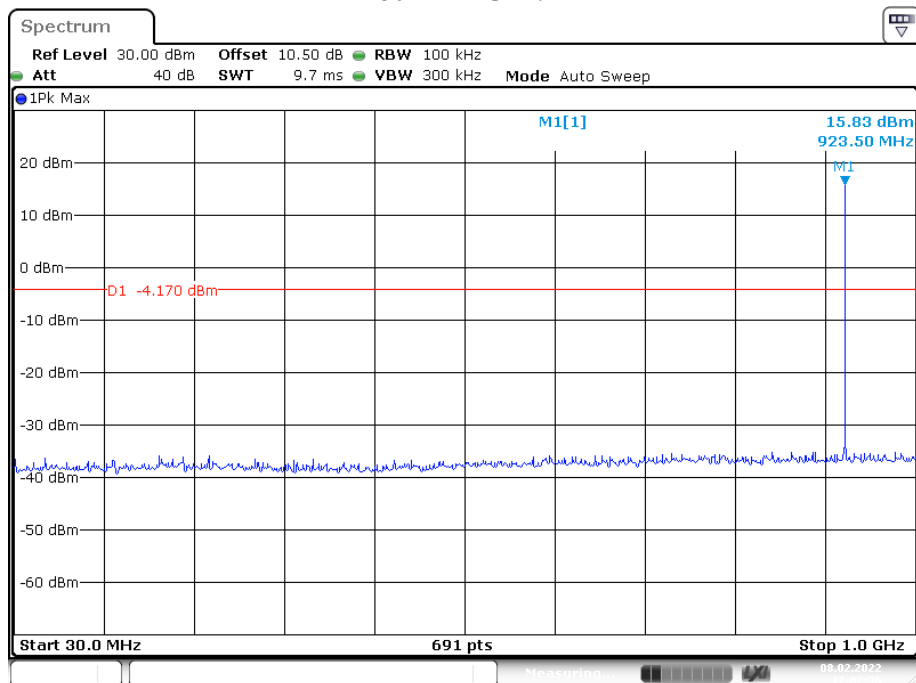
Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Level = Factor + Reading

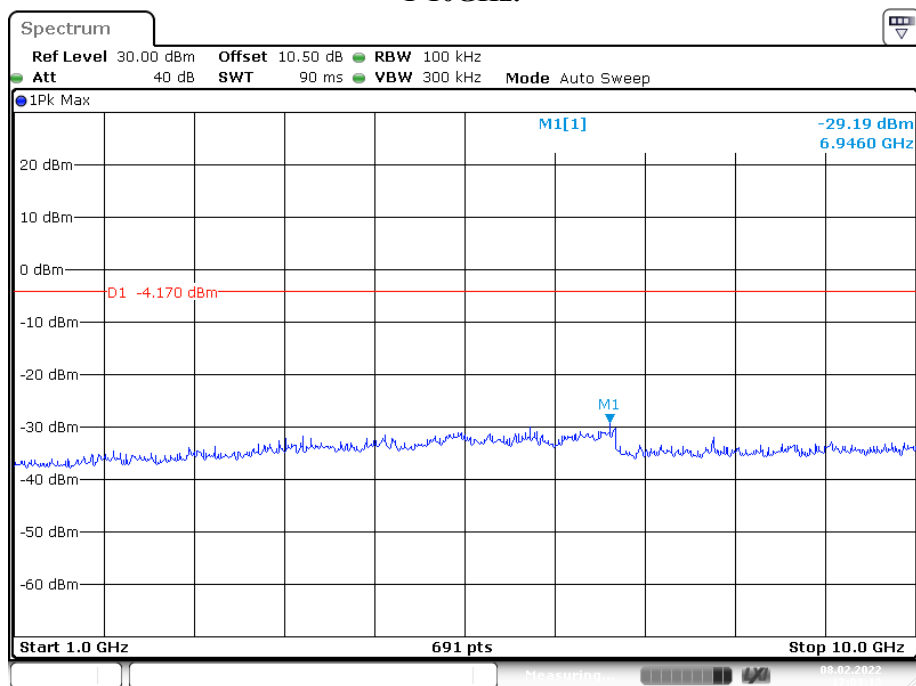
Over limit = Level - Limit

The other spurious emission which is in the noise floor level was not recorded.

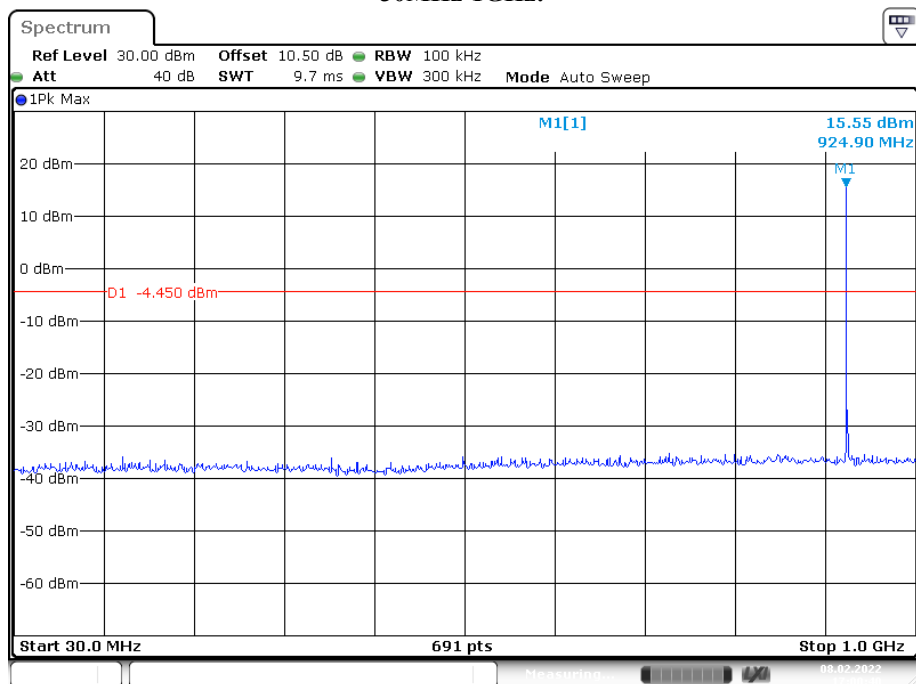
For the RSE above 1GHz, the test result of peak was 20dB below to the limit of peak, which can be compliant to the average limit, so just peak value was recorded.

