

TEST REPORT

Applicant: Seeed Technology Co., Ltd.
Address: 9F, G3 Building, TCL International E City,
Zhongshanyuan Road, Nanshan District, Shenzhen,
Guangdong Province, P.R.C
Equipment Type: SenseCAP Card Tracker
Model Name: T1000-A (refer to section 2.4)
Brand Name: Seeed Studio
Test Standard: MIC Ordinance Regulating Radio Equipment Article
2 paragraph 1 item (8)
Sample Arrival Date: May 29, 2023
Test Date: Jun. 02, 2023 - Jul. 13, 2023
Date of Issue: Jul. 25, 2023

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

**Tested by:** Julie Zhu**Checked by:** Ye Hongji**Approved by:** Liao Jianming
(Technical Director)

Revision History

Version	Issue Date	Revisions
<u>Rev. 01</u>	<u>Jul. 20, 2023</u>	<u>Initial Issue</u>
<u>Rev. 02</u>	<u>Jul. 25, 2023</u>	<u>1. Page6, the device name has been modified to SenseCAP Card Tracker.</u> <u>2. Page57~Page58, the declare rated power has been modified to 10mW.</u>

TABLE OF CONTENTS

1.	GENERAL INFORMATION.....	4
1.1	Test Laboratory	4
1.2	Test Location.....	4
2.	PRODUCT INFORMATION	5
2.1	Applicant Information.....	5
2.2	Manufacturer Information.....	5
2.3	Factory Information.....	5
2.4	General Description for Equipment under Test (EUT).....	5
2.5	Technical Information	6
3.	SUMMARY OF TEST RESULTS	8
3.1	MEASUREMENT UNCERTAINTY.....	8
4.	GENERAL TEST CONFIGURATIONS	9
4.1	Test Environment Conditions.....	9
4.2	Test Equipment List.....	9
4.3	Description of Test Setup	10
5.	TEST ITEMS	11
5.1	Frequency Tolerance.....	11
5.2	Permissible value for occupied bandwidth	12
5.3	Antenna Power	13
5.4	Permissible values for unwanted emission intensity	14
5.5	Antenna Power Error Measurement.....	16
5.6	Limit on secondary radiated emission(receiver).....	17

5.7	Adjacent Channel Leakage Power.....	18
5.8	Transmit time control equipment.....	19
5.9	Carrier Sense	21
5.10	Radio Channel.....	22
5.11	Modulation Method	22
5.12	Antenna.....	22
ANNEX A	TEST RESULT	23
A.1	Frequency Tolerance.....	23
A.2	Permission value for occupied bandwidth	28
A.3	Antenna Power	33
A.4	Permissible values for unwanted emission intensity	38
A.5	Antenna Power Error Measurement.....	57
A.6	Limit on secondary radiated emission(receiver).....	59
A.7	Adjacent channel leakage power	78
A.8	Transmission time control equipment	80
A.9	Carrier sense	85
A.10	Construction Protection Confirmation Method.....	85
ANNEX B	TEST SETUP PHOTOS	86
ANNEX C	EUT EXTERNAL PHOTOS.....	86
ANNEX D	EUT INTERNAL PHOTOS.....	86

1. GENERAL INFORMATION

1.1 Test Laboratory

Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100

1.2 Test Location

Name	Shenzhen BALUN Technology Co., Ltd.
Location	☒ Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
	☐ 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park, No. 1008, Songbai Road, Yangguang Community, Xili Sub-district, Nanshan District, Shenzhen, Guangdong Province, P. R. China

2. PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Seeed Technology Co., Ltd.
Address	9F, G3 Building, TCL International E City, Zhongshanyuan Road, Nanshan District, Shenzhen, Guangdong Province, P.R.C

2.2 Manufacturer Information

Manufacturer	Seeed Technology Co., Ltd.
Address	9F, Building G3, TCL International E city, Shuguang Community, Xili street, Nanshan, Shenzhen

2.3 Factory Information

Factory	Shenzhen Xinxian Technology Co; Limited
Address	F5, Building B17, Hengfeng Industrial City, No. 739 Zhoushi Rd, Baoan District, Shenzhen, Guangdong, P.R.C

2.4 General Description for Equipment under Test (EUT)

EUT Name	SenseCAP Card Tracker		
Model Name Under Test	T1000-A		
Series Model Name	T1000-B, T1000-C, T1000-D		
Description of Model name differentiation	All models are same with electrical parameters and internal circuit structure, but only differ as below (this information provided by the customer):		
	Model	Light, Temperature and Accelerometer sensor	GNSS Chip
	T1000-A	Support	AG3335
	T1000-B	Not support	AG3335
	T1000-C	Support	LR1110
	T1000-D	Not support	LR1110
Hardware Version	v1.2		
Software Version	v1.8		
Dimensions (Approx.)	N/A		
Weight (Approx.)	N/A		

2.5 Technical Information

Network and Wireless connectivity	Bluetooth BLE WIFI 802.11b, 802.11g, 802.11n (Only RX) LoRa, GPS, BDS, GLONASS, Galileo
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The requirement for the following technical information of the EUT was tested in this report:

Modulation Technology	LoRa	
Frequency Range	125 kHz	The frequency range used is 920.6 MHz – 928.0 MHz
	250 kHz	The frequency range used is 920.7 MHz – 927.9 MHz
Frequency Bandwidth	125 kHz, 250 kHz	
Number of channel	125 kHz	38
	250 kHz	37
Tested Channel	125 kHz	Low (920.6 MHz), Middle (924.2 MHz), High (928.0 MHz)
	250 kHz	Low (920.7 MHz), Middle (924.1 MHz), High (927.9 MHz)
Antenna Type	PCB Antenna	
Antenna Gain	-0.45 dBi (In test items related to antenna gain, the final results reflect this figure. This value is provided by the applicant.)	
About the Product	The equipment is SenseCAP Card Tracker, used for data transmission.	

Channel List:

125 kHz

Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)
24	920.6(Low)	37	923.2	50	925.8
25	920.8	38	923.4	51	926.0
26	921.0	39	923.6	52	926.2
27	921.2	40	923.8	53	926.4
28	921.4	41	924.0	54	926.6
29	921.6	42	924.2(Middle)	55	926.8
30	921.8	43	924.4	56	927.0
31	922.0	44	924.6	57	927.2
32	922.2	45	924.8	58	927.4
33	922.4	46	925.0	59	927.6
34	922.6	47	925.2	60	927.8
35	922.8	48	925.4	61	928.0(High)
36	923.0	49	925.6	--	--

250 kHz

Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)
1	920.7(Low)	14	923.3	27	925.9
2	920.9	15	923.5	28	926.1
3	921.1	16	923.7	29	926.3
4	921.3	17	923.9	30	926.5
5	921.5	18	924.1(Middle)	31	926.7
6	921.7	19	924.3	32	926.9
7	921.9	20	924.5	33	927.1
8	922.1	21	924.7	34	927.3
9	922.3	22	924.9	35	927.5
10	922.5	23	925.1	36	927.7
11	922.7	24	925.3	37	927.9(High)
12	922.9	25	925.5	--	--
13	923.1	26	925.7	--	--

3. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

Part	Description	Channel	Verdict
5.1	Frequency Tolerance	Low/Middle/High	Pass
5.2	Permissible value for occupied bandwidth	Low/Middle/High	Pass
5.3	Antenna Power	Low/Middle/High	Pass
5.4	Permissible values for unwanted emission intensity	Low/Middle/High	Pass
5.5	Antenna Power Error Measurement	Low/Middle/High	Pass
5.6	Limit on secondary radiated emission (receiver)	Low/Middle/High	Pass
5.7	Adjacent channel leakage power	Low/Middle/High	Pass
5.8	Transmission time control equipment	Low/Middle/High	Pass
5.9	Carrier Sense	Low/Middle/High	Pass
5.10	Construction Protection Confirmation	Low/Middle/High	Pass
5.11	Radio channel	N/A	N/A ^{Note 1}
5.12	Modulation method	N/A	N/A ^{Note 1}
5.13	Antenna	N/A	Pass ^{Note 1}
Note 1: see section 2.5 for this information.			

