

TEST REPORT

Applicant Name : Shenzhen Hi-Link Electronic co., Ltd.
Address : 1705, 1706, 1709A, Building E, Xinghe WORLD, Minle Community,
Minzhi Street, Longhua District, Shenzhen, China
Report Number : RA230426-22448E-RF
FCC ID: 2AD56HLK-L06-915

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type: LoRa Module
Model No.: HLK-L06-915
Trade Mark: Hi-link
Date Received: 2023-04-26
Date of Test: 2023-05-14 to 2023-07-13
Report Date: 2023-07-13

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

Prepared and Checked By:

Roger.Ling

Roger.Ling
EMC Engineer

Approved By:

Candy Li

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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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 Fax: +86 755-26503290 Web: www.atc-lab.com

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FCC-RF

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RA230426-22448E-RF	Original Report	2023-07-13

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	LoRa Module
Tested Model	HLK-L06-915
Frequency Range	903-927 MHz (Lora, DTS 500kHz mode)
Maximum Conducted Peak Output Power	14.29dBm
Modulation Technique	LoRa: Chirp Spread Spectrum
Voltage Range	DC3.0-3.6V(typical DC3.3V)
Antenna Specification*	Dipole Antenna: 3.85dBi(provided by the applicant)
Sample serial number	2564-1
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		0.71dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.74dB
Emissions, Radiated	30MHz - 1GHz	5.08dB
	1GHz - 18GHz	4.96dB
	18GHz - 26.5GHz	5.16dB
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 4297.01.

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)
1	903	10	912	19	921
2	904	11	913	20	922
3	905	12	914	21	923
4	906	13	915	22	924
5	907	14	916	23	925
6	908	15	917	24	926
7	909	16	918	25	927
8	910	17	919	/	/
9	911	18	920	/	/

Channel 1, 13 and 25 were tested.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

“SecureCRT”* software was used to the EUT tested and power level is 4*.

Duty cycle

Test Result: Compliant. Please refer to the Appendix.

Support Equipment List and Details

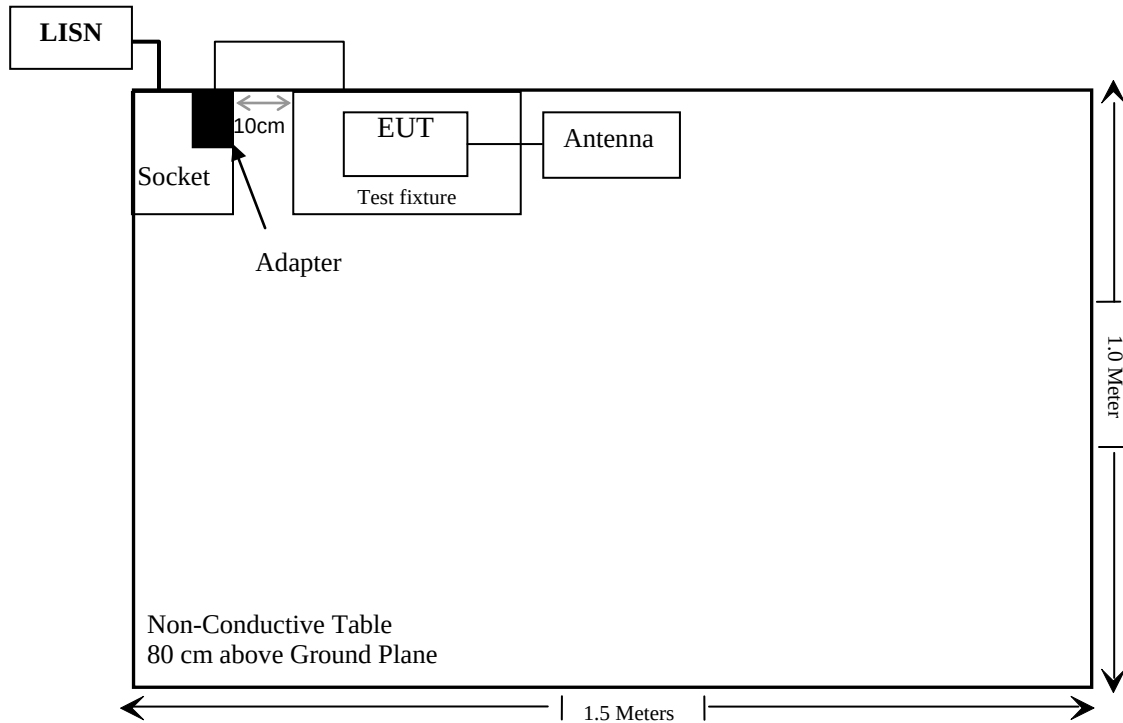
Manufacturer	Description	Model	Serial Number
RISUNIC	Adapter	RA040-0503000EU	2031000001
Unknown	Test Fixture	Unknown	Unknown
LENOVO	Notebook	ThinkPad x240	Unknown
Unknown	Antenna	Unknown	Unknown

External I/O Cable

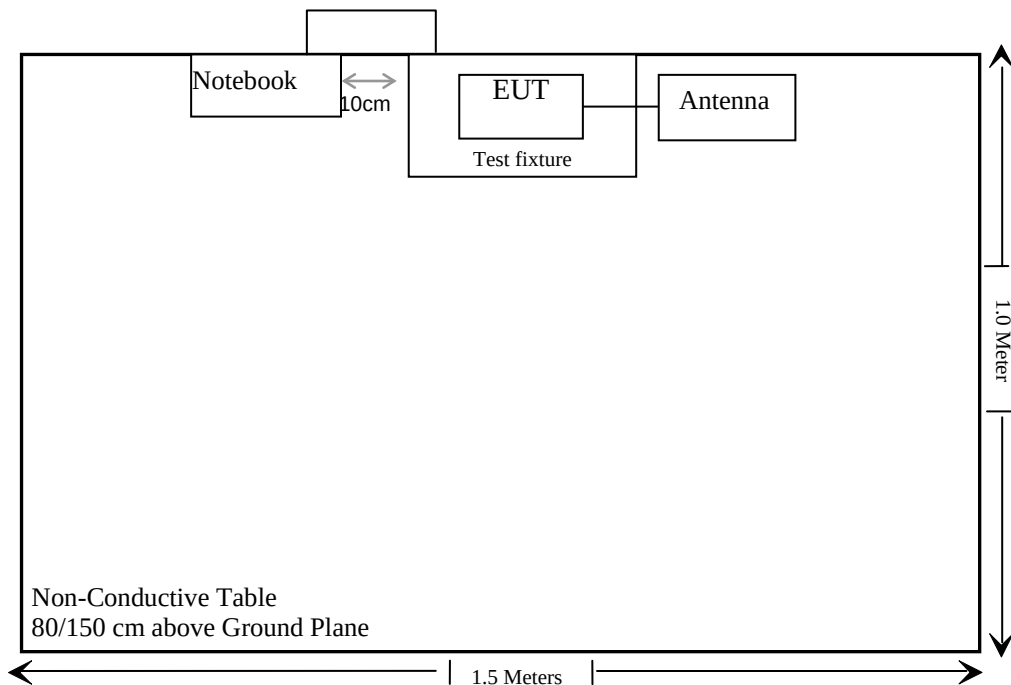
Cable Description	Length (m)	From Port	To
Un-shielding Detachable USB Cable	1.2	Adapter	Test Fixture
Un-shielding Detachable USB Cable (with a ferrite cord)	1.2	Notebook	Test Fixture
Shielding Detachable RF Cable	0.1	EUT	Antenna

Block Diagram of Test Setup

For Conducted Emission:



For Radiated Emission:



Note: the support table edge was flush with the center of turntable

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §1.1307(b)	RF EXPOSURE	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	2022/11/25	2023/11/24
Rohde & Schwarz	L.I.S.N.	ENV216	101314	2022/11/25	2023/11/24
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2022/12/07	2023/12/06
Unknown	RF Coaxial Cable	No.17	N0350	2022/11/25	2023/11/24
Conducted Emission Test Software: e3 191218 (V9)					
Radiated Emissions 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	837	2023/02/22	2026/02/21
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
Radiated Emission Test Software:e3 191218 (V9)					
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101948	2022/11/25	2023/11/24
WEINSCHTEL	10dB Attenuator	5324	AU 3842	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 §1.1307(b) –RF EXPOSURE

Applicable Standard

According to KDB 447498 D04 Interim General RF Exposure Guidance v01, clause 2.1.4 –MPE-Based Exemption:

An alternative to the SAR-based exemption is provided in § 1.1307(b)(3)(i)(C), for a much wider frequency range, from 300 kHz to 100 GHz, applicable for separation distances greater or equal to $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. The MPE-based test exemption condition is in terms of ERP, defined as the product of the maximum antenna gain and the delivered maximum time-averaged power. For this case, a RF source is an RF exempt device if its ERP (watts) is no more than a frequency-dependent value, as detailed tabular form in Appendix B. These limits have been derived based on the basic specifications on Maximum Permissible Exposure (MPE) considered for the FCC rules in § 1.1310(e)(1).

Table 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	$19.2 R^2$.

f = frequency in MHz;

R = minimum separation distance from the body of a nearby person (appropriate units, e.g., m);

Test result

For worst case:

Frequency Range (MHz)	Tune-up Output Power		Antenna Gain		ERP		Evaluation Distance (cm)	MPE-based exemption Limit (mW)
	(dBm)	(mW)	(dBi)	(dBd)	(dBm)	(mW)		
903-927	14.5	28.18	3.85	1.7	16.2	41.69	20	462

Note 1: The tune-up power was declared by the applicant.

Note 2: 0dBd=2.15dBi.

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.
- c. 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 test use a external dipole antenna with I-PEX antenna connector, the maximum antenna gain is 3.85dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Type	Antenna Gain	Impedance
Dipole	3.85dBi	50 Ω

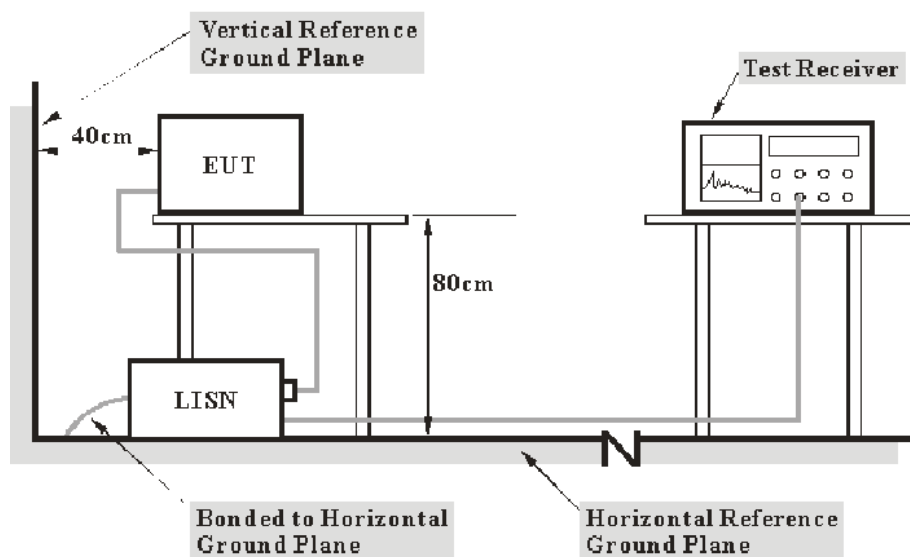
Result: Compliant.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

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 measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

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.