**Conducted spurious emissions:****Low Channel:****30MHz-1GHz:**

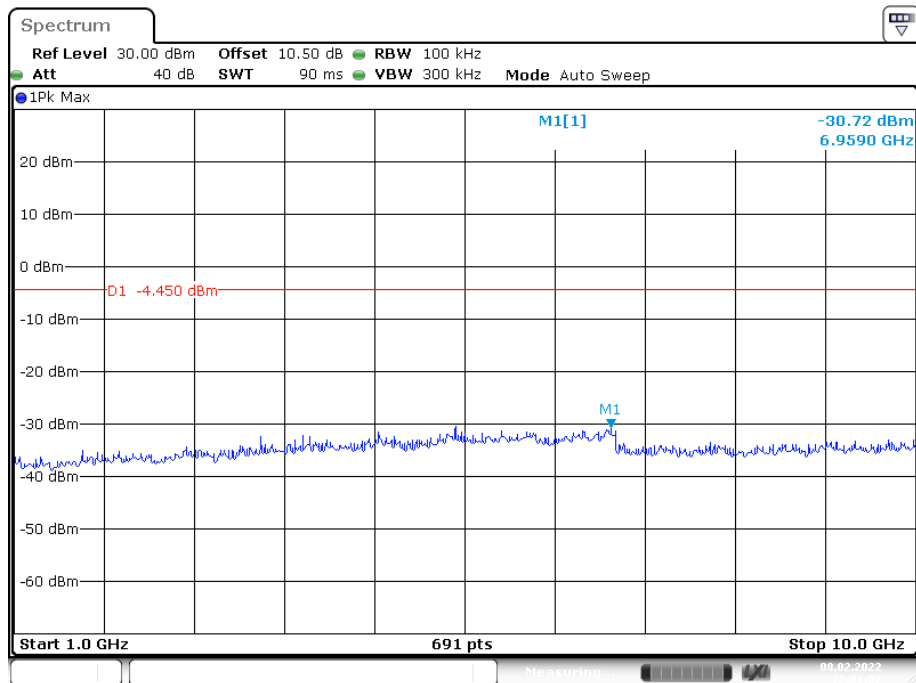
Date: 8.FEB.2022 17:02:36

**1-10GHz:**

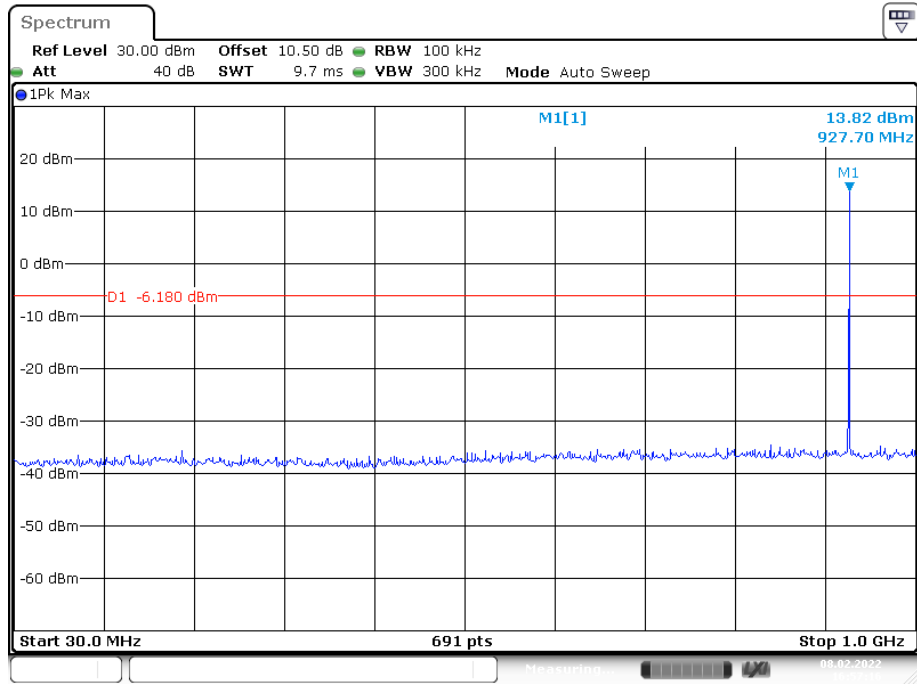
Date: 8.FEB.2022 17:03:12

**Middle Channel:****30MHz-1GHz:**

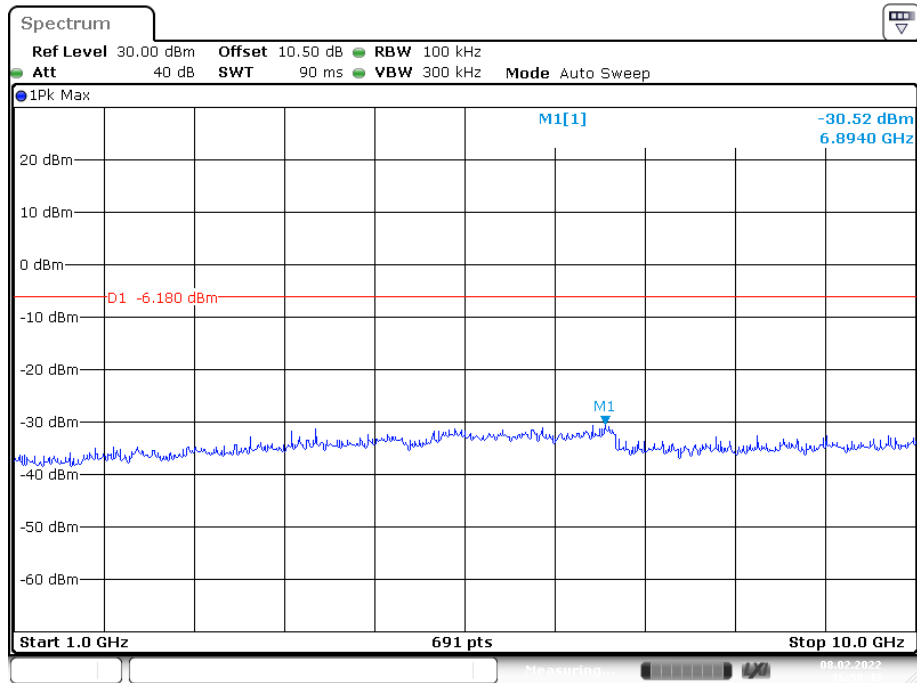
Date: 8.FEB.2022 17:00:40

**1-10GHz:**

Date: 8.FEB.2022 17:01:07

**High Channel:****30MHz-1GHz:**

Date: 8.FEB.2022 16:57:15

**1-10GHz:**

Date: 8.FEB.2022 16:58:43

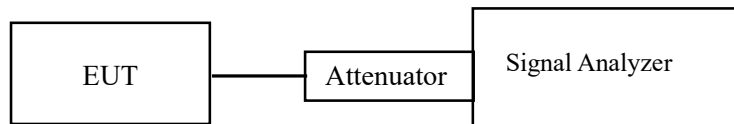
## FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH & OCCUPIED BANDWIDTH

### 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:	23 °C
Relative Humidity:	55%
ATM Pressure:	102.0 kPa

*The testing was performed by Key Pei on 2022-02-08.*

*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the Appendix.

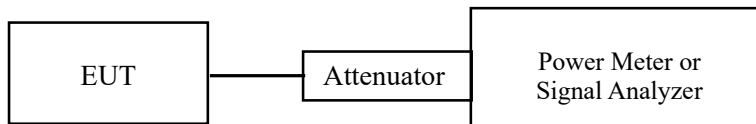
## FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

### 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:	23 °C
Relative Humidity:	55 %
ATM Pressure:	102.0 kPa

The testing was performed by Key Pei on 2022-02-08.