The test channel corresponding to the frequency list

Mode	Frequency Bandwidth	Description	Frequency(MHz)
LoRa	125 kHz	Low/Middle/High(L/M/H)	920.6/924.2/928.0
	250 kHz	Low/Middle/High(L/M/H)	920.7/924.1/927.9

3.1 MEASUREMENT UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Parameters	Uncertainty
Frequency Error / 99% & 90% Bandwidth	$(3.2 \times f \times 10^{-6})$ Hz
Antenna Power	1.82 dB
TX-RX Spurious Emissions	1.84 dB
Transmission Antenna Gain	5.36 dB
Temperature	0.8 °C
Humidity	4 %
DC / AC Power Source	0.04 %
Note: “ f ” is the nominal signal frequency in Hz.	

4. GENERAL TEST CONFIGURATIONS

4.1 Test Environment Conditions

During the measurement, the normal environment conditions were within the listed ranges:

Relative Humidity (%)	51% to 69%	
Atmospheric Pressure (kPa)	86 kPa to 106 kPa	
Temperature	+20.1°C to +26.1°C	
Working Voltage of the EUT	NV (Normal Voltage)	3.7 V
	LV (Low Voltage)	3.3 V
	HV (High Voltage)	4.1 V

4.2 Test Equipment List

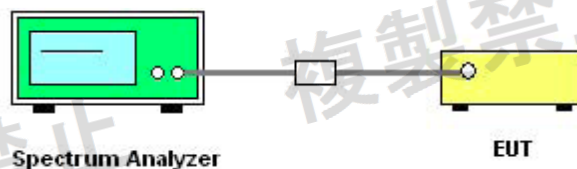
Description	Manufacturer	Model	Serial No.	Calibration Company	Calibration Address	Calibration By	Cal. Date	Cal. Due	Calibration Method
Spectrum Analyzer	KEYSIGHT	N9020A	MY50330200	Shenzhen Academy of Metrology & Quality Inspection	92 Longzhu Avenue, Nanshan District, Shenzhen, Guangdong, China	HuanJun	2023.05.16	2024.05.15	c)
Spectrum Analyzer	KEYSIGHT	N9020A	MY46471071	Shenzhen Academy of Metrology & Quality Inspection	92 Longzhu Avenue, Nanshan District, Shenzhen, Guangdong, China	HuanJun	2022.07.26	2023.07.25	c)
Multimeter	CEM	DT-9915	12104971	GUANGZHOU NEM METROLOGY & TEST TECHNOLOGY CO., LTD.	2/F., Building 1, No.176, Hedong Road, Liwan District, Guangzhou, Guangdong, China	LiXiang	2022.12.28	2023.12.27	c)
DC Power Supply	ITECH	IT6863A	800014020757810006	GUANGZHOU NEM METROLOGY & TEST TECHNOLOGY CO., LTD.	2/F., Building 1, No.176, Hedong Road, Liwan District, Guangzhou, Guangdong, China	LiXiang	2022.09.25	2023.09.24	c)

Note:

- Calibration conducted by the National Institute of Information and Communications Technology (NICT) (hereinafter referred to as "NICT") or a designated calibration agency under Article 102-18 paragraph (1)
- Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law (Law No. 51 of 1992)
- Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1)
- Calibration conducted by using measuring instruments and other equipment listed in the right column of Table No. 3 attached hereto, which shall have been given any of calibration, etc. listed above from a) to c)

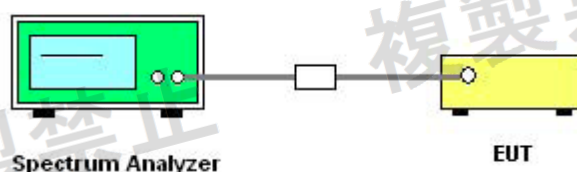
4.3 Description of Test Setup

4.3.1 For Antenna Port Test



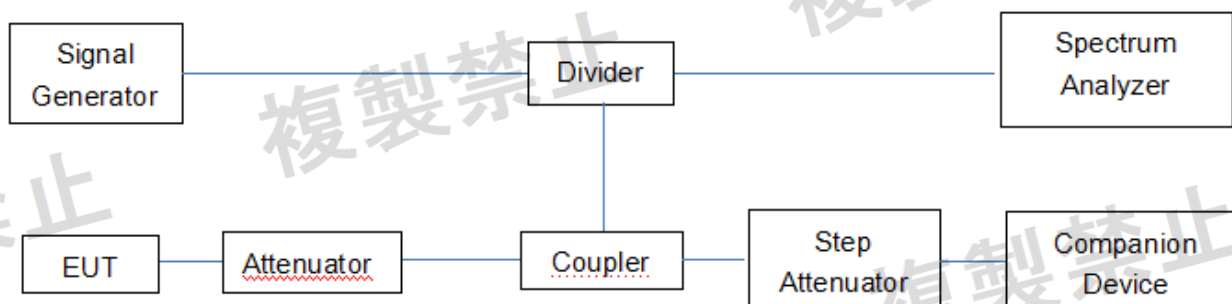
(Diagram 1)

4.3.2 For EIRP Antenna Power Test



(Diagram 2)

4.3.3 For Carrier Sense Test



(Diagram 3)

5. TEST ITEMS

5.1 Frequency Tolerance

5.1.1 Limit

Item	Limits
Frequency Tolerance	$\leq \pm 20$ ppm

5.1.2 Test Setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.1.3 Test Procedure

- 1: In the case of unmodulated waves: Continuous burst transmission of continuous or unmodulated wave of unmodulated wave from test equipment, Measured with a frequency meter.
- 2: In the case of modulated waves (unmodulated waves can not be generated): Transmit a modulated wave whose occupied bandwidth is the maximum * from the test equipment, Set the spectrum analyzer to the setting on the right to measure the frequency. 99% Measure the frequency of "upper limit + lower limit" / 2 of power. (= OBW).

5.1.4 Test Deviation

There is no deviation with the original standard.

5.1.5 Test Result

Please refer to ANNEX A.1.

5.2 Permissible value for occupied bandwidth

5.2.1 Limit

It shall be $(200 \times n)$ kHz or less. However, in the case that the center frequency is from 928.15 MHz to 929.65 MHz, it shall be $(100 \times n)$ kHz or less. (n is a number of unit radio channels constituting the radio channel and is an integer from 1 to 5.)

5.2.2 Test set up

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B

5.2.3 Test procedure

- 1: The test equipment transmits continuous burst transmission.
- 2: Transmit the modulated wave with the largest occupied bandwidth.
- 3: Measure the occupied frequency bandwidth (99% of total power) by setting the spectrum analyzer to the right setting.
- 4: Search spectrum antenna by setting spectrum analyzer as below.
 - Center frequency: Test frequency
 - SPAN: 2 to 3.5 times the allowable value of OBW
 - RBW: About 1% of the allowable value of OBW
 - VBW: equivalent to RBW
 - Number of data points: 400 or more
 - Sweep time: In the case of burst waves, the duration of one burst per sample or more
 - Sweep mode: Continuous sweep
 - Detection mode: positive peak
 - Display mode: Max hold

5.2.4 Test deviation

There is no deviation with the original standard

5.2.5 Test result

Please refer to ANNEX A.2.

5.3 Antenna Power

5.3.1 Limit

It shall be 20 mW or less. However, it shall be 1 mW or less for radio channels consisting of at least one of unit radio channels whose center frequencies are located from 916.0 MHz to 916.8 MHz or from 928.15 MHz to 929.65 MHz.