Calculation

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

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

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

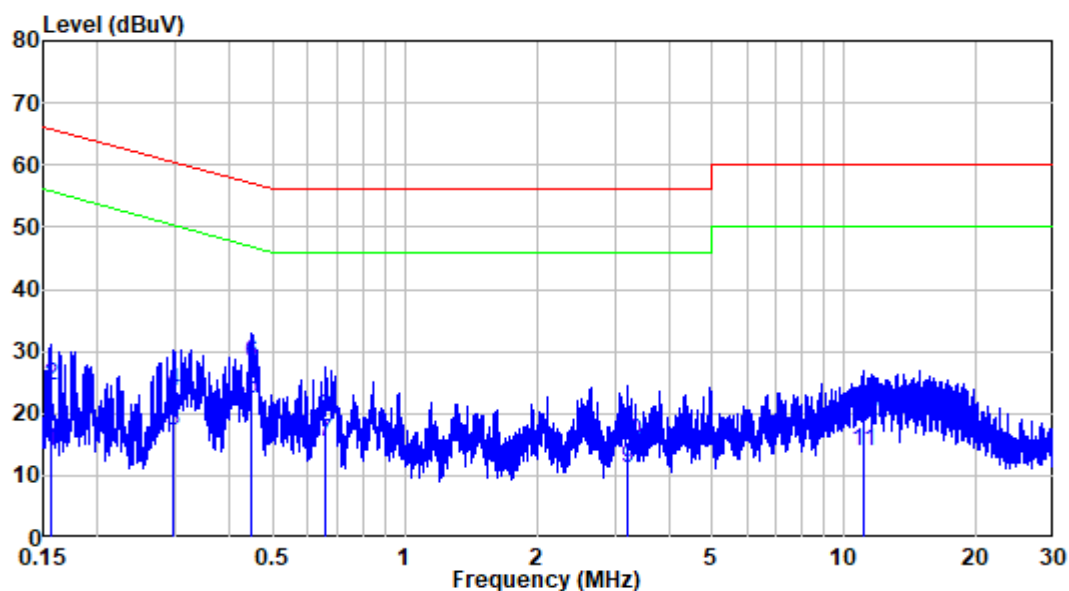
Environmental Conditions

Temperature:	23 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Jerry Wu on 2023-05-17.

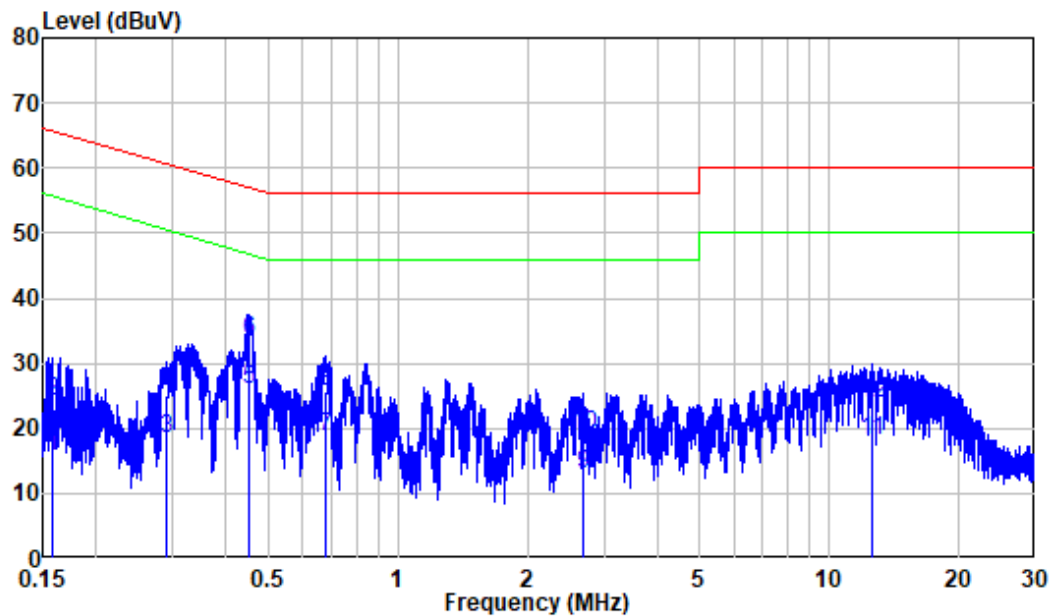
EUT operation mode: Transmitting(worst case low channel)

AC 120V/60 Hz, Line



Site : Shielding Room
 Condition: Line
 Job No. : RA230426-22448E-RF
 Mode : Transmitting
 Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.156	10.40	3.43	13.83	55.65	-41.82	Average
2	0.156	10.40	14.15	24.55	65.65	-41.10	QP
3	0.297	10.40	6.76	17.16	50.32	-33.16	Average
4	0.297	10.40	13.26	23.66	60.32	-36.66	QP
5	0.448	10.40	11.95	22.35	46.91	-24.56	Average
6	0.448	10.40	17.74	28.14	56.91	-28.77	QP
7	0.660	10.57	4.89	15.46	46.00	-30.54	Average
8	0.660	10.57	8.62	19.19	56.00	-36.81	QP
9	3.207	10.50	0.64	11.14	46.00	-34.86	Average
10	3.207	10.50	4.83	15.33	56.00	-40.67	QP
11	11.087	10.43	3.59	14.02	50.00	-35.98	Average
12	11.087	10.43	8.44	18.87	60.00	-41.13	QP

AC 120V/60 Hz, Neutral

Site : Shielding Room
 Condition: Neutral
 Job No. : RA230426-22448E-RF
 Mode : Transmitting
 Power : AC 120V 60Hz

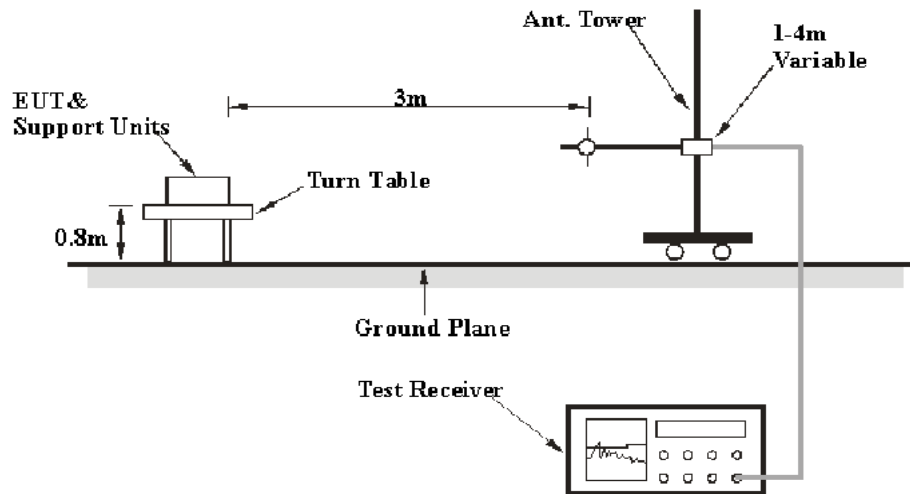
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.157	10.42	5.20	15.62	55.60	-39.98	Average
2	0.157	10.42	13.88	24.30	65.60	-41.30	QP
3	0.291	10.46	7.85	18.31	50.50	-32.19	Average
4	0.291	10.46	14.46	24.92	60.50	-35.58	QP
5	0.450	10.41	15.68	26.09	46.87	-20.78	Average
6	0.450	10.41	23.03	33.44	56.87	-23.43	QP
7	0.679	10.50	8.10	18.60	46.00	-27.40	Average
8	0.679	10.50	15.05	25.55	56.00	-30.45	QP
9	2.694	10.54	2.50	13.04	46.00	-32.96	Average
10	2.694	10.54	8.37	18.91	56.00	-37.09	QP
11	12.549	10.29	7.90	18.19	50.00	-31.81	Average
12	12.549	10.29	13.63	23.92	60.00	-36.08	QP

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

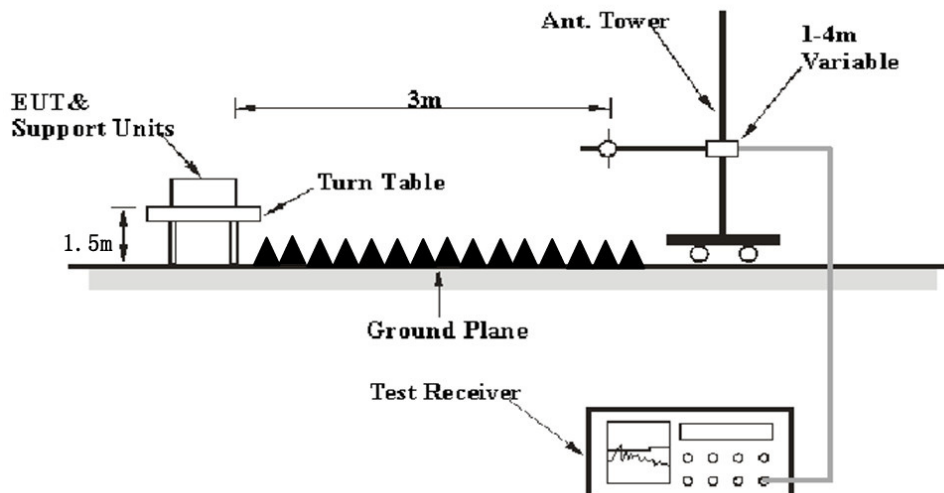
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



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

EMI Test Receiver & Spectrum Analyzer Setup

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

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

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

Note 2: when duty cycle is less than 98%

Test Procedure

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

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

Factor & Margin Calculation

The 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:	23-26 °C
Relative Humidity:	47-55 %
ATM Pressure:	101.0 kPa

The Radiated Spurious Emissions testing was performed by Jason Liu on 2023-05-17 and 2023-06-07.
The Conducted Emission testing was performed by Matt Liang on 2023-07-11.

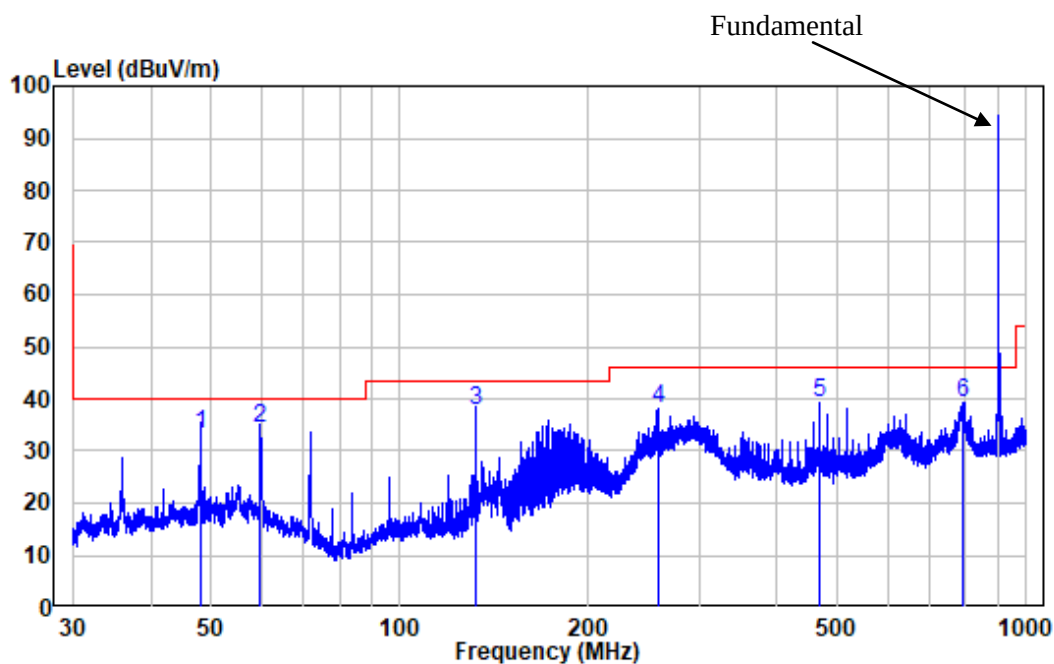
EUT operation mode: Transmitting (Pre-scan in the X,Y and Z axes of orientation, the worst case Y-axis of orientation was recorded)

Radiated Spurious Emissions:

Low Channel:

30MHz-1GHz:

Horizontal



Site : chamber

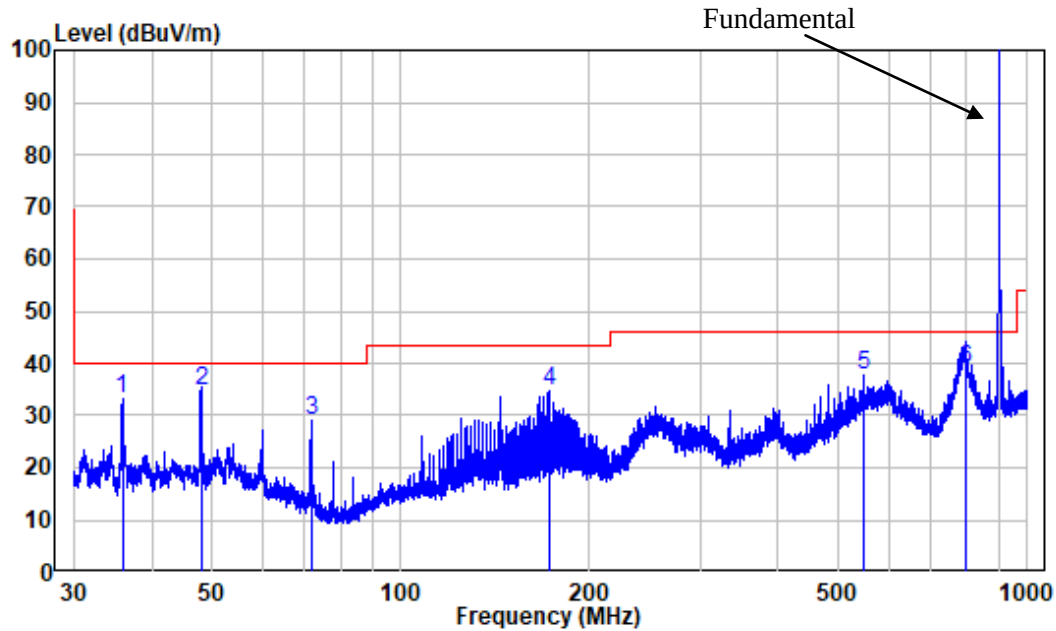
Condition: 3m HORIZONTAL

Job No. : RA230426-22448E-RF

Test Mode: 903MHz TX

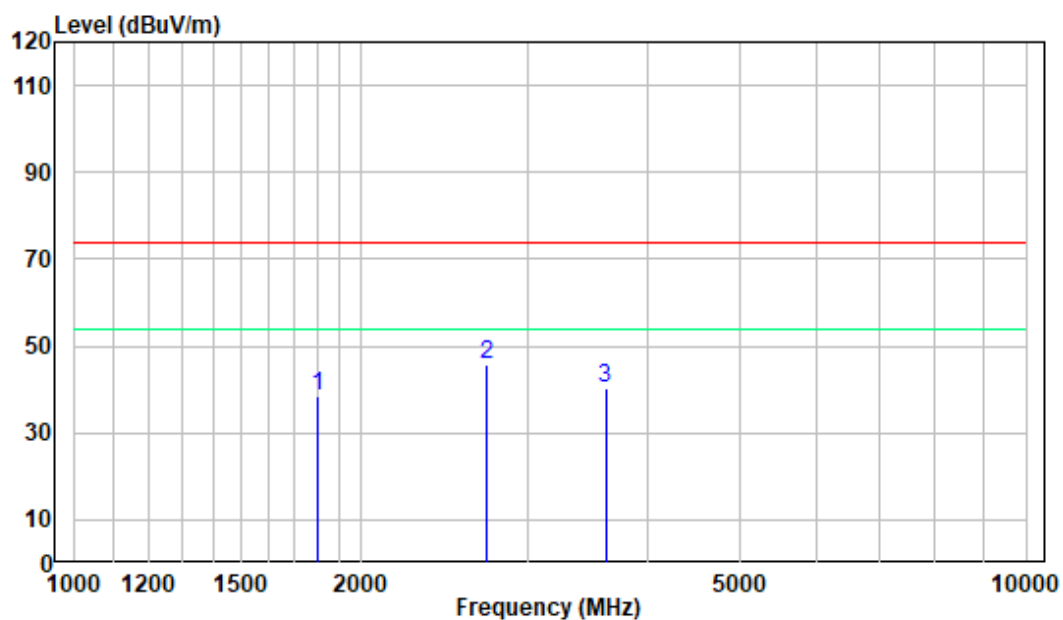
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	47.973	-10.00	43.39	33.39	40.00	-6.61	QP
2	59.833	-10.56	44.80	34.24	40.00	-5.76	QP
3	131.873	-14.97	52.89	37.92	43.50	-5.58	QP
4	257.761	-10.59	48.56	37.97	46.00	-8.03	Peak
5	468.055	-5.53	44.84	39.31	46.00	-6.69	Peak
6	789.580	-0.13	39.32	39.19	46.00	-6.81	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA230426-22448E-RF
Test Mode: 903MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	35.890	-11.23	44.40	33.17	40.00	-6.83	Peak
2	47.973	-10.00	44.54	34.54	40.00	-5.46	QP
3	72.021	-15.63	44.80	29.17	40.00	-10.83	Peak
4	172.978	-13.28	47.84	34.56	43.50	-8.94	Peak
5	549.260	-4.03	41.76	37.73	46.00	-8.27	Peak
6	798.280	-0.31	39.10	38.79	46.00	-7.21	QP

1-10GHz:**Horizontal**

Site : chamber

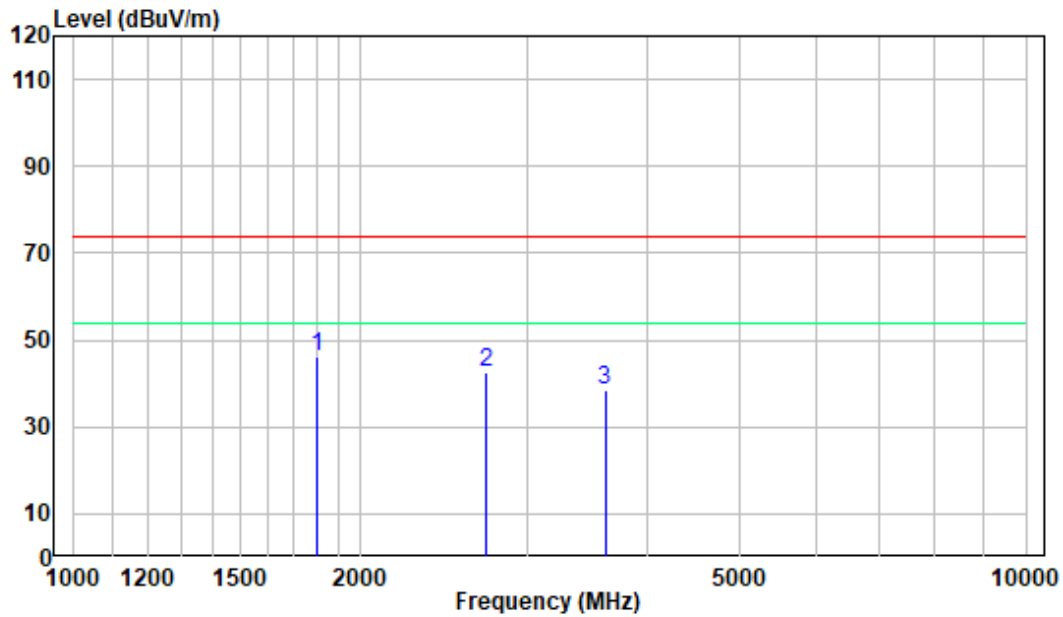
Condition: 3m HORIZONTAL

Job No. : RA230426-22448E-RF

Test Mode: 903MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1806.000	-13.07	51.76	38.69	74.00	-35.31	Peak
2	2709.000	-9.98	55.77	45.79	74.00	-28.21	Peak
3	3612.000	-9.18	49.35	40.17	74.00	-33.83	Peak

Vertical



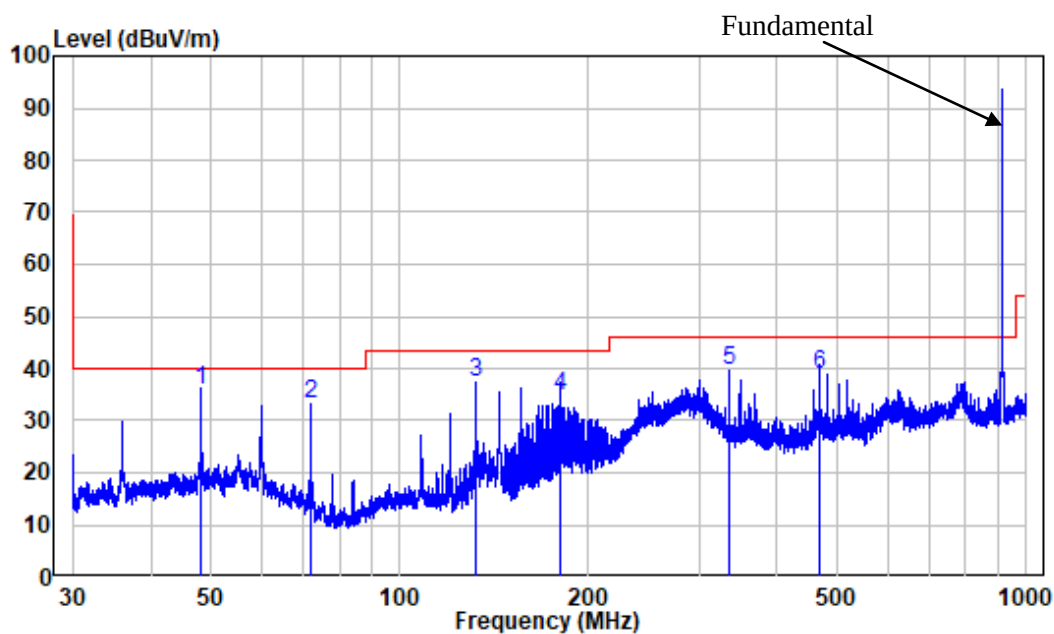
Site : chamber
Condition: 3m VERTICAL
Job No. : RA230426-22448E-RF
Test Mode: 903MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1806.000	-13.07	59.34	46.27	74.00	-27.73	Peak
2	2709.000	-9.98	52.45	42.47	74.00	-31.53	Peak
3	3612.000	-9.18	47.63	38.45	74.00	-35.55	Peak

Middle Channel

30MHz-1GHz:

Horizontal



Site : chamber

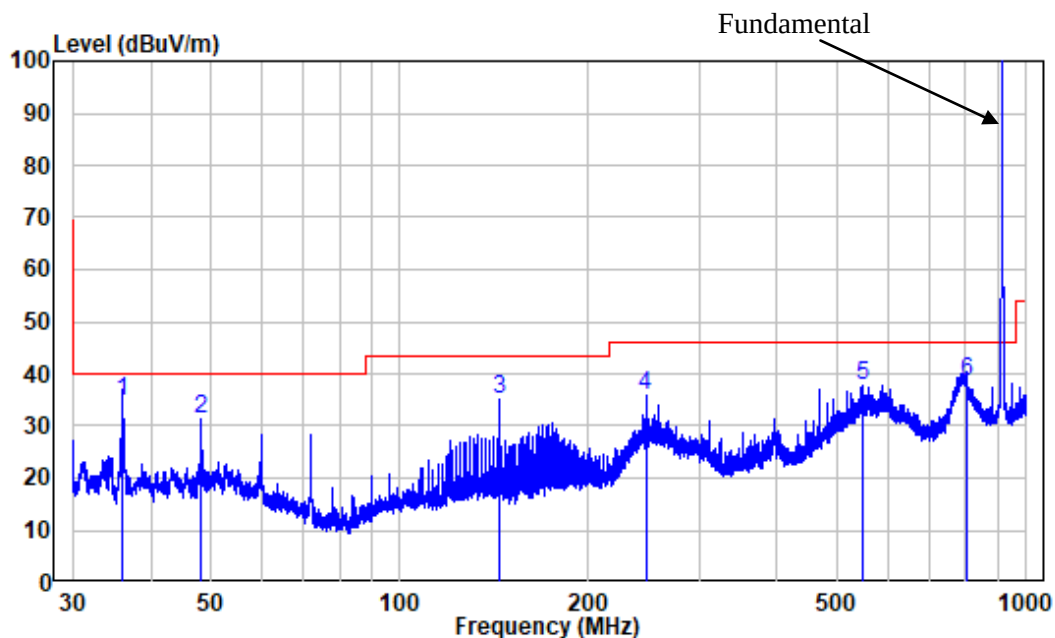
Condition: 3m HORIZONTAL

Job No. : RA230426-22448E-RF

Test Mode: 915MHz TX

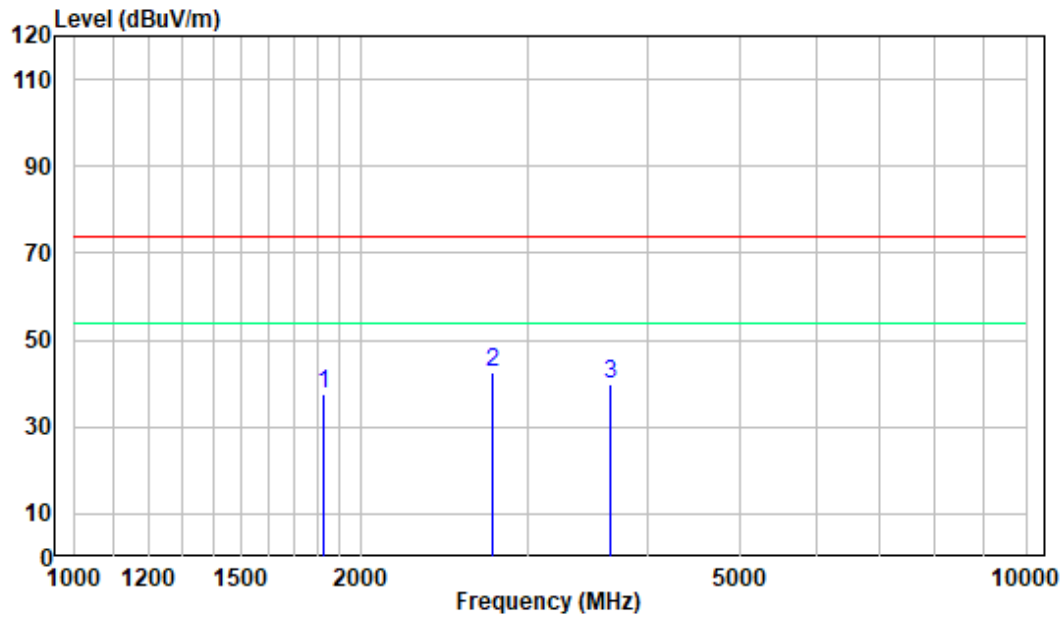
	Freq	Factor	Read Level	Level	Limit	Over	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	48.078	-10.00	45.80	35.80	40.00	-4.20	QP
2	72.242	-15.67	49.06	33.39	40.00	-6.61	Peak
3	131.931	-14.98	52.43	37.45	43.50	-6.05	Peak
4	180.174	-12.75	47.30	34.55	43.50	-8.95	QP
5	336.330	-7.57	47.07	39.50	46.00	-6.50	Peak
6	468.055	-5.53	44.40	38.87	46.00	-7.13	QP

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA230426-22448E-RF
Test Mode: 915MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	36.001	-11.20	45.80	34.60	40.00	-5.40	QP
2	48.078	-10.00	41.35	31.35	40.00	-8.65	Peak
3	143.956	-15.52	50.56	35.04	43.50	-8.46	Peak
4	246.815	-10.64	46.60	35.96	46.00	-10.04	Peak
5	548.298	-4.02	41.77	37.75	46.00	-8.25	Peak
6	802.841	-0.40	38.70	38.30	46.00	-7.70	QP

1-10GHz:**Horizontal**

Site : chamber

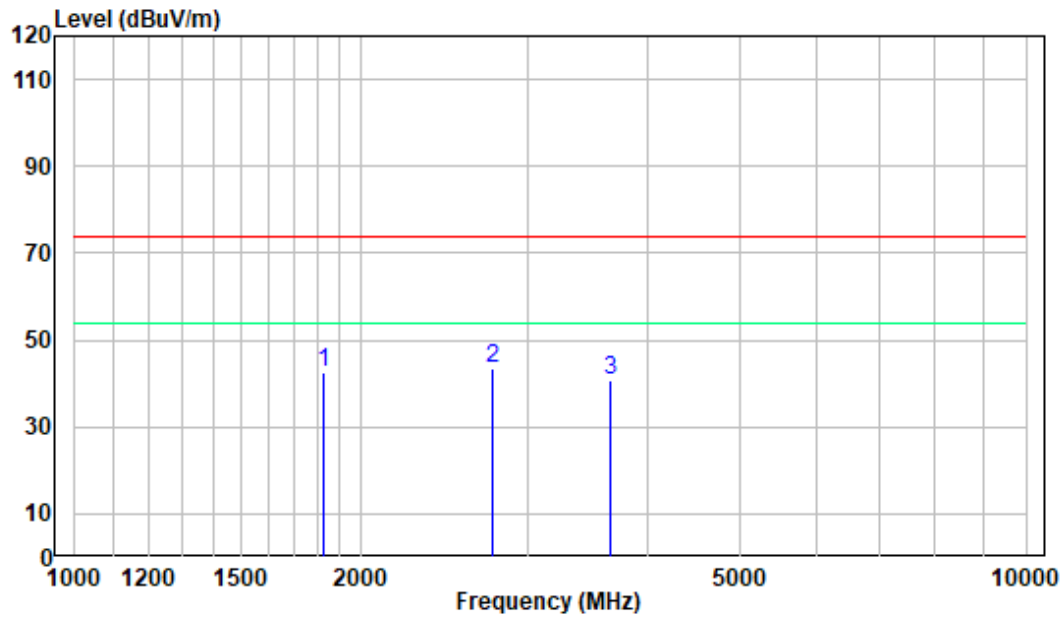
Condition: 3m HORIZONTAL

Job No. : RA230426-22448E-RF

Test Mode: 915MHz TX

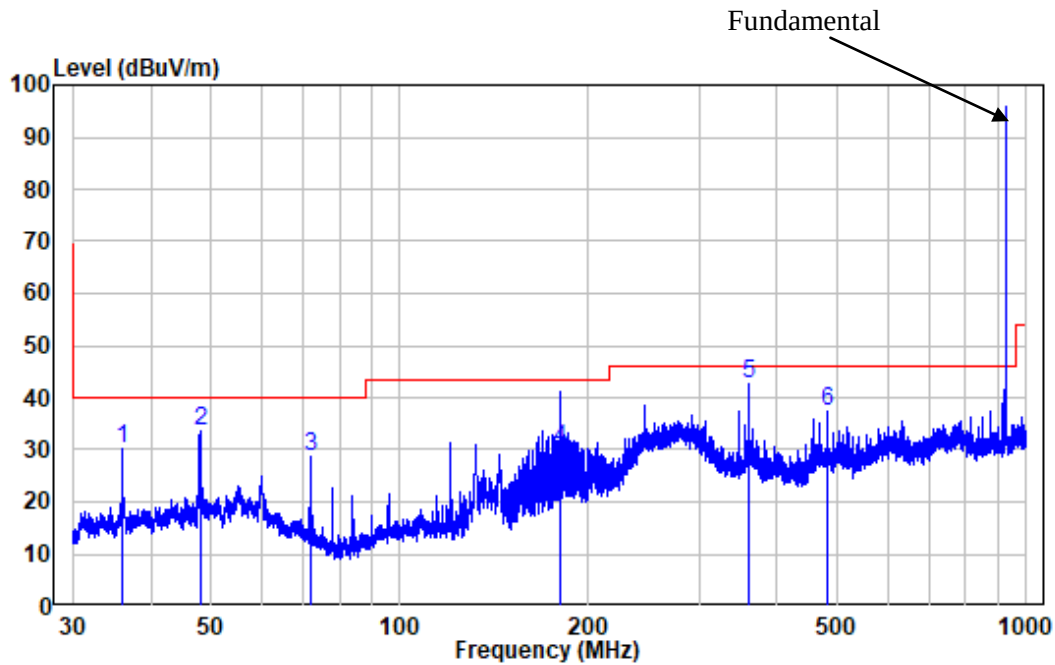
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1830.000	-13.38	51.10	37.72	74.00	-36.28	Peak
2	2745.000	-10.18	52.55	42.37	74.00	-31.63	Peak
3	3660.000	-8.82	48.89	40.07	74.00	-33.93	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA230426-22448E-RF
Test Mode: 915MHz TX

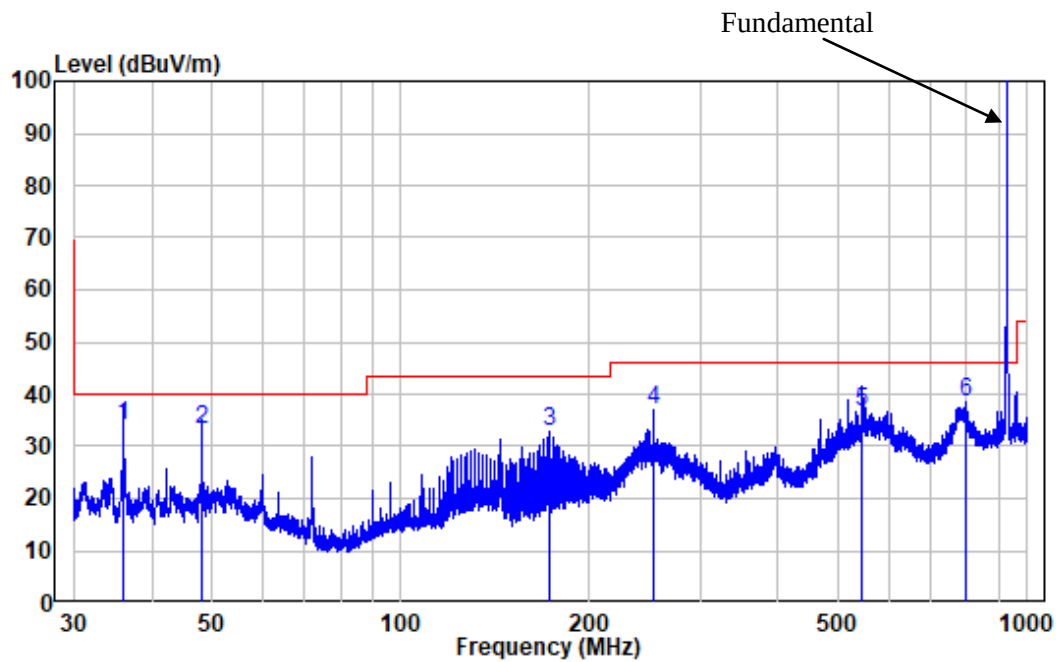
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1830.000	-13.38	56.15	42.77	74.00	-31.23	Peak
2	2745.000	-10.18	53.63	43.45	74.00	-30.55	Peak
3	3660.000	-8.82	49.68	40.86	74.00	-33.14	Peak

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

Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA230426-22448E-RF
Test Mode: 927MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	36.048	-11.18	41.47	30.29	40.00	-9.71	Peak
2	48.036	-10.00	43.44	33.44	40.00	-6.56	Peak
3	72.084	-15.63	44.30	28.67	40.00	-11.33	Peak
4	180.253	-12.74	42.80	30.06	43.50	-13.44	QP
5	360.922	-7.65	50.14	42.49	46.00	-3.51	Peak
6	480.107	-5.00	42.32	37.32	46.00	-8.68	Peak