EUT operation mode: Transmitting

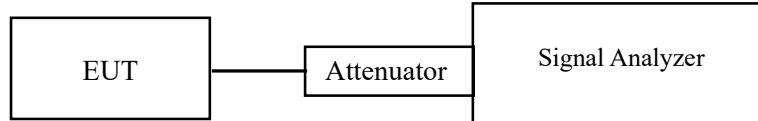
Test Result: Compliant. Please refer to the Appendix.

**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**

<b>Temperature:</b>	23 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	102.0 kPa

*The testing was performed by Key Pei on 2022-02-08*

*EUT operation mode: Transmitting*

Test Result: Compliant.

**Conducted Band Edge Result:**

Please refer to the Appendix.

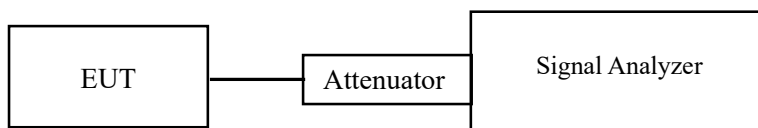


**FCC §15.247(e) - POWER SPECTRAL DENSITY****Applicable Standard**

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**

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to:  $3\text{kHz} \leq \text{RBW} \leq 100\text{ kHz}$ .
3. Set the VBW  $\geq 3 \times \text{RBW}$ .
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:	23 °C
Relative Humidity:	55 %
ATM Pressure:	102.0 kPa

*The testing was performed by Key Pei on 2022-02-08.*

*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the Appendix.

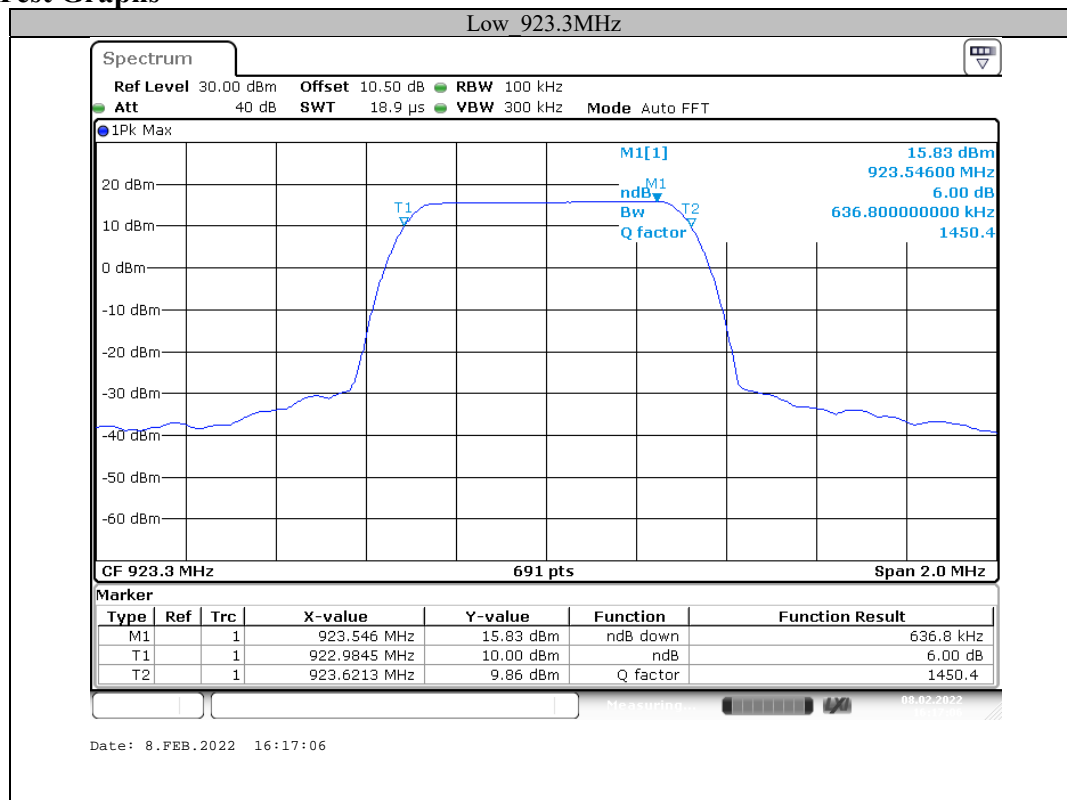
## APPENDIX

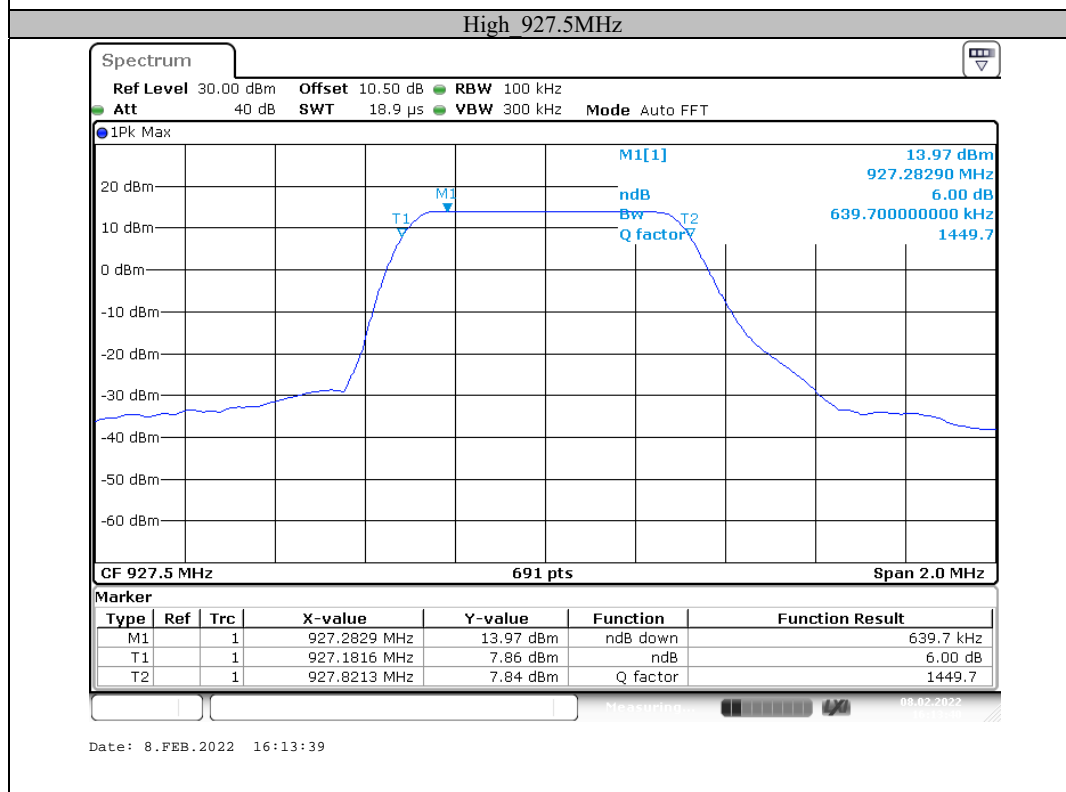
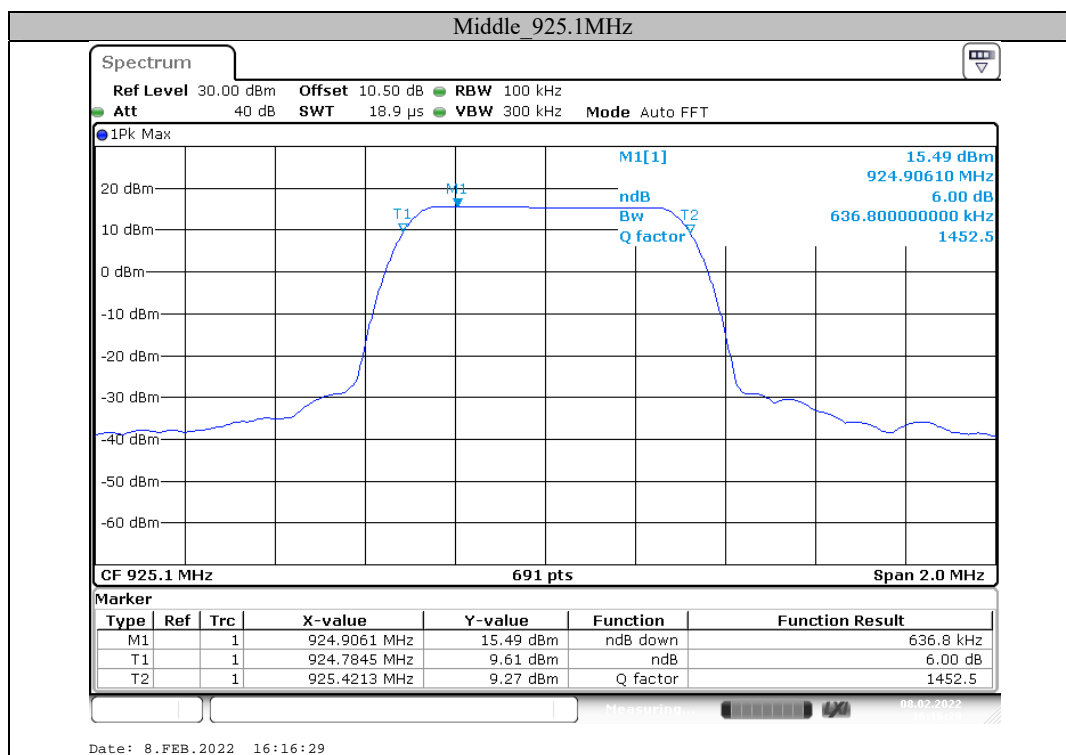
### Appendix A: 6dB Emission Bandwidth