Regardless of the above specification, on and before July 24, 2012, it shall be 1 mW or less for radio channels consisting of at least one of unit radio channels whose center frequencies are located from 928.15 MHz to 929.65 MHz. It shall be 20 mW or less for radio channels consisting of only unit radio channels whose center frequencies are located from 920.6 MHz to 928.0 MHz and 920.7 MHz to 927.9 MHz only

5.3.2 Test Setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

1: Continuous transmission of normal modulated wave from test equipment, continuous burst transmission

2: Search spectrum antenna by setting spectrum analyzer as below

Center frequency: Test frequency

SPAN: 2 to 3.5 times the OBW tolerance

RBW: 1 MHz

VBW: 3 times or more than RBW

Number of data points: 400 or more

Sweep time: In the case of burst waves, the duration of one burst per sample or more

Sweep mode: Continuous sweep

Detection mode: positive peak

Display mode: Max hold.

5.3.4 Test Deviation

There is no deviation with the original standard.

5.3.5 Test Result

Please refer to ANNEX A.3.

5.4 Permissible values for unwanted emission intensity

5.4.1 Limit

Frequency Band	Spurious emission /Unwanted Emission Intensity (average power)	Reference Bandwidth
$f \leq 710 \text{ MHz}$	- 36 dBm	100 kHz
$710 \text{ MHz} < f \leq 900 \text{ MHz}$	- 55 dBm	1M Hz
$900 \text{ MHz} < f \leq 915 \text{ MHz}$	- 55 dBm	100 kHz
$915 \text{ MHz} < f \leq 930 \text{ MHz}^*$ (Except for $ f-f_c \leq (200+100 \times n) \text{ kHz}$ if bandwidth of unit radio channel is 200kHz, except for $ f-f_c \leq (100+50 \times n) \text{ kHz}$ if bandwidth of unit radio channel is 100kHz. Except for $ f-f_c \leq (100+100 \times n) \text{ kHz}$ if frequency band is $915.9 \text{ MHz} \leq f \leq 916.9 \text{ MHz}$ and $920.5 \text{ MHz} \leq f \leq 922.3 \text{ MHz}$. Where n is a number of unit radio channels constituting the radio channel and is an integer from 1 to 5)	- 36 dBm	100 kHz
$930 \text{ MHz} < f \leq 1000 \text{ MHz}$	- 55 dBm	100 kHz
$1000 \text{ MHz} < f \leq 1,215 \text{ MHz}$	- 45 dBm	1M Hz
$1,215 \text{ MHz} < f$	- 30 dBm	1M Hz

5.4.2 Test Setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.4.3 Test Procedure

- 1: Carrier suppression filter is used as necessary
- 2: Transmit from test equipment with normal modulation state / modulation degree
- 3: Set up spectrum analyzer and search for spurious

SPAN: (described in Table 1)

RBW: (described in Table 1)

VBW: equivalent to RBW

Number of data points: 400 points or more (eg 1001 points)

Sweep time: In the case of burst waves, the duration of one burst per sample or more

Sweep mode: Single sweep

Detection mode: positive peak

5.4.4 Test Deviation

There is no deviation with the original standard.

5.4.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.4.6 Test Result

Please refer to ANNEX A.4.

5.5 Antenna Power Error Measurement

5.5.1 Limit

+20%, -80%

5.5.2 Test Setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.5.3 Test Procedure

1: Continuous transmission of normal modulated wave from test equipment, continuous burst transmission

2: Search spectrum antenna by setting spectrum analyzer as below

Center frequency: Test frequency

SPAN: 2 to 3.5 times the OBW tolerance

RBW: 1 MHz

VBW: 3 times or more than RBW

Number of data points: 400 or more

Sweep time: In the case of burst waves, the duration of one burst per sample or more

Sweep mode: Continuous sweep

Detection mode: positive peak

Display mode: Max hold.

Then Detect peaks from the entire display screen with the Zone marker We will display that level in W units.

Please calculate deviation from the rated power by the following procedure. (Measurement result - rated power) ÷ (rated power) × 100 [%]

5.5.4 Test Deviation

There is no deviation with the original standard.

5.5.5 Test Result

Please refer to ANNEX A.5.

5.6 Limit on secondary radiated emission(receiver)

5.6.1 Limit

Frequency Band	Limit on Secondary Radiated Emissions (Antenna input)	Reference Bandwidth
$f \leq 710 \text{ MHz}$	- 54 dBm	100 kHz
$710 \text{ MHz} < f \leq 900 \text{ MHz}$	- 55 dBm	1 MHz
$900 \text{ MHz} < f \leq 915 \text{ MHz}$	- 55 dBm	100 kHz
$915 \text{ MHz} < f \leq 930 \text{ MHz}$	- 54 dBm	100 kHz
$930 \text{ MHz} < f \leq 1000 \text{ MHz}$	- 55 dBm	100 kHz
$1000 \text{ MHz} < f$	- 47 dBm	1 MHz

5.6.2 Test Setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.6.3 Test Procedure

1: The test equipment stops transmission and puts it in a state of reception only.

2: Search for secondary fire by setting spectrum analyzer as below.

SPAN: (described in Limit Table)

RBW: (described in Limit Table)

VBW: equivalent to RBW

Number of data points: 400 points or more

Sweep time: Minimum time to guarantee measurement accuracy

Sweep mode: Single sweep

Detection mode: positive peak

5.6.4 Test Deviation

There is no deviation with the original standard.

5.6.5 EUT Operation during Test

The EUT was programmed to be in continuously receiving mode

5.6.6 Test result

Please refer to ANNEX A.6.

5.7 Adjacent Channel Leakage Power

5.7.1 Limit

Range	Limit
915.9-916.9MHz	i) Spectral power at the edge of a radio channel: It shall be -20dBm or less. ii) Leakage power in unit radio channel adjacent to a radio channel: It shall be -26dBm or less.
920.5-922.3MHz	i) Spectral power at the edge of a radio channel: It shall be -7dBm or less. ii) Leakage power in unit radio channel adjacent to a radio channel: It shall be -15dBm or less. If antenna power is reduced by 1mW or less, each adjacent channel leakage power is -26dBm or less.
922.3-928.1MHz (≤1mw)	i) Leakage power in unit radio channel adjacent to a radio channel: It shall be -26dBm or less.
920.5-928.1MHz (1mw<P<20mw)	i) Leakage power in unit radio channel adjacent to a radio channel: It shall be -15dBm or less.
928.1-929.7MHz	i) Leakage power in unit radio channel adjacent to a radio channel: It shall be -26dBm or less.

5.7.2 Test setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.7.3 Test procedure

- 1: The test equipment transmits continuous burst transmission.
- 2: Transmit the modulated wave with the largest occupied bandwidth.
- 3: Set spectrum analyzer, measure adjacent channel leakage power
 - Center frequency: Test frequency
Radio channel width: $n \times \text{unit channel}$
 - Adjacent channel width: Unit channel - 1 kHz * 1
 - RBW: 1 kHz
 - VBW: 3 times or more than RBW
 - Number of data points: 400 or more
 - Sweep time * 2: In the case of burst waves, the duration of one burst per sample or more
 - Sweep mode: Single sweep
 - Detection mode: positive peak

5.7.4 Test Deviation

There is no deviation with the original standard

5.7.5 Test result

Please refer to ANNEX A.7.

5.8 Transmit time control equipment

5.8.1 Limit

(1) In case the 5ms or more carrier sense is required:

If the center frequency is from 920.6MHz to 922.2MHz, or if the center frequency is from 922.4MHz to 923.4MHz, radio equipment shall stop its emission of radio wave less than 4s after it starts to emit radio wave. It shall wait 50ms or more for the consecutive emission. Meanwhile, it may emit radio wave again without waiting 50ms, if the emission time is less than 4s after its first emission, and this re-emission is started after 128 μ s or more carrier sense, and is finished less than 4s after its first emission.

(2) In case the 128 μ s or more and less than 5ms carrier sense time is required: If the center frequency is from 920.5MHz to 928.1MHz, the following conditions shall be satisfied. Radio equipment shall stop its emission of radio wave less than 400ms after it starts to emit radio wave. The sum of emission time per arbitrary one hour shall be 360s or less. Meanwhile, it shall wait for 2ms for the consecutive emission.