Vertical



Site : chamber

Condition: 3m VERTICAL

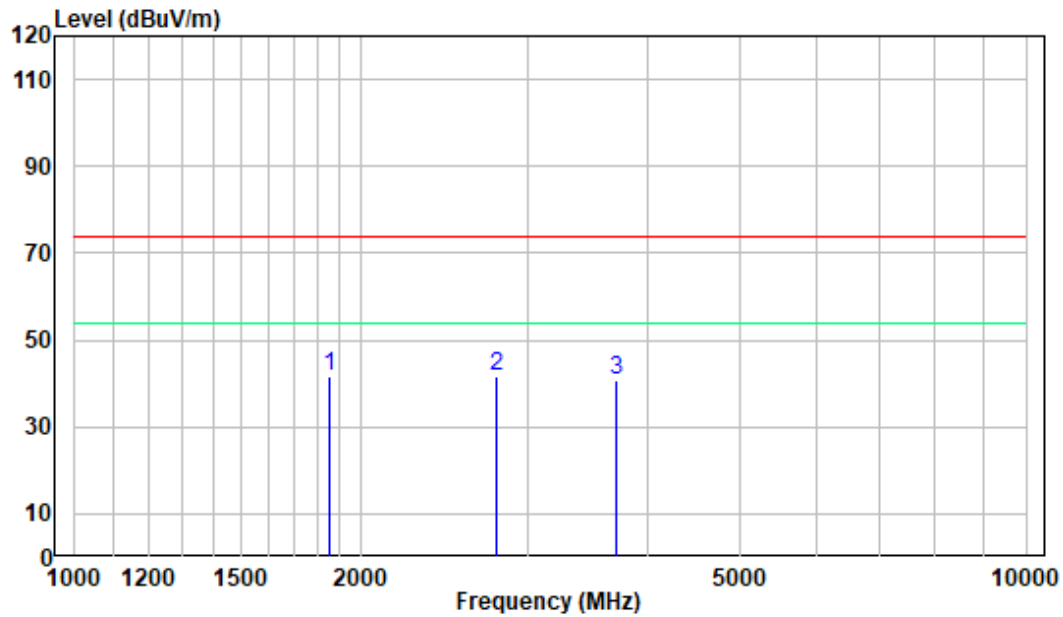
Job No. : RA230426-22448E-RF

Test Mode: 927MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	35.938	-11.22	45.02	33.80	40.00	-6.20	QP
2	48.099	-10.00	43.04	33.04	40.00	-6.96	QP
3	172.978	-13.28	46.13	32.85	43.50	-10.65	Peak
4	252.616	-10.68	47.67	36.99	46.00	-9.01	Peak
5	544.466	-4.00	40.56	36.56	46.00	-9.44	QP
6	797.930	-0.30	38.95	38.65	46.00	-7.35	Peak

1-10GHz:

Horizontal



Site : chamber

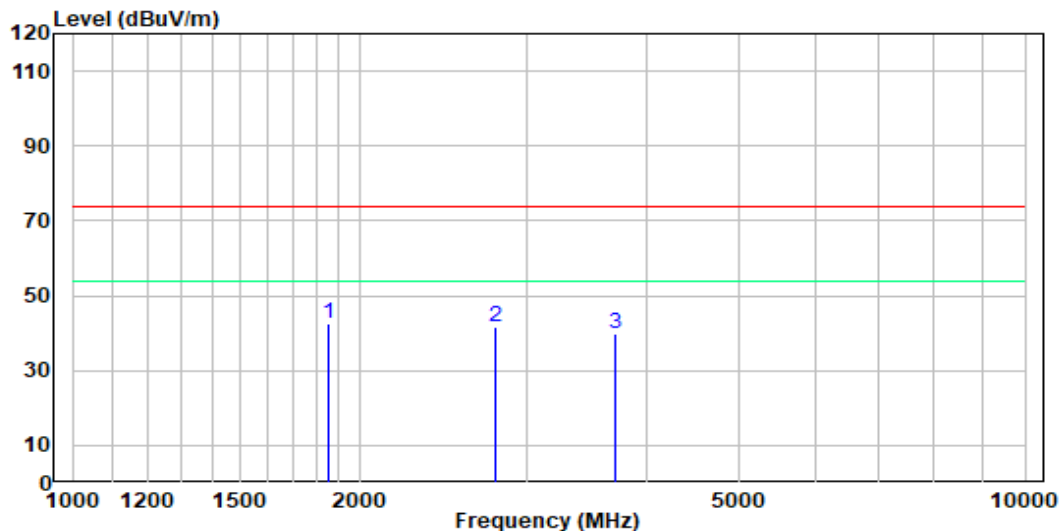
Condition: 3m HORIZONTAL

Job No. : RA230426-22448E-RF

Test Mode: 927MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1854.000	-13.62	55.12	41.50	74.00	-32.50	Peak
2	2781.000	-10.31	51.97	41.66	74.00	-32.34	Peak
3	3708.000	-8.90	49.47	40.57	74.00	-33.43	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA230426-22448E-RF
Test Mode: 927MHz TX

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	1854.000	-13.62	56.04	42.42	74.00	-31.58	Peak
2	2781.000	-10.31	52.01	41.70	74.00	-32.30	Peak
3	3708.000	-8.90	48.75	39.85	74.00	-34.15	Peak

Note:

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

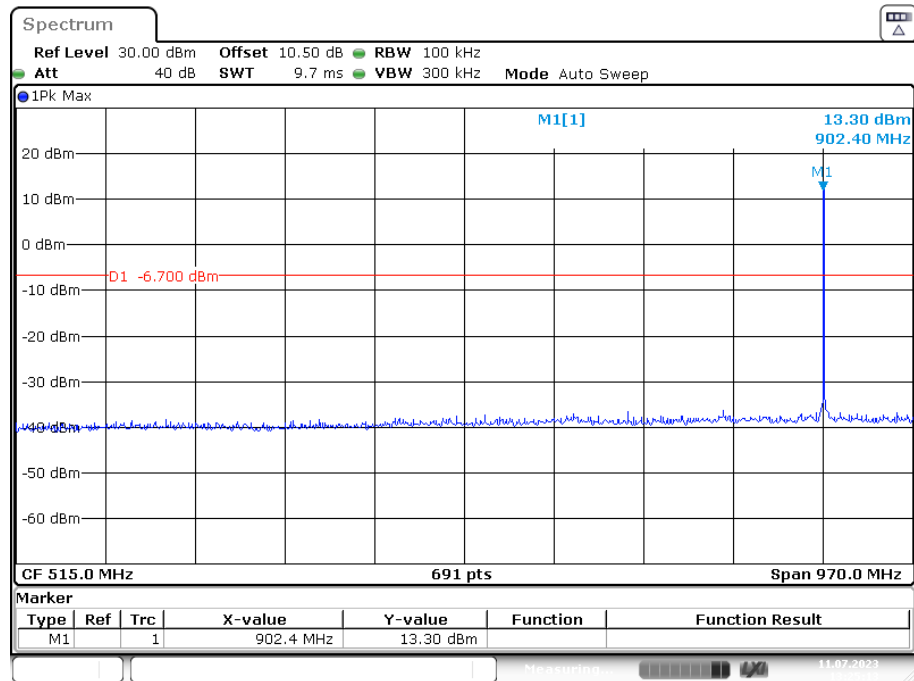
Level = Factor + Reading

Over limit = Level - Limit

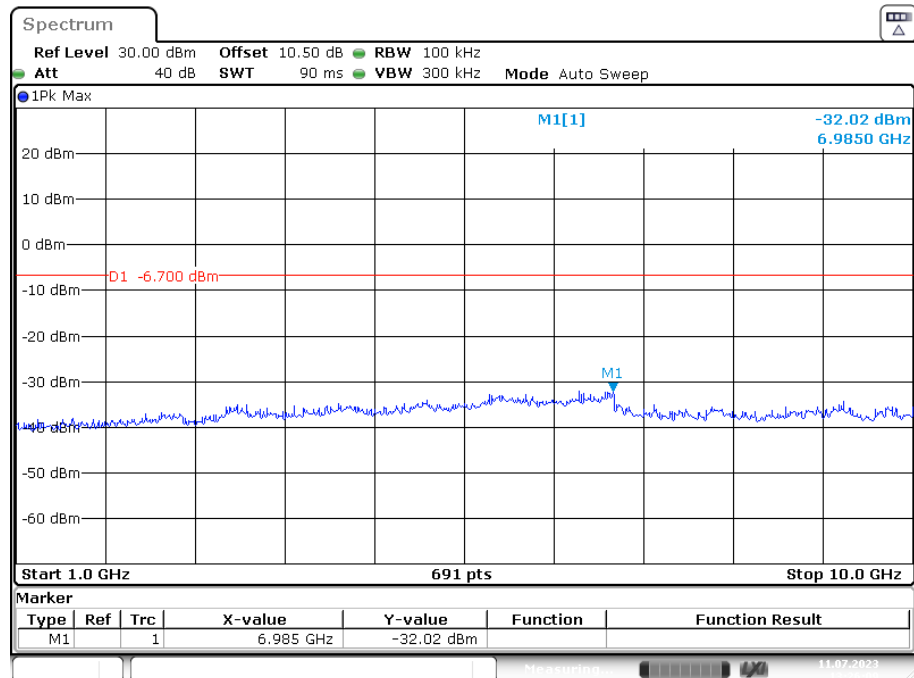
The other spurious emission which is in the noise floor level was not recorded.

For the RSE below 1GHz, when the test result of peak was 6dB below to the limit of QP, just peak value was 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:**

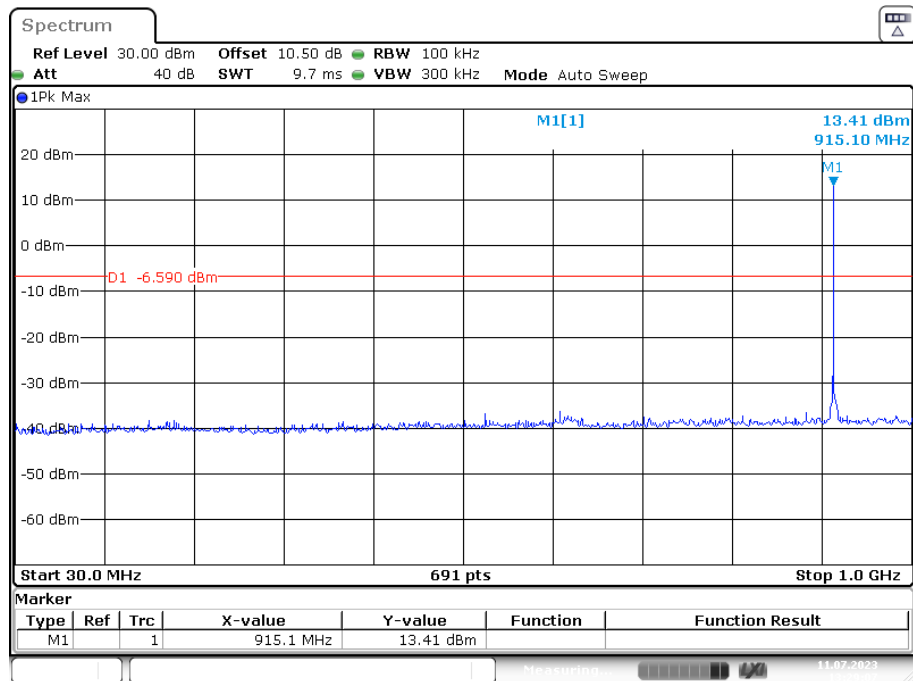
Date: 11.JUL.2023 13:25:14

1GHz-10GHz:

Date: 11.JUL.2023 13:26:10

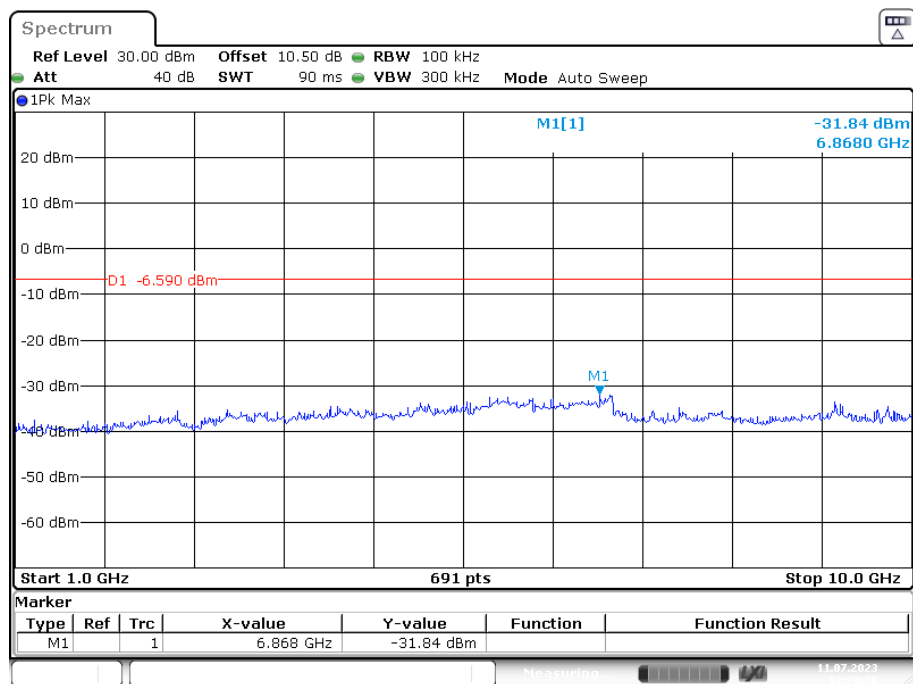
Middle Channel:

30MHz-1GHz:

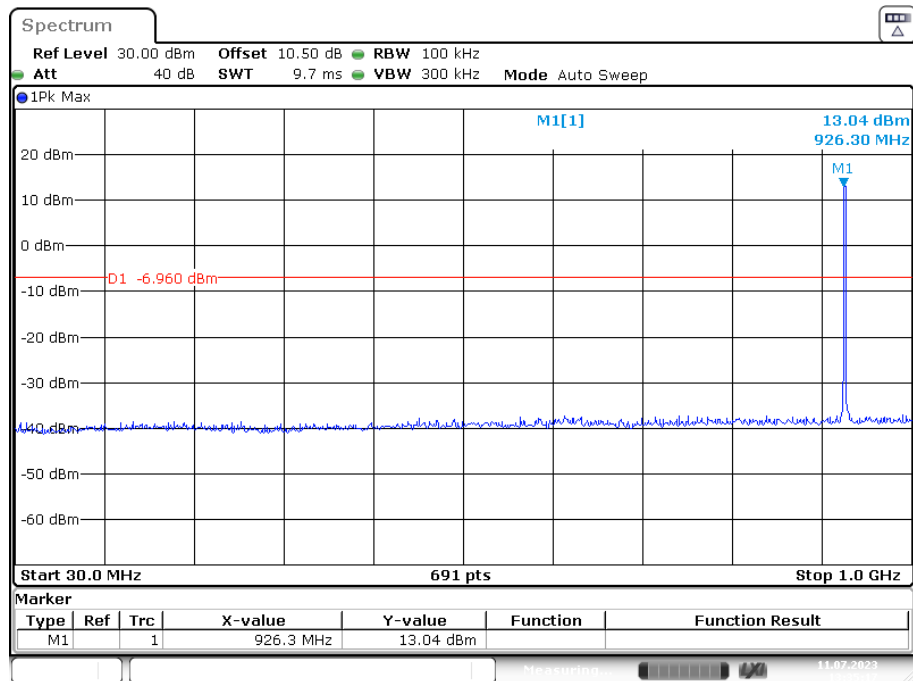


Date: 11.JUL.2023 13:29:08

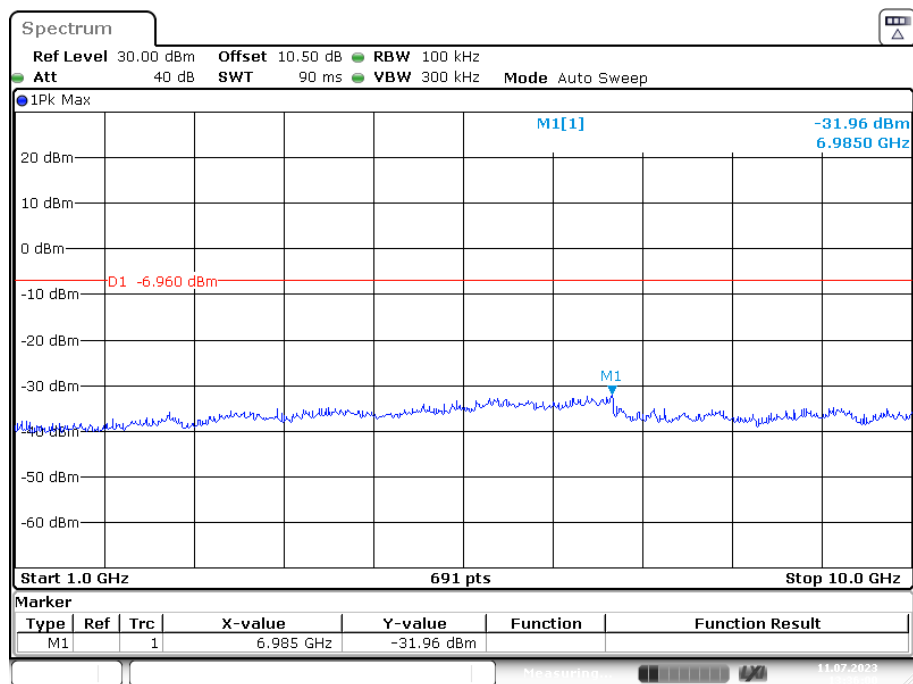
1GHz-10GHz:



Date: 11.JUL.2023 13:29:56

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

Date: 11.JUL.2023 13:35:17

1GHz-10GHz:

Date: 11.JUL.2023 13:36:00

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

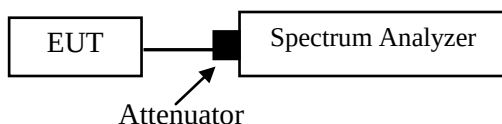
Applicable Standard

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

According to ANSI C63.10-2013, section 11.8 and section 6.9

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:	24 °C
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Matt Liang on 2023-05-14.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

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

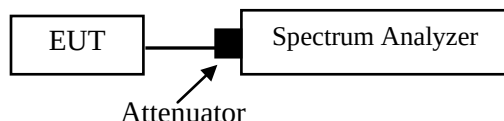
Applicable Standard

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

According to ANSI C63.10-2013, section 11.9.1.1

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:	24 °C
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Matt Liang on 2023-05-14.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

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

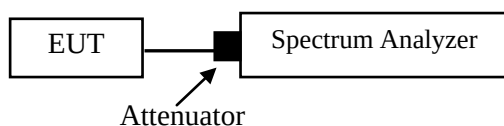
Applicable Standard

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

According to ANSI C63.10-2013, section 11.11

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 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Matt Liang on 2023-07-11.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

Conducted Band Edge Result:

FCC §15.247(e) - POWER SPECTRAL DENSITY

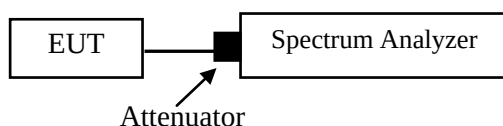
Applicable Standard

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

According to ANSI C63.10-2013, section 11.10.2

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:	24 °C
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Matt Liang on 2023-05-14.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

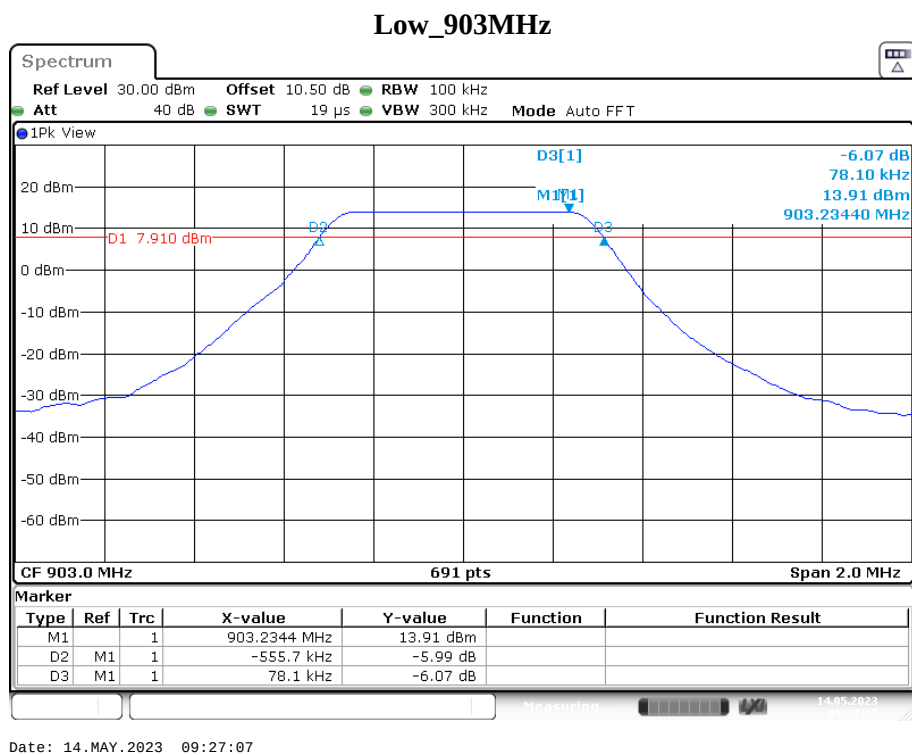
APPENDIX

Appendix A: 6dB Emission Bandwidth

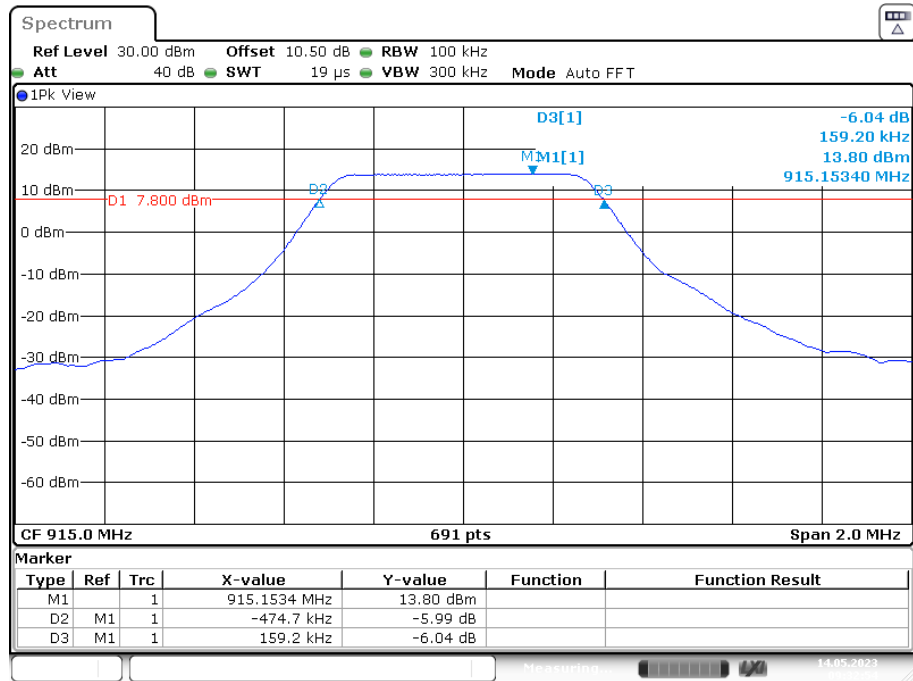
Test Result

Channel [MHz]	DTS BW [MHz]	Limit[MHz]	Verdict
903	0.634	0.5	PASS
915	0.634	0.5	PASS
927	0.622	0.5	PASS