#### Test Result

Channel [MHz]	DTS BW [MHz]	Limit [MHz]	Verdict
923.3	0.637	0.5	PASS
925.1	0.637	0.5	PASS
927.5	0.640	0.5	PASS

#### Test Graphs



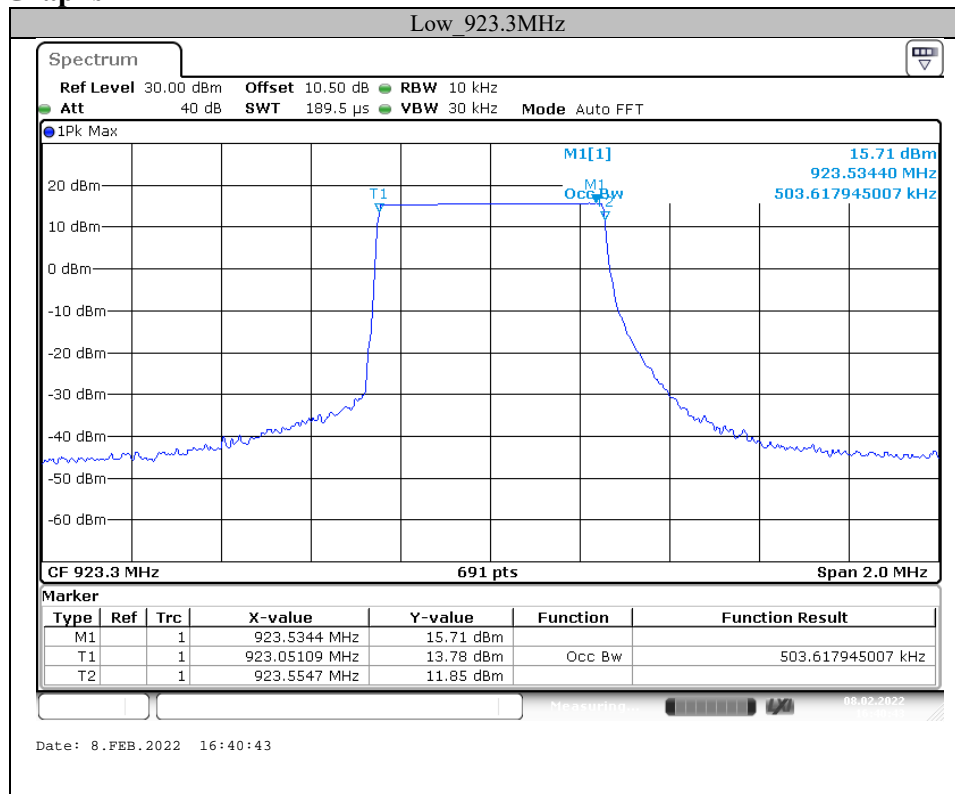


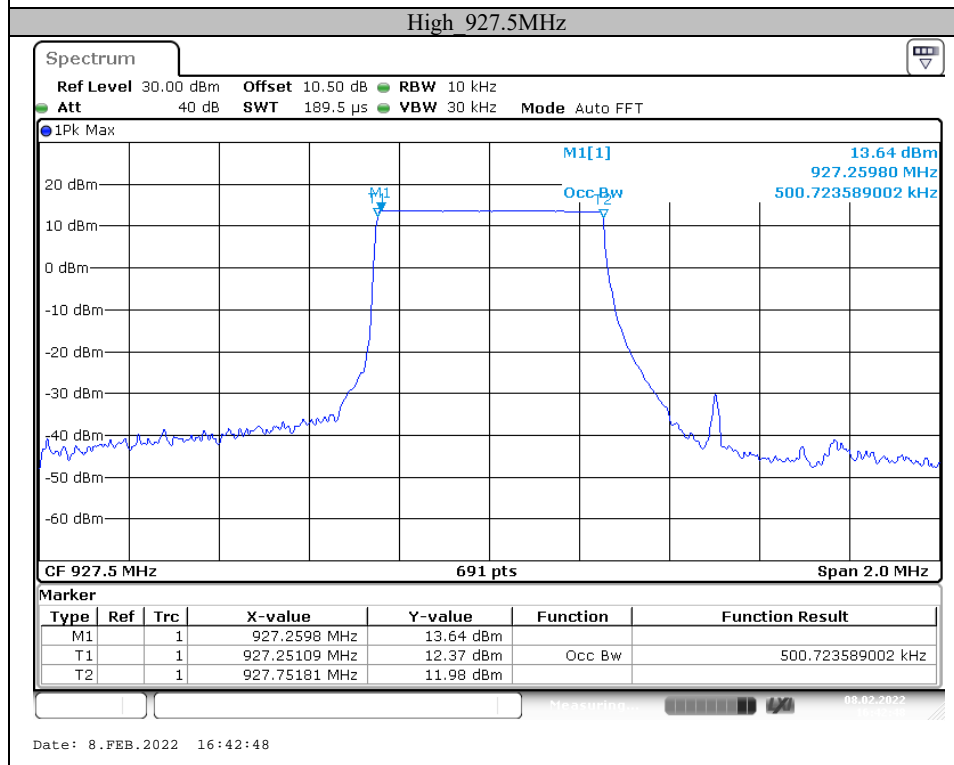
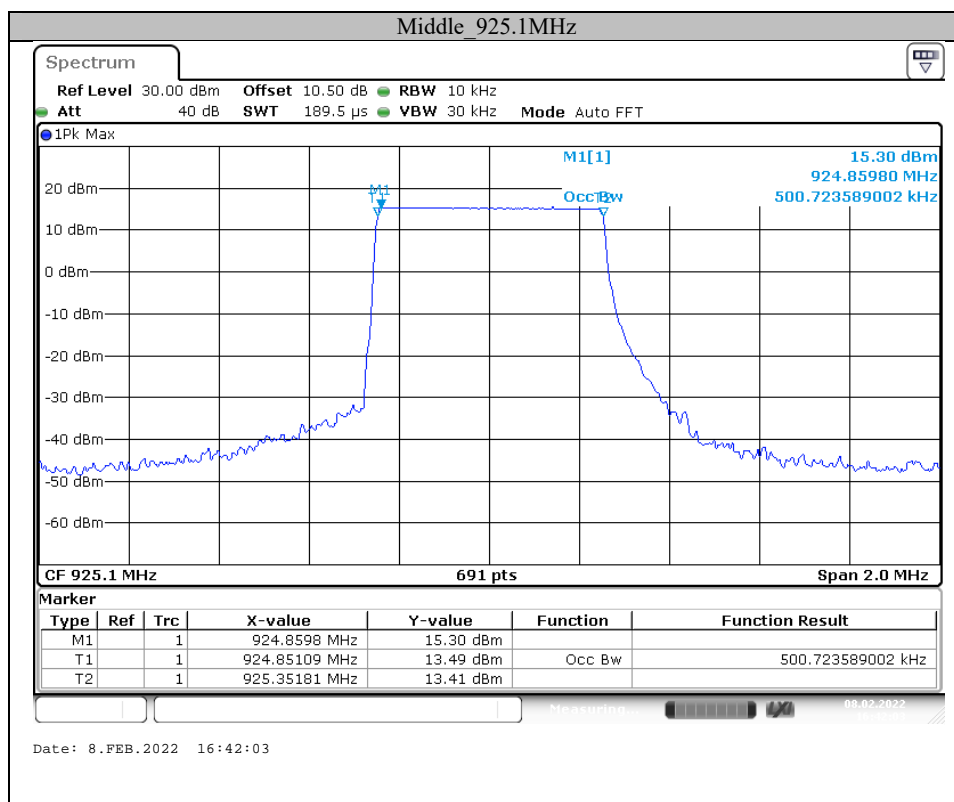