(3) In case non carrier sense is required:

The following conditions shall be satisfied:

1. If the center frequency is from 916.0MHz to 916.8MHz, or from 922.4MHz to 928.0MHz, and the antenna power is 1mW or less, radio equipment shall stop its emission of radio wave less than 100ms after it starts to emit radio wave. It shall wait 100ms or more for the consecutive emission. The sum of emission time per arbitrary one hour shall be 3.6s or less. Meanwhile, it may emit radio wave again without waiting 100ms, if the emission time less than 100ms after its first emission

2. If the center frequency is from 928.15MHz to 929.65MHz, radio equipment shall stop its emission of radio wave less than 50ms after it starts to emit radio wave. It shall wait 50ms or more for the consecutive emission. Meanwhile, it may emit radio wave again without waiting 50ms, if the emission time is less than 50ms after its first emission and the re-emission is finished less than 50ms after its first emission.

5.8.2 Test Setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.8.3 Test Procedure

1: From the reception state of the test equipment, the transmission time is maximum, the transmission pause time is the minimum state

2: Set the spectrum analyzer, measure the transmission signal with the rising trigger

3: Confirm that the transmission time is less than the specified value and the pause time is over the specified value

Center frequency: Test frequency

SPAN: 0 Hz

RBW: 1 MHz

VBW: same level as RBW (1 MHz)

Sweep time: about twice the allowable value (8 seconds)

Sweep mode: positive peak

Trigger condition: level rising

5.8.4 Test Deviation

There is no deviation with the original standard.

5.8.5 EUT Operation during Test

The EUT was programmed to be in switch between transmitting and receiving mode.

5.8.6 Test Result

Please refer to ANNEX A.8.

5.9 Carrier Sense

5.9.1 Limit

- (1) Radio equipment shall check if the interference exists by the career sense procedure before its new emission.
- (2) Carrier sense time shall be 128 μ s or more.
- (3) Carrier sense level, amount of received power at all of unit radio channels included in the radio channel to emit, shall be -80dBm at the antenna input. When the carrier sense level is more than -80dBm, radio equipment shall not emit any radio wave.
- (4) Carrier sense is not necessary if the antenna power is 1mW or less and the conditions of 3.4.1 (3) are satisfied

5.9.2 Test Setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.9.3 Test Procedure

- 1: Adjust the output level of SG so that it becomes the specified level at the receiving end of the test equipment.
- 2: With the SG output OFF state, put the test equipment in the transmission state and check the output from the test equipment with the spectrum analyzer
- 3: Take test equipment into receive state
- 4: Set the SG output to the ON state, the test equipment to the transmission state, and confirm that there is no output by the spectrum analyzer

5.9.4 Test Deviation

There is no deviation with the original standard.

5.9.5 Test Result

Please refer to ANNEX A.9.

5.10 Radio Channel

N/A

Note: Please refer to section 2.5 for this information.

5.11 Modulation Method

N/A

Note: It shall not be specified, please refer to section 2.5 for this information

5.12 Antenna

5.12.1 Limit

3dBi or less (absolute gain).

The value was declared by the manufacture. please refer to section 2.5 for this information.

ANNEX A TEST RESULT

A.1 Frequency Tolerance

Test Data

125 kHz

Test Mode	Test Voltage	Channel	Frequency f_c (MHz)	Test Frequency f (MHz)	Frequency Error ppm	Limit (ppm)	Refer to Plot	Verdict
Unmodulated	LV	Low	920.6	920.5996	-0.43	± 20	A.1.1	Pass
		Middle	924.2	924.1996	-0.43	± 20	A.1.2	Pass
		High	928.0	927.9995	-0.54	± 20	A.1.3	Pass
	NV	Low	920.6	920.5996	-0.43	± 20	A.1.4	Pass
		Middle	924.2	924.1996	-0.43	± 20	A.1.5	Pass
		High	928.0	927.9995	-0.54	± 20	A.1.6	Pass
	HV	Low	920.6	920.5996	-0.43	± 20	A.1.7	Pass
		Middle	924.2	924.1996	-0.43	± 20	A.1.8	Pass
		High	928.0	927.9995	-0.54	± 20	A.1.9	Pass

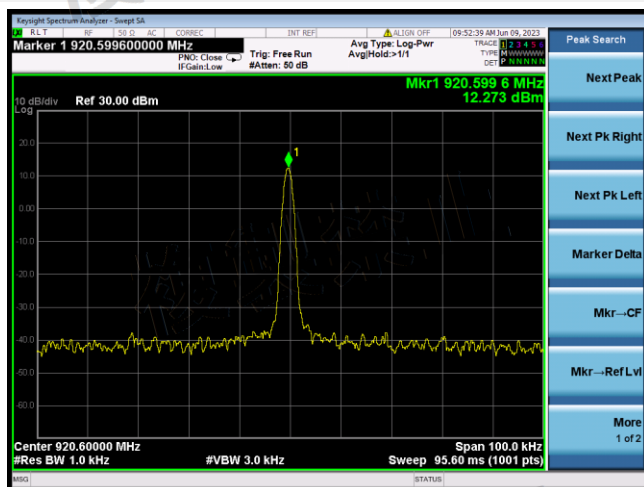
250 kHz

Test Mode	Test Voltage	Channel	Frequency f_c (MHz)	Test Frequency f (MHz)	Frequency Error ppm	Limit (ppm)	Refer to Plot	Verdict
Unmodulated	LV	Low	920.7	920.6998	-0.22	± 20	A.1.10	Pass
		Middle	924.1	924.0998	-0.22	± 20	A.1.11	Pass
		High	927.9	927.8997	-0.32	± 20	A.1.12	Pass
	NV	Low	920.7	920.6998	-0.22	± 20	A.1.13	Pass
		Middle	924.1	924.0998	-0.22	± 20	A.1.14	Pass
		High	927.9	927.8997	-0.32	± 20	A.1.15	Pass
	HV	Low	920.7	920.6997	-0.33	± 20	A.1.16	Pass
		Middle	924.1	924.0997	-0.32	± 20	A.1.17	Pass
		High	927.9	927.8997	-0.32	± 20	A.1.18	Pass