Test Graphs

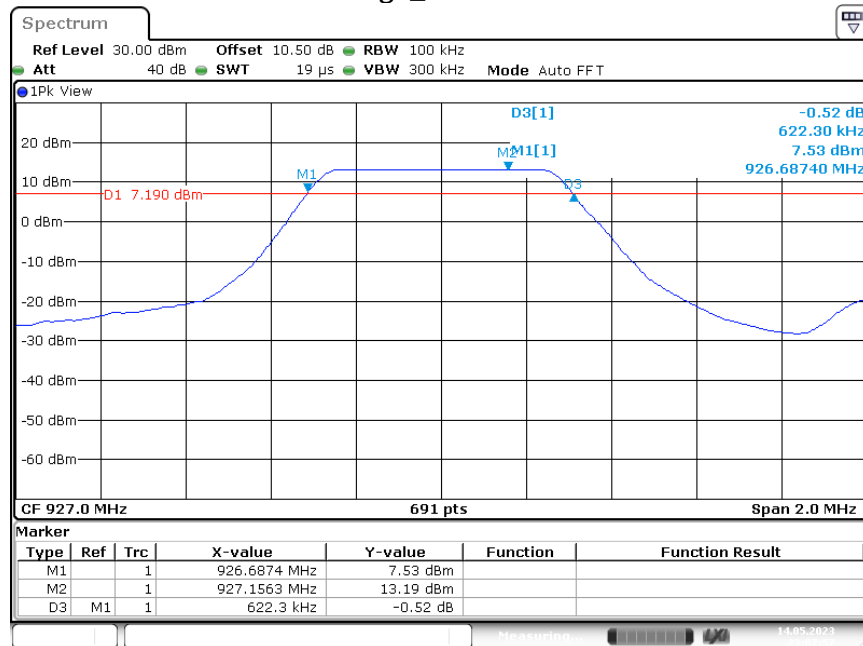


Middle_915MHz



Date: 14.MAY.2023 09:32:54

High_927MHz



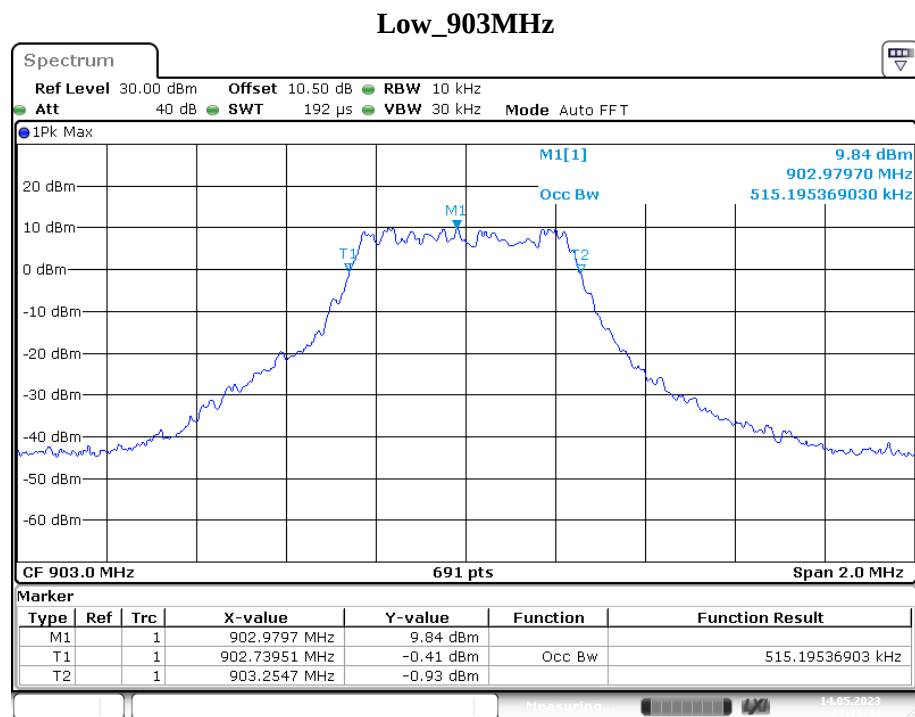
Date: 14.MAY.2023 23:07:58

Appendix B: Occupied Channel Bandwidth

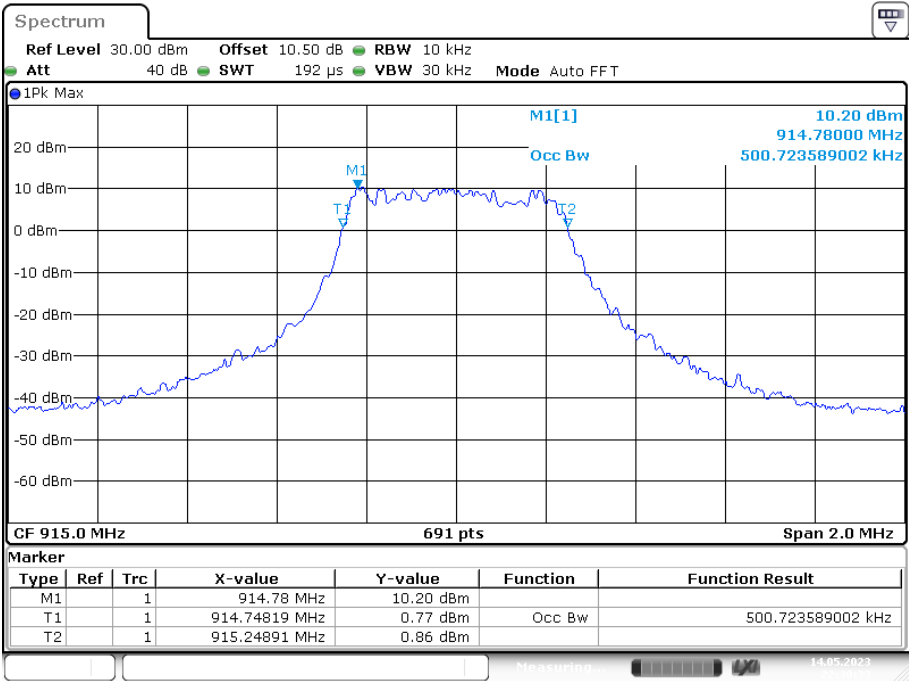
Test Result

Channel [MHz]	OCB [MHz]	Limit[dBm]	Verdict
903	0.515	---	---
915	0.501	---	---
927	0.515	---	---

Test Graphs

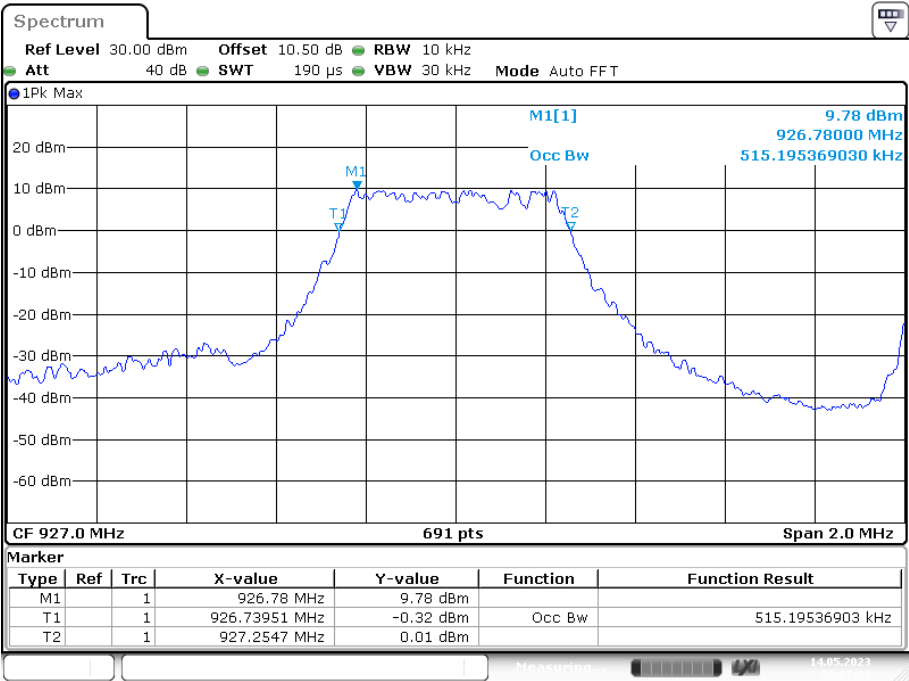


Middle_915MHz



Date: 14.MAY.2023 22:30:33

High_927MHz



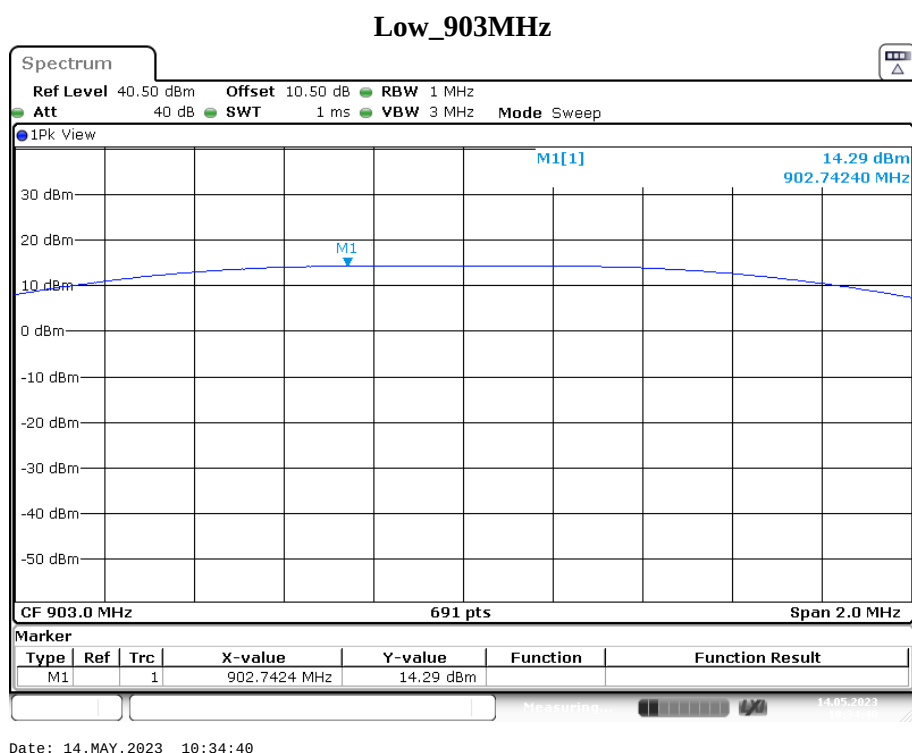
Date: 14.MAY.2023 22:07:21

Appendix C: Maximum Conducted Peak Output Power

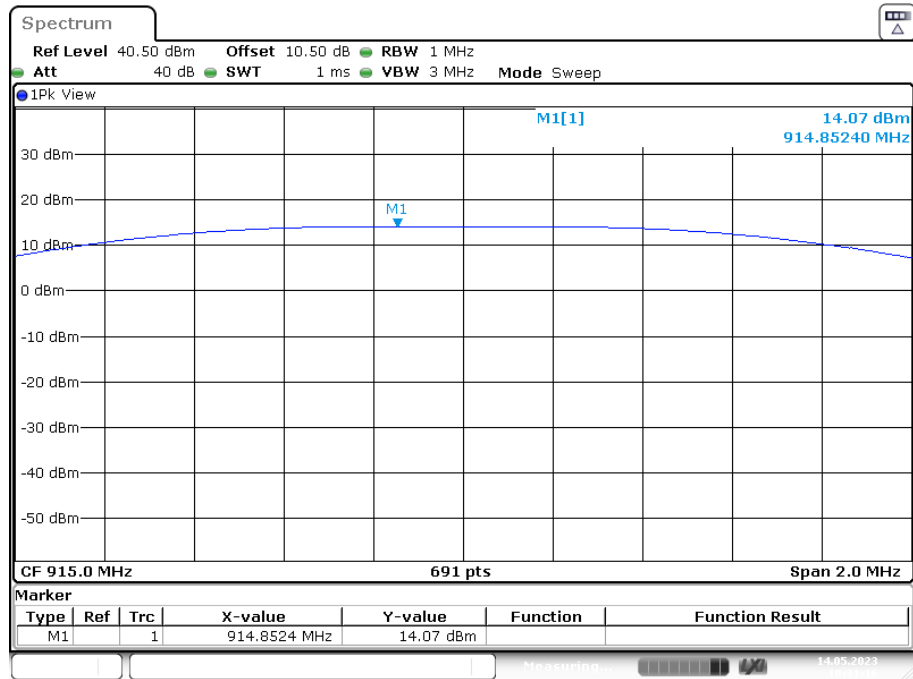
Test Result

Channel [MHz]	Result [dBm]	Limit[dBm]	Verdict
903	14.29	<=30	PASS
915	14.07	<=30	PASS
927	13.19	<=30	PASS