## Appendix B: Occupied Channel Bandwidth

### Test Result

Channel [MHz]	OCB [MHz]	Limit[dBm]	Verdict
923.3	0.504	---	PASS
925.1	0.501	---	PASS
927.5	0.501	---	PASS

### Test Graphs





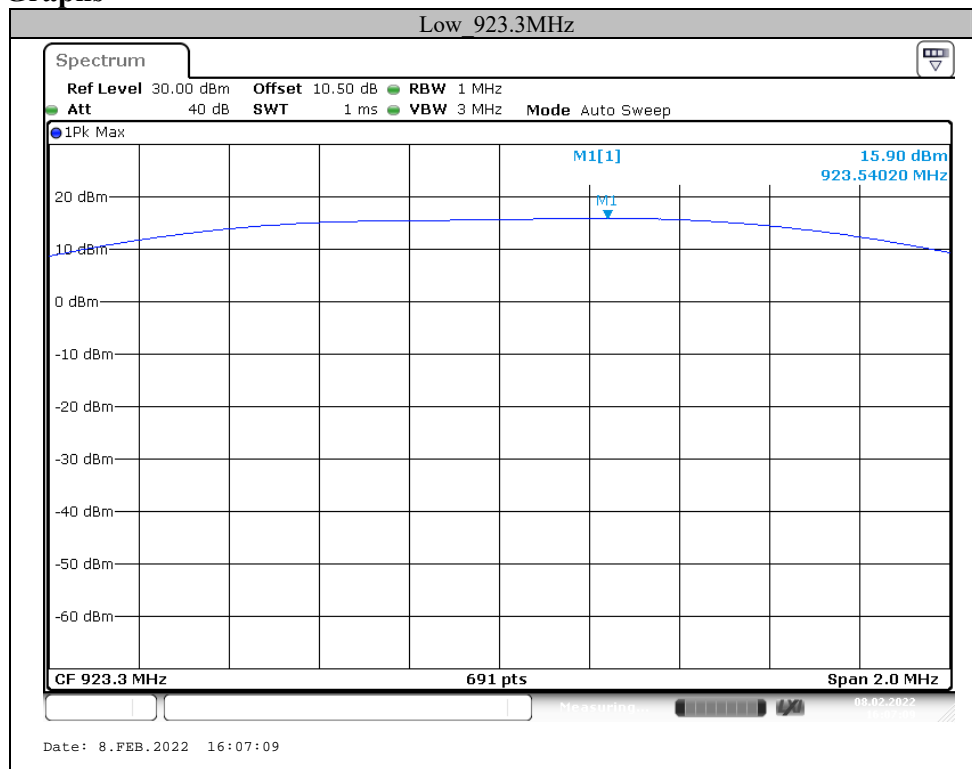
## Appendix C: Maximum conducted Peak output power