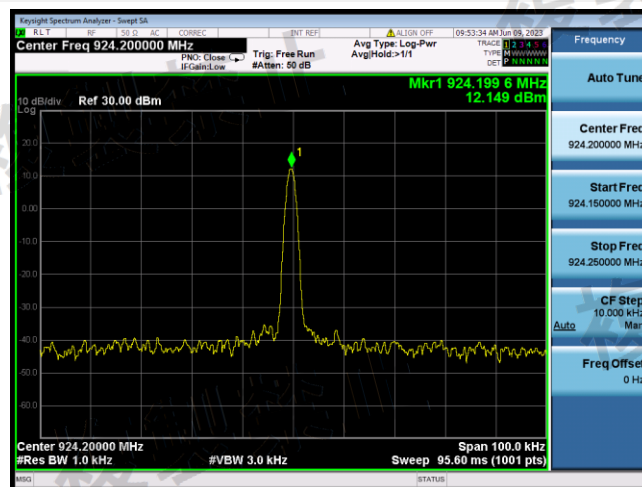
Test Plots

125 kHz

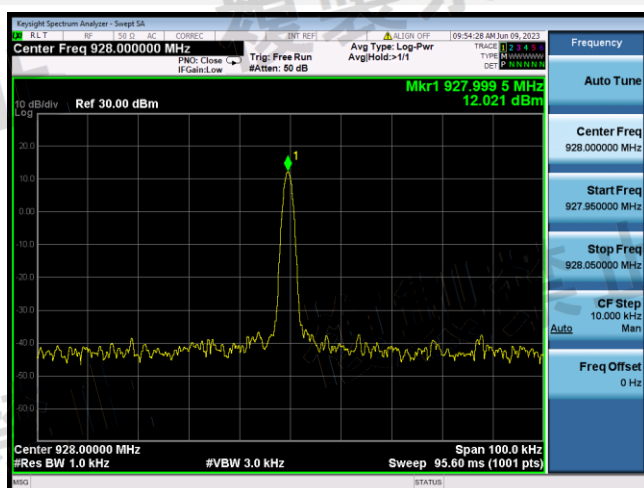
A.1.1 LV Low Channel



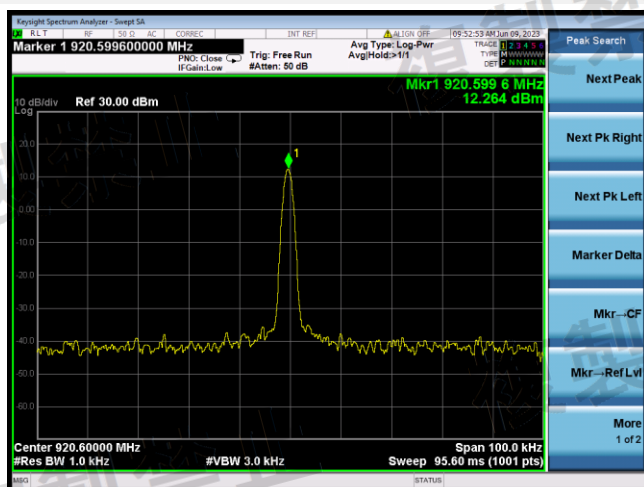
A.1.2 LV Middle Channel



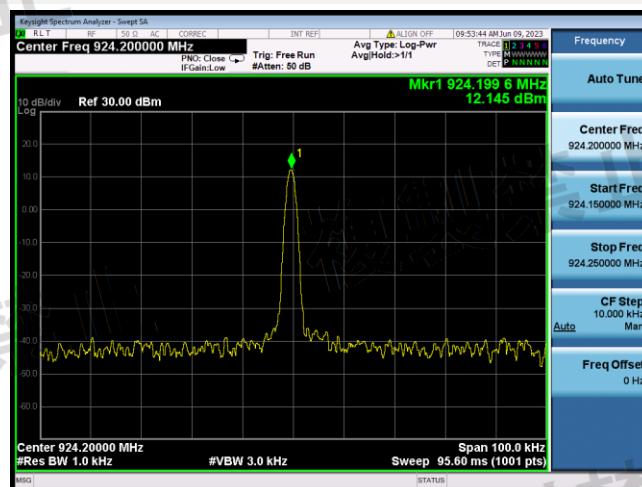
A.1.3 LV High Channel



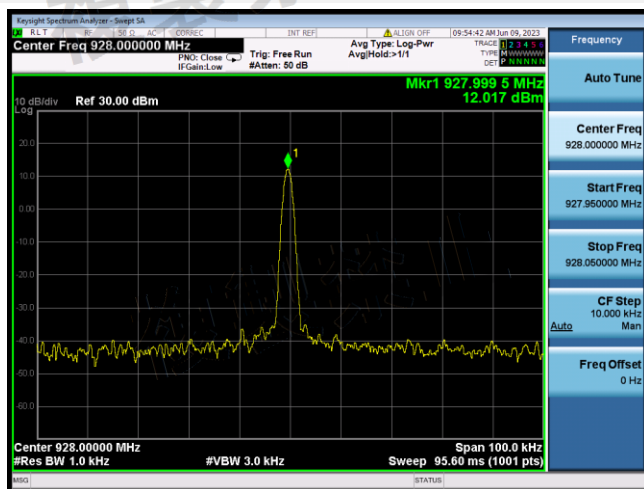
A.1.4 NV Low Channel



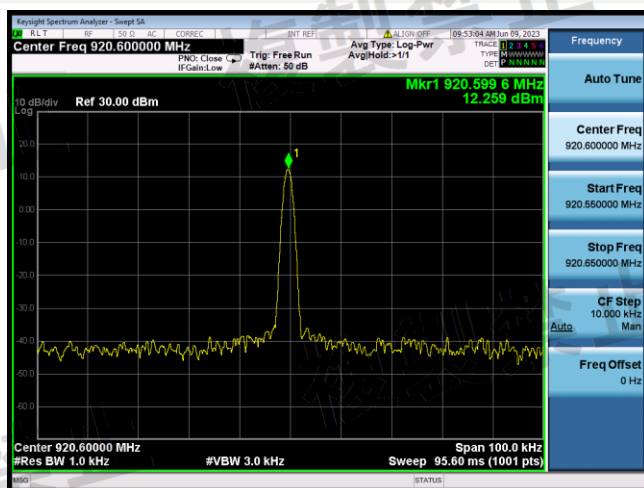
A.1.5 NV Middle Channel



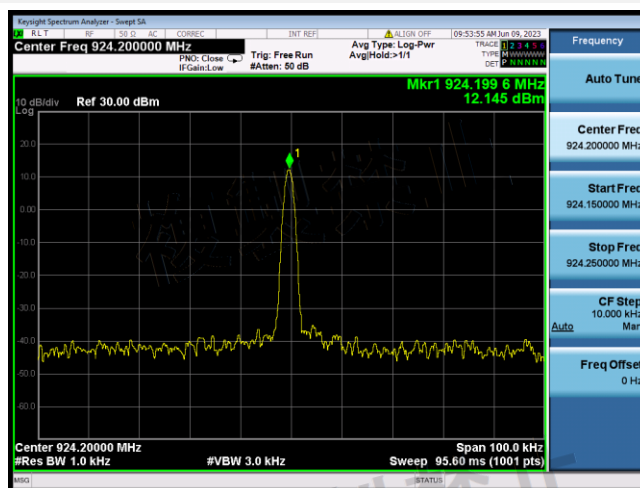
A.1.6 NV High Channel



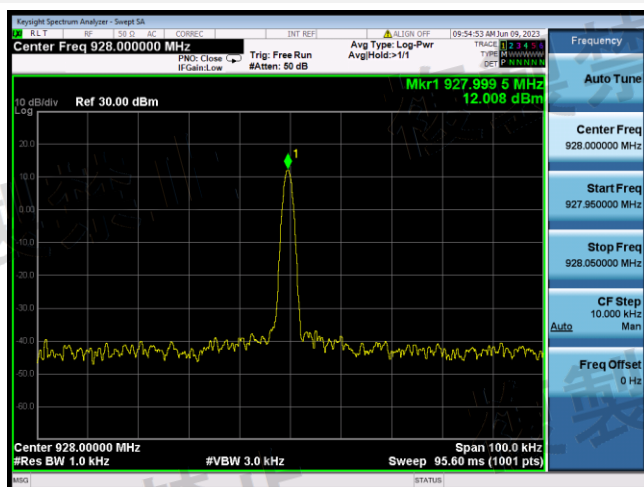
A.1.7 HV Low Channel



A.1.8 HV Middle Channel

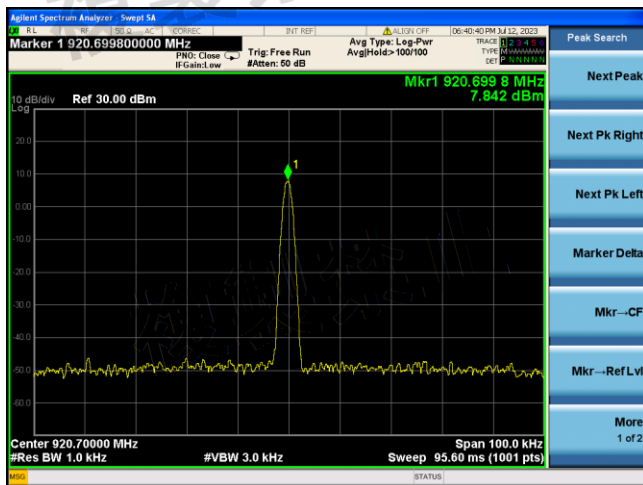


A.1.9 HV High Channel

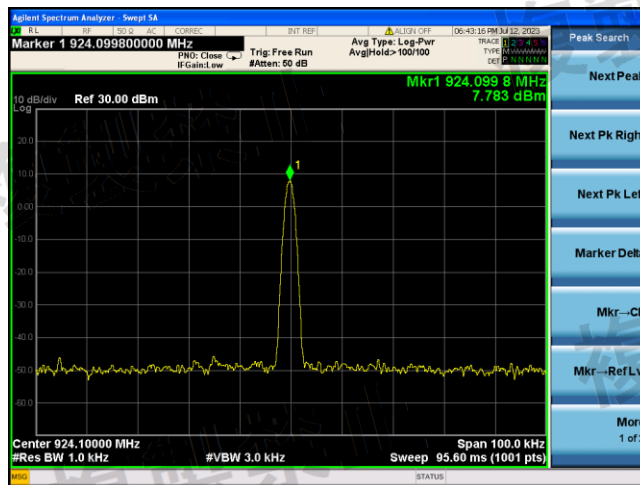


250 kHz

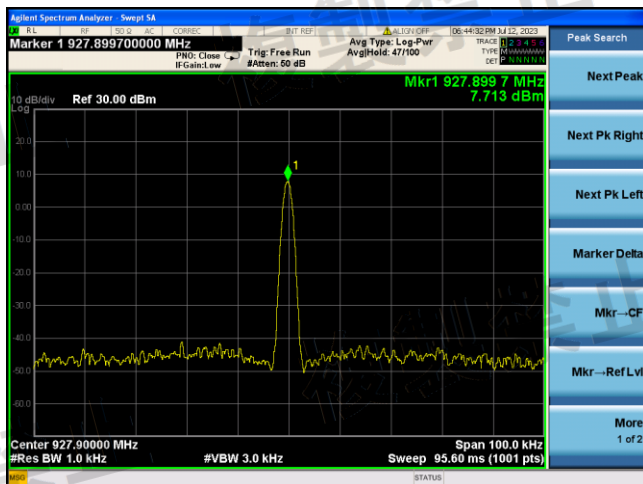
A.1.10 LV Low Channel



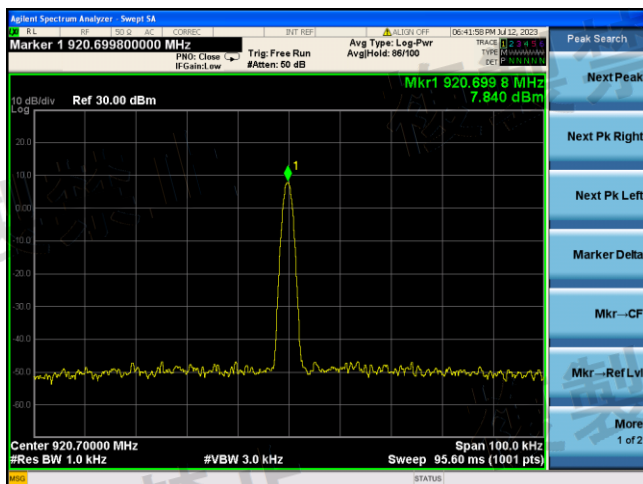
A.1.11 LV Middle Channel



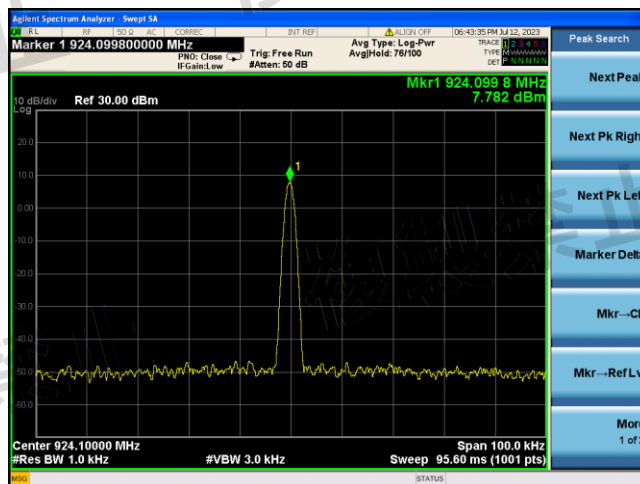
A.1.12 LV High Channel



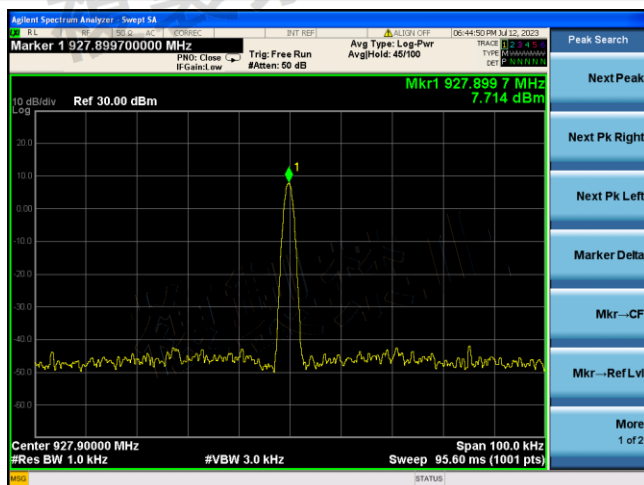
A.1.13 NV Low Channel



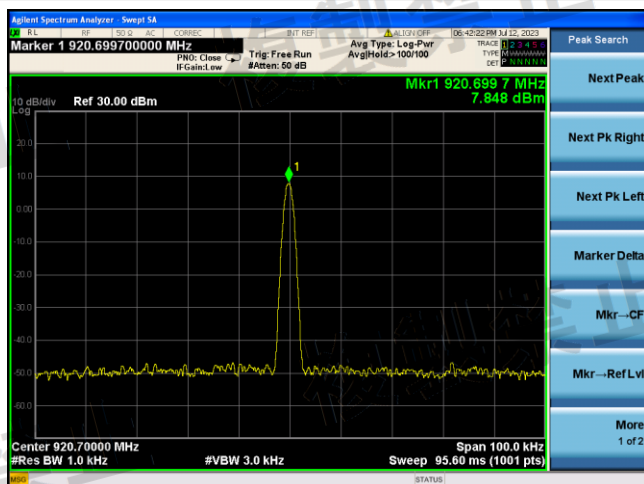
A.1.14 NV Middle Channel



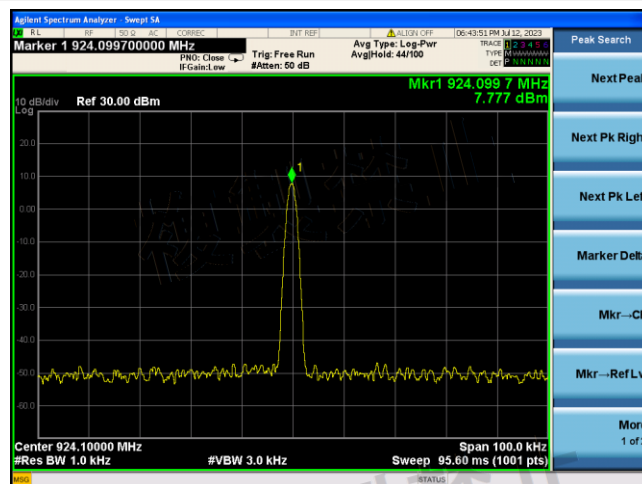