Test Graphs

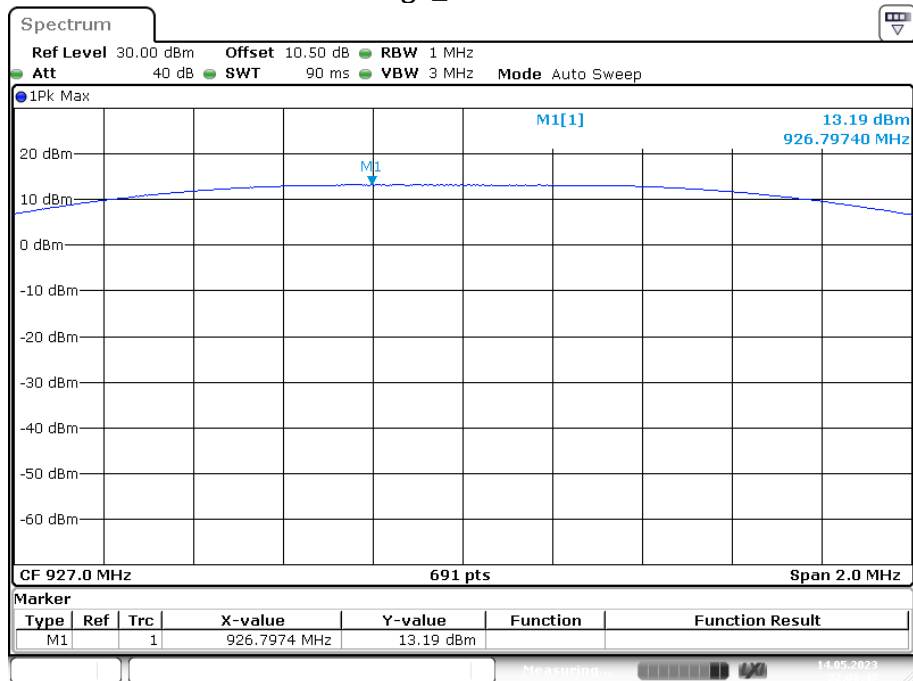


Middle_915MHz



Date: 14.MAY.2023 10:31:16

High_927MHz



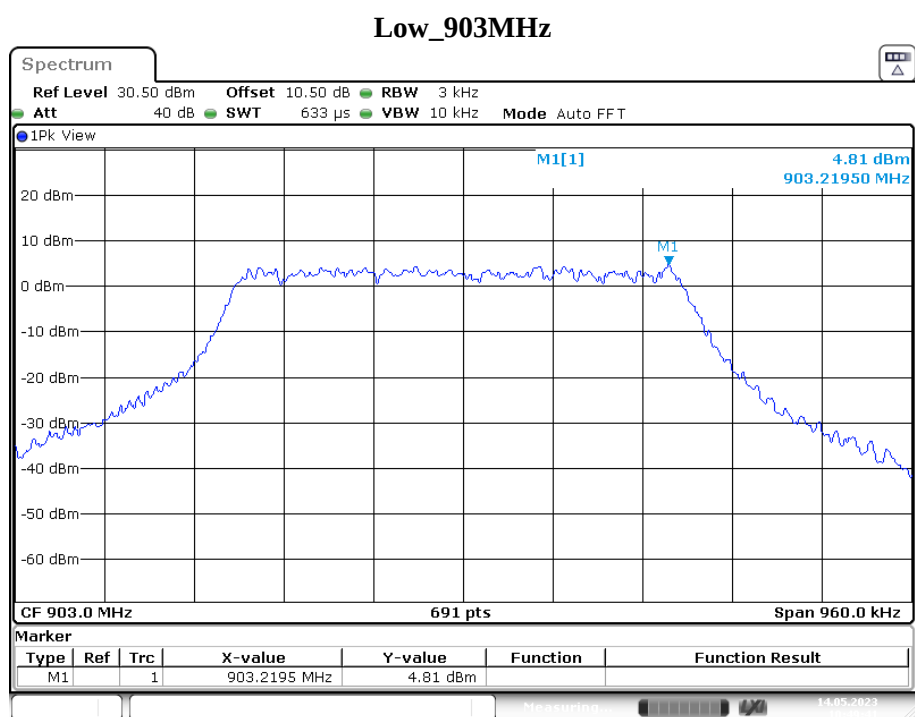
Date: 14.MAY.2023 22:08:47

Appendix D: Power spectral density

Test Result

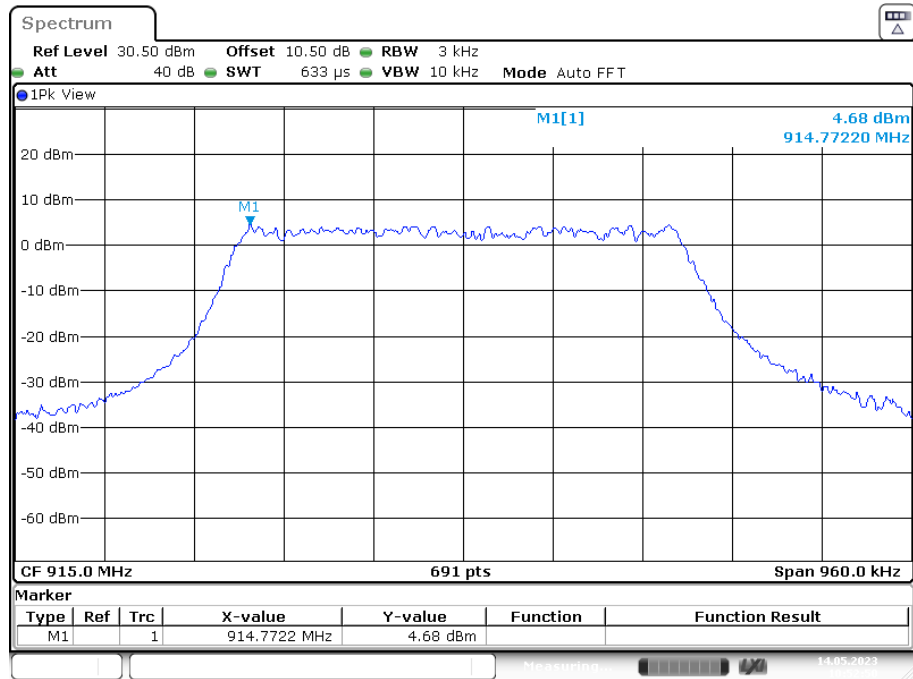
Channel[MHz]	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
903	4.81	<=8	PASS
915	4.68	<=8	PASS
927	3.93	<=8	PASS

Test Graphs



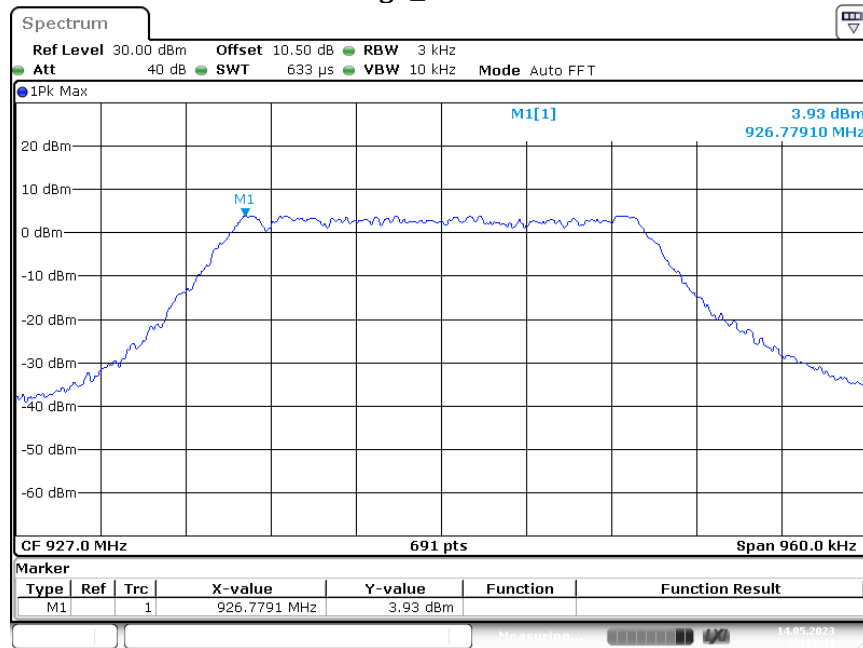
Date: 14. MAY. 2023 10:49:41

Middle_915MHz



Date: 14.MAY.2023 10:52:50

High_927MHz

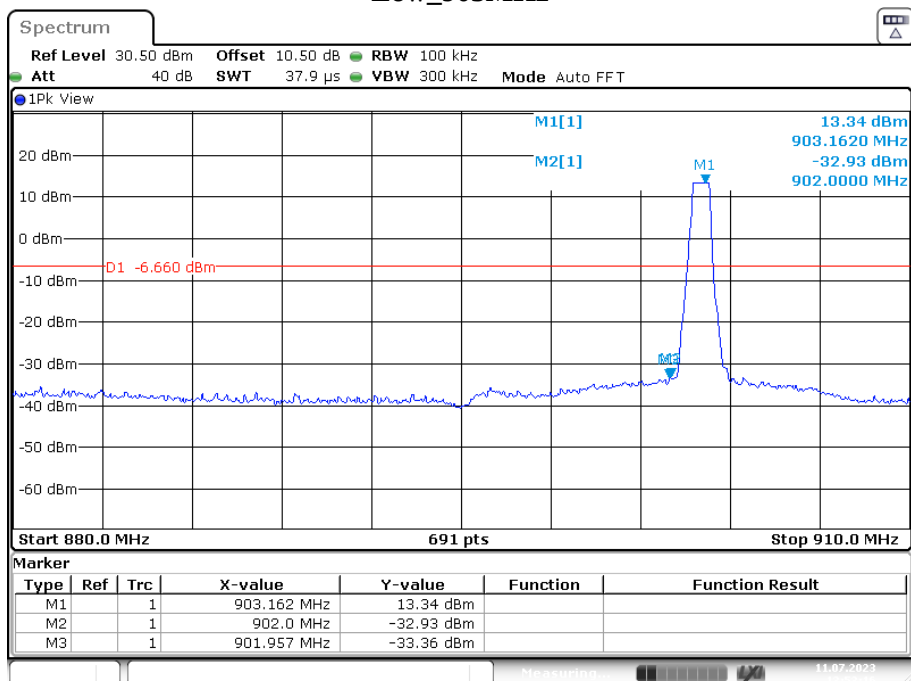


Date: 14.MAY.2023 23:13:45

Appendix E: Band edge measurements

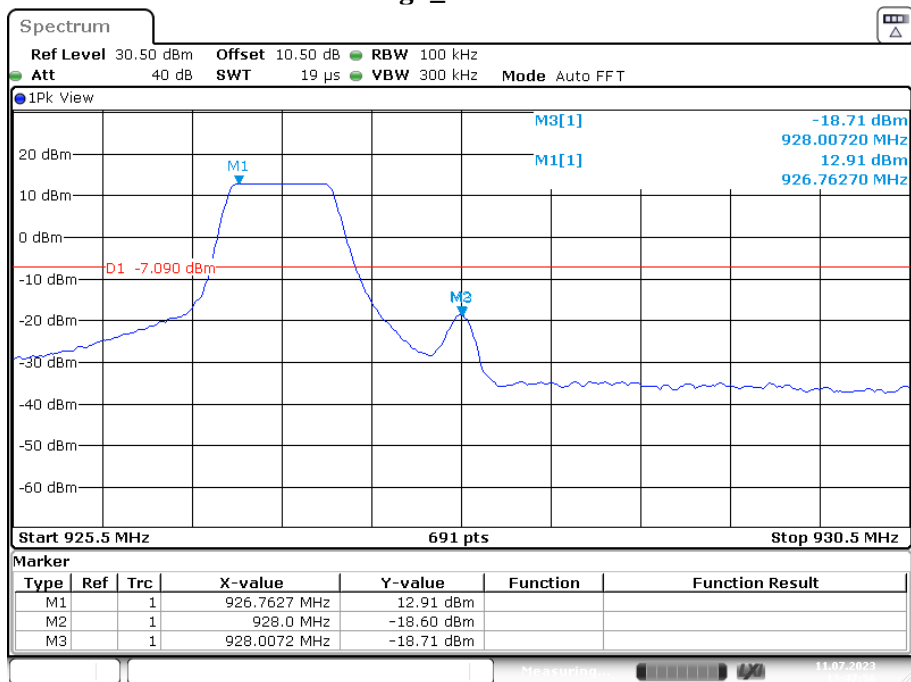
Test Graphs

Low_903MHz



Date: 11.JUL.2023 13:53:16

High_927MHz



Date: 11.JUL.2023 13:47:56

Appendix F: Duty Cycle

Test Data

Environmental Conditions

Temperature:	24-26.2 °C
Relative Humidity:	46-47 %
ATM Pressure:	101.0-101.19 kPa

The testing was performed by Matt Liang on 2023-05-24 and 2023-07-13.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the table and plots.

Channel [MHz]	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]	1/T Minimum VBW[kHz]
903	29.71	40.725	72.95	0.034
915	29.565	42.609	69.39	0.034
927	30.29	41.594	72.82	0.034

Test Graphs