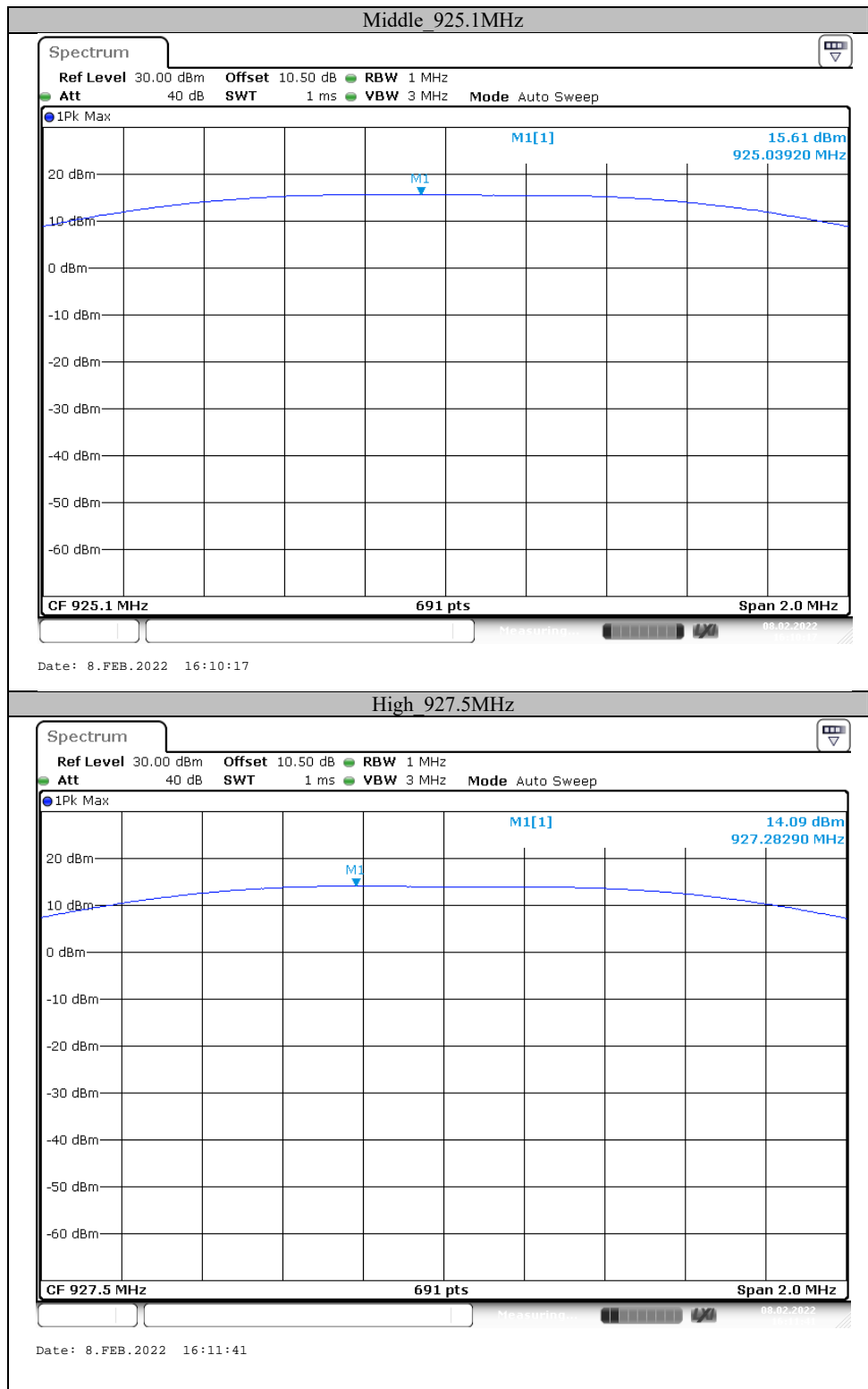
### Test Result

Channel [MHz]	Result [dBm]	Limit[dBm]	Verdict
923.3	15.90	<=30	PASS
925.1	15.61	<=30	PASS
927.5	14.09	<=30	PASS

Note: The maximum antenna gain is 1dBi.