A.1.15 NV High Channel



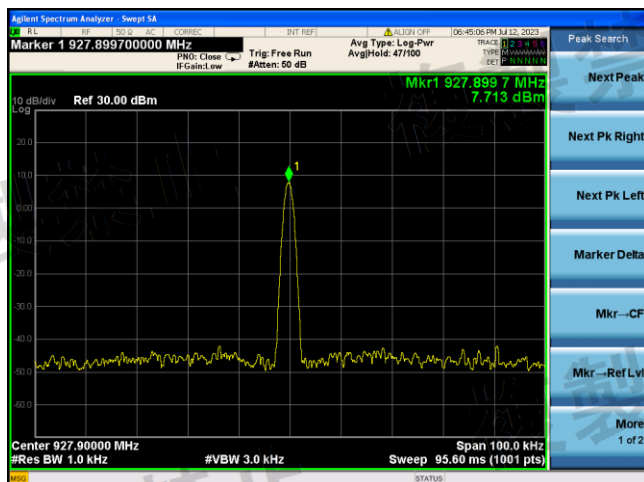
A.1.16 HV Low Channel



A.1.17 HV Middle Channel



A.1.18 HV High Channel



A.2 Permission value for occupied bandwidth

Test Data

125 kHz

	Test Mode	Channel	Test Voltage	Measured Occupied Bandwidth (kHz)	Limit (kHz)	Refer to Plot	Verdict
Results of Occupied Bandwidth	LoRa	Low	LV	125.30	200	A.2.1	Pass
			NV	125.20	200	A.2.2	Pass
			HV	125.21	200	A.2.3	Pass
		Middle	LV	125.25	200	A.2.4	Pass
			NV	125.24	200	A.2.5	Pass
			HV	125.13	200	A.2.6	Pass
		High	LV	125.26	200	A.2.7	Pass
			NV	125.18	200	A.2.8	Pass
			HV	125.30	200	A.2.9	Pass

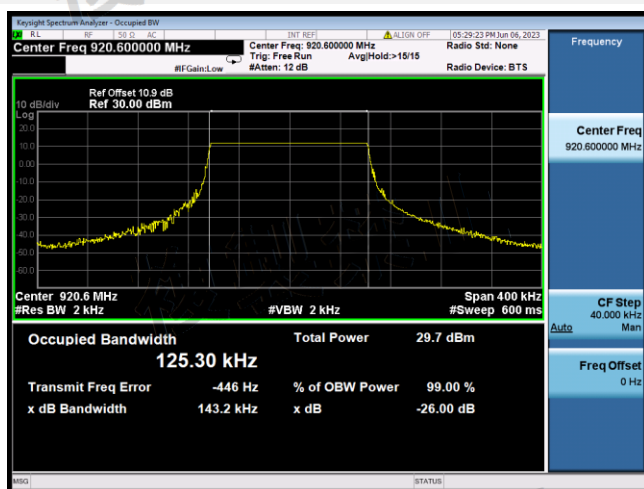
250 kHz

	Test Mode	Channel	Test Voltage	Measured Occupied Bandwidth (kHz)	Limit (kHz)	Refer to Plot	Verdict
Results of Occupied Bandwidth	LoRa	Low	LV	248.60	400	A.2.10	Pass
			NV	247.86	400	A.2.11	Pass
			HV	248.59	400	A.2.12	Pass
		Middle	LV	248.86	400	A.2.13	Pass
			NV	247.41	400	A.2.14	Pass
			HV	247.51	400	A.2.15	Pass
		High	LV	247.69	400	A.2.16	Pass
			NV	248.67	400	A.2.17	Pass
			HV	248.52	400	A.2.18	Pass