### Test Graphs



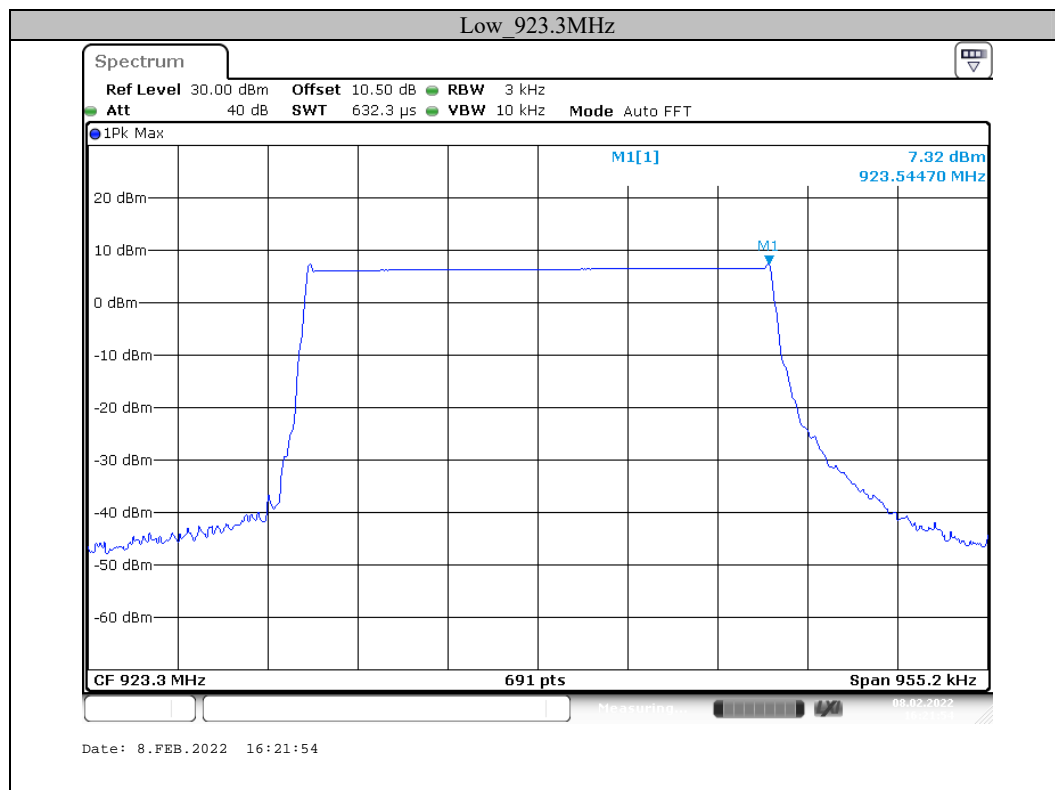


## Appendix D: Power spectral density

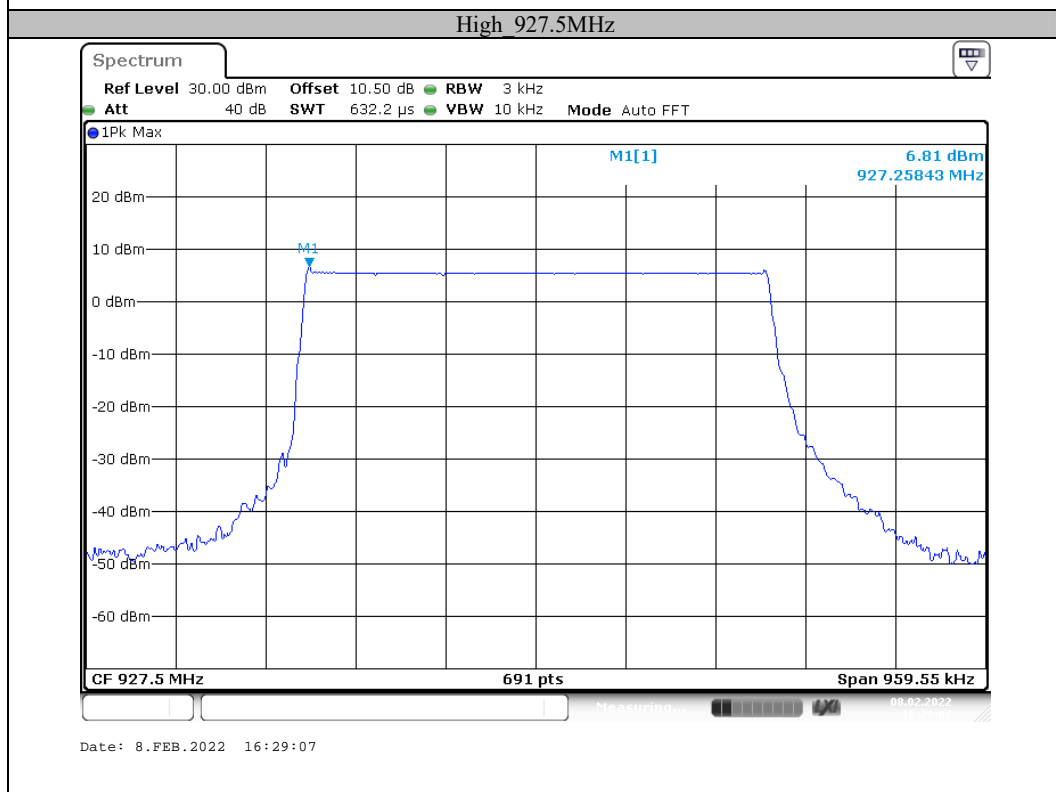
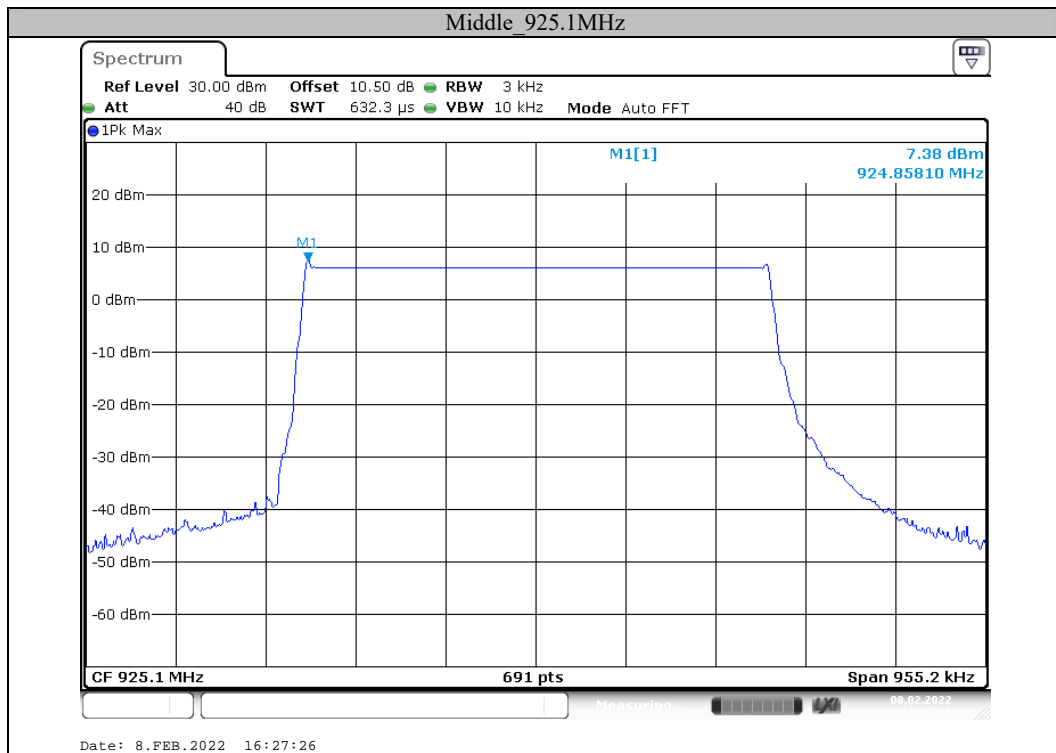
### Test Result

Channel[MHz]	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
923.3	7.32	$\leq 8$	PASS
925.1	7.38	$\leq 8$	PASS
927.5	6.81	$\leq 8$	PASS