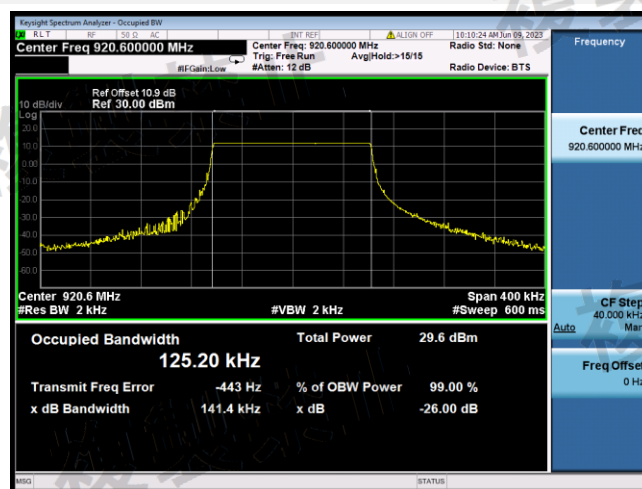
Test Plots

125 kHz

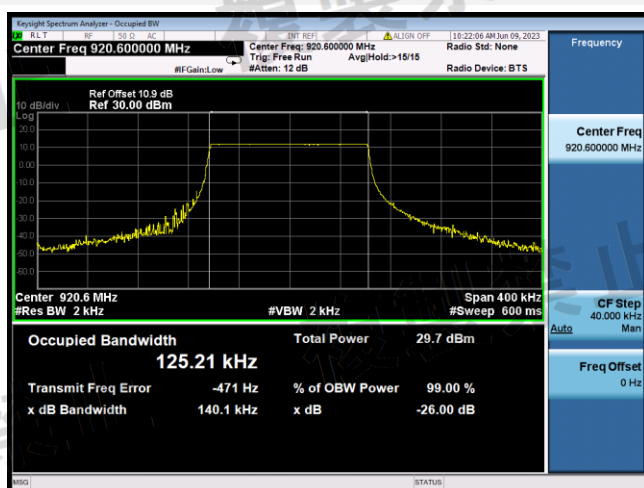
A.2.1. LV Low Channel



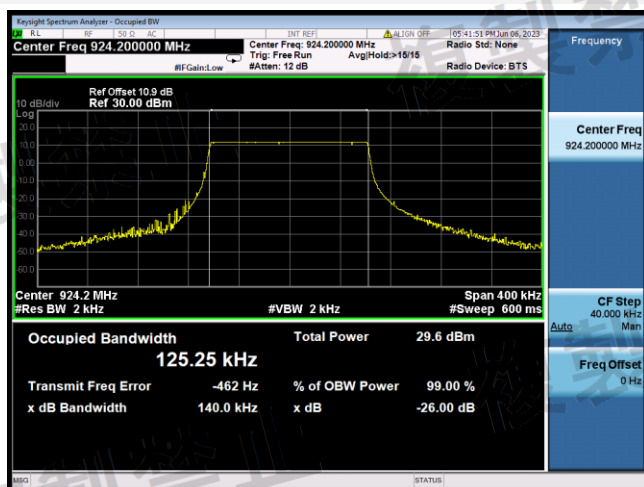
A.2.2. NV Low Channel



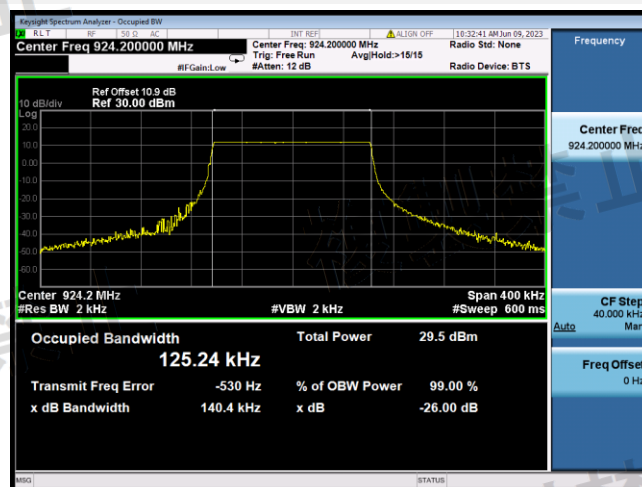
A.2.3. NV Low Channel



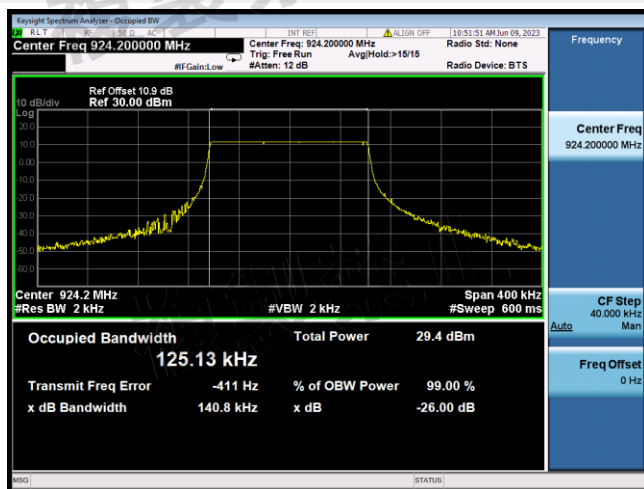
A.2.4. LV Middle Channel



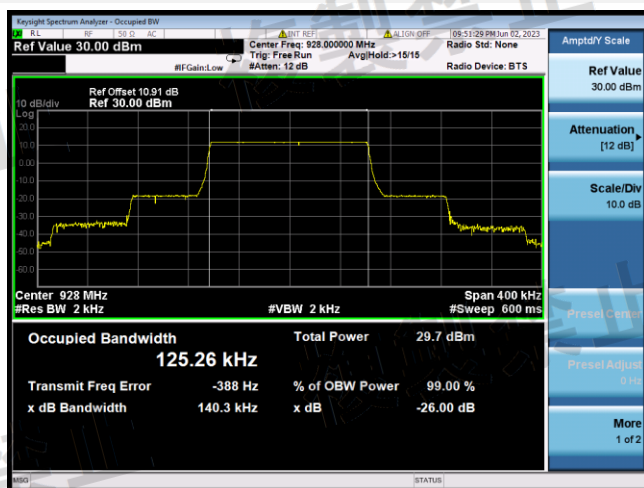
A.2.5. NV Middle Channel