### Test Graphs

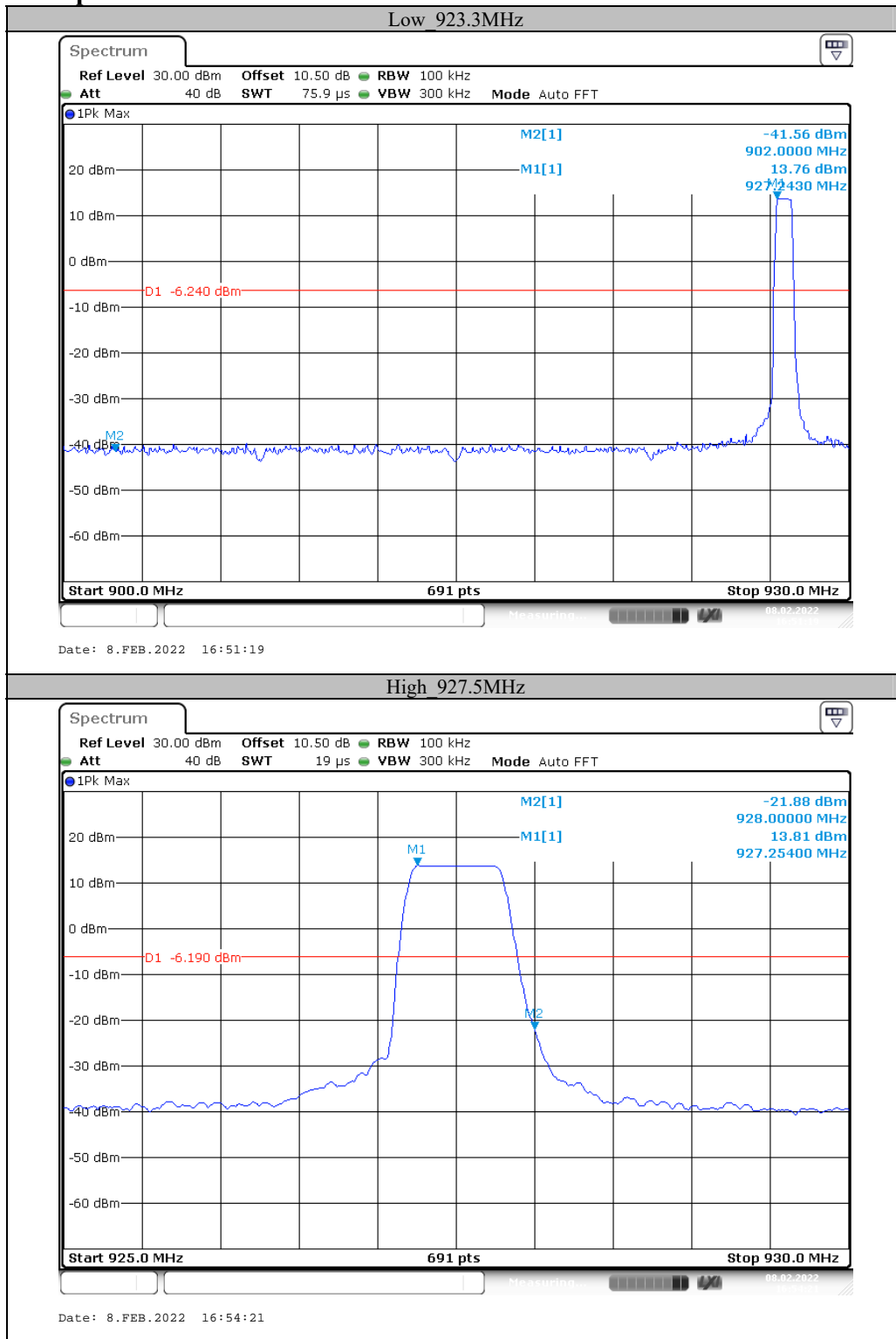






## Appendix E: Band edge measurements

### Test Graphs

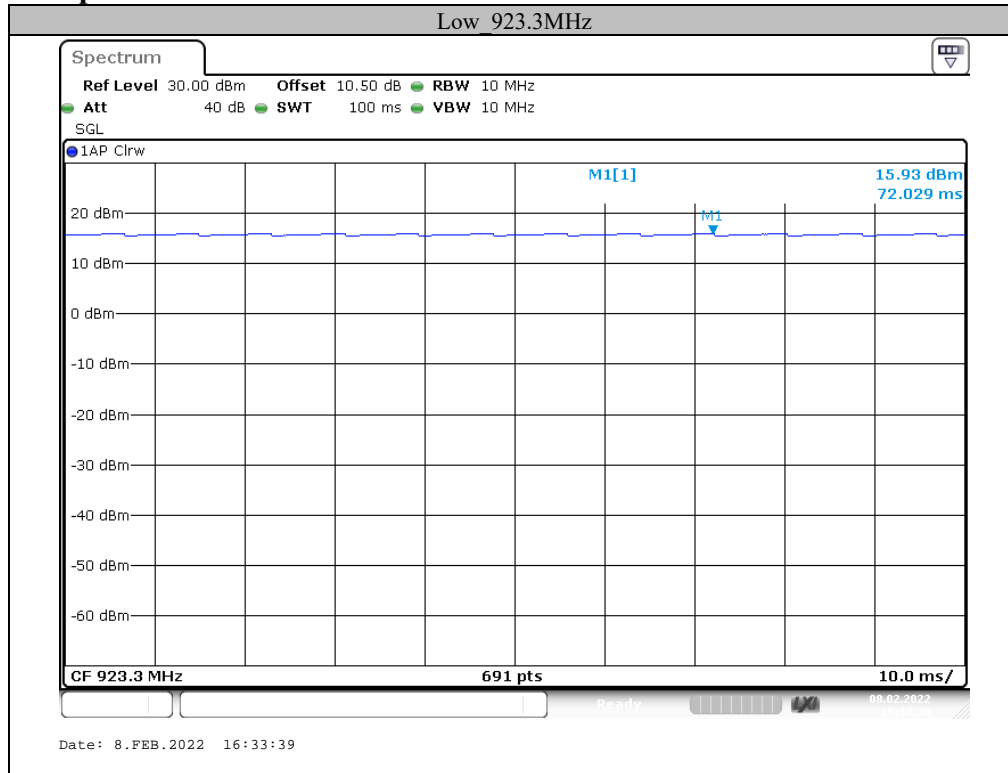


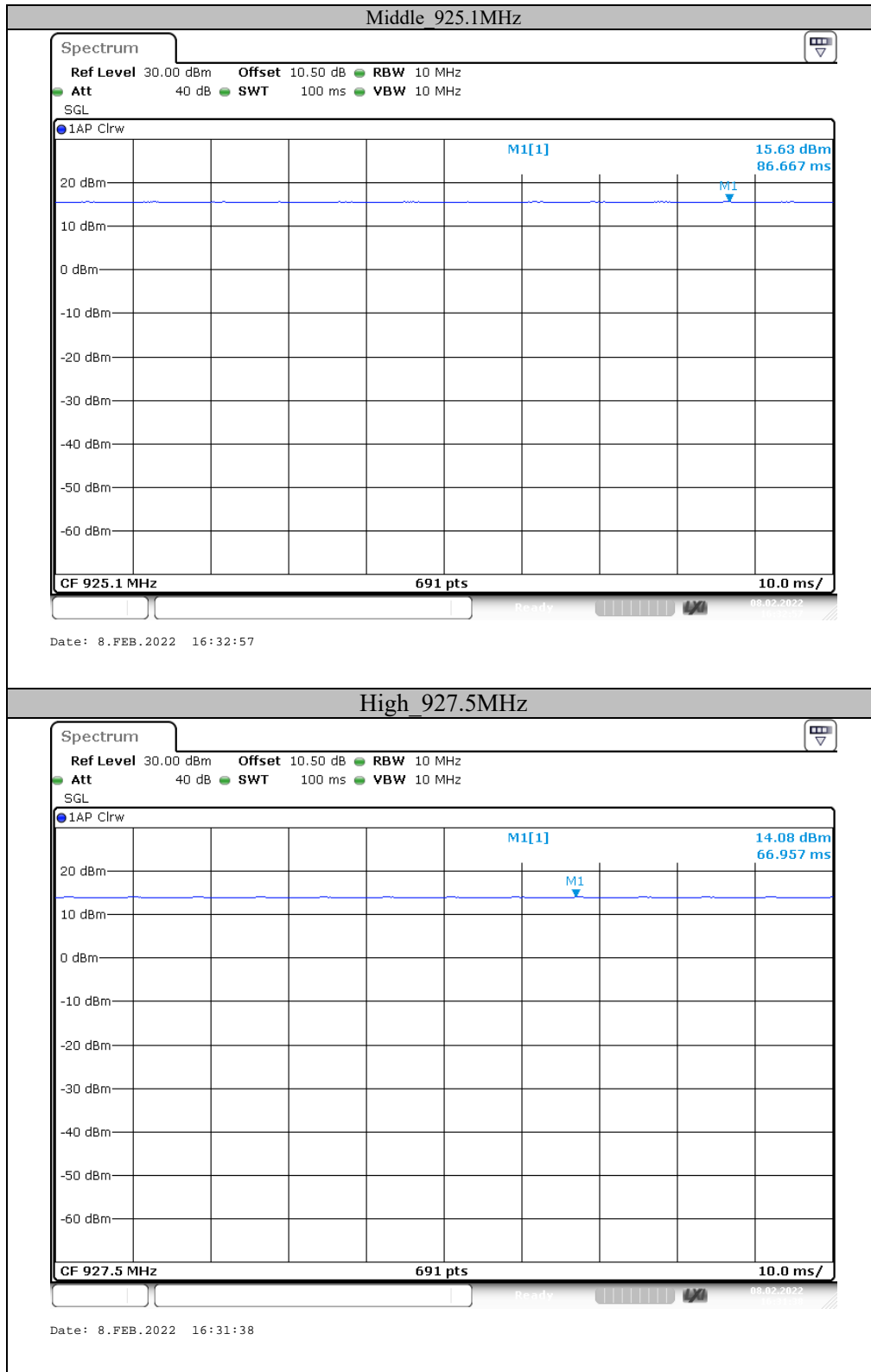
## Appendix F: Duty Cycle

### Test Result

Channel [MHz]	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
923.3	100	100	100
925.1	100	100	100
927.5	100	100	100

### Test Graphs





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