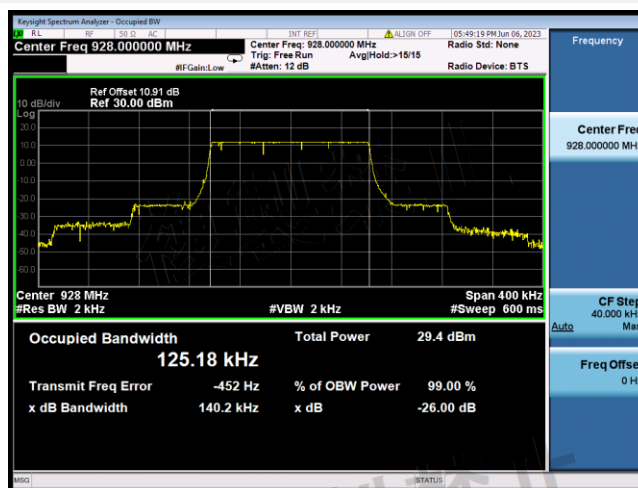
A.2.6. HV Middle Channel



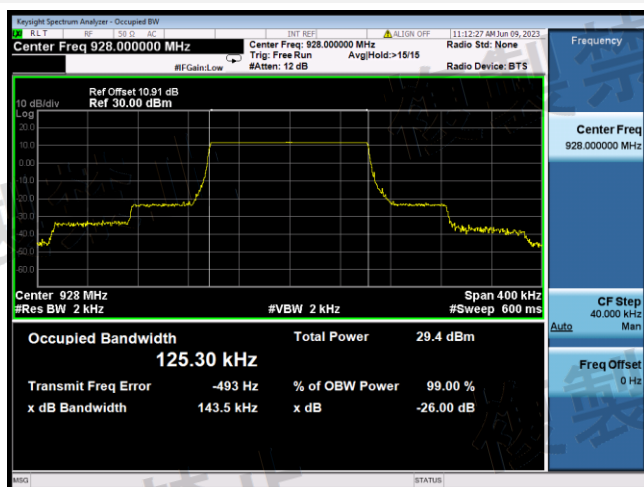
A.2.7. NV High Channel



A.2.8. NV High Channel

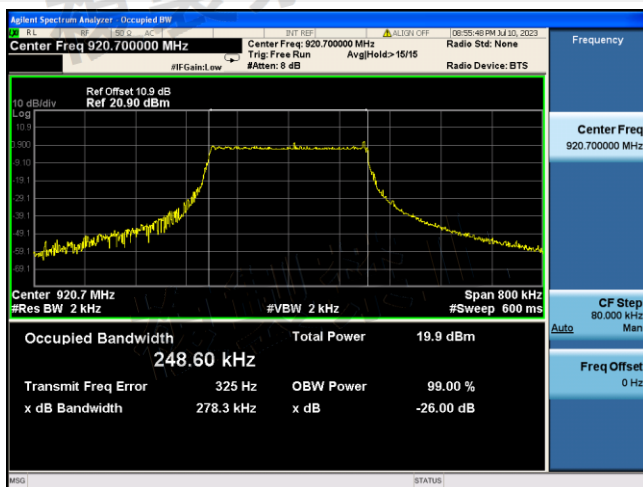


A.2.9. HV High Channel

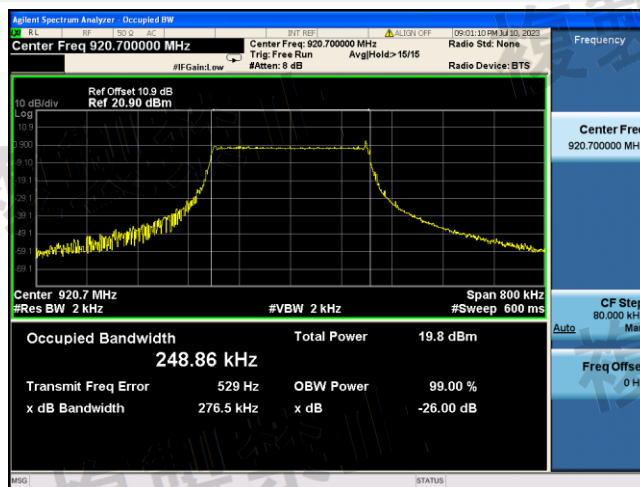


250 kHz

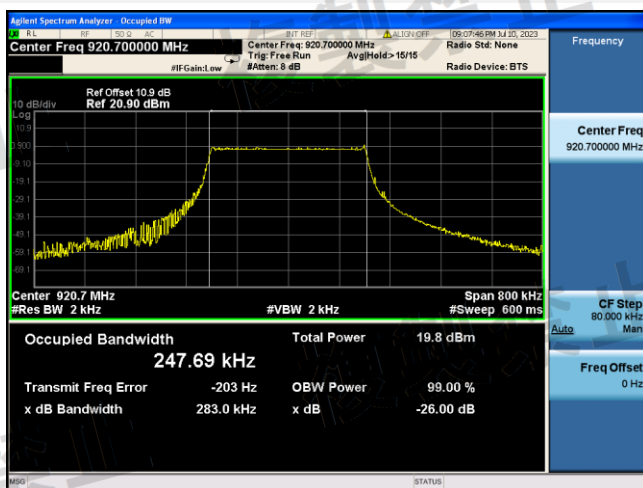
A.2.10. LV Low Channel



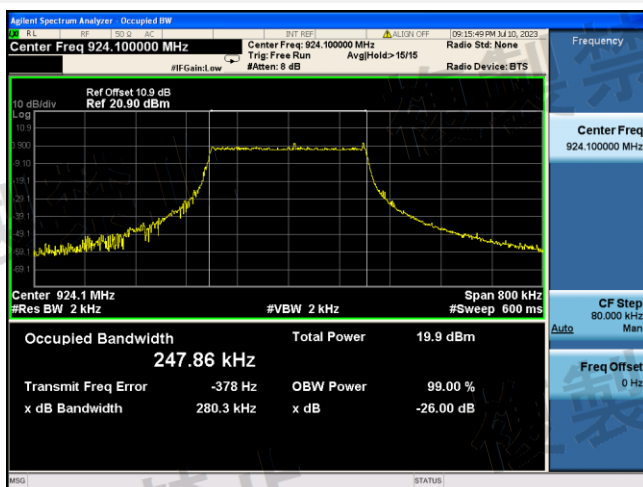
A.2.11. NV Low Channel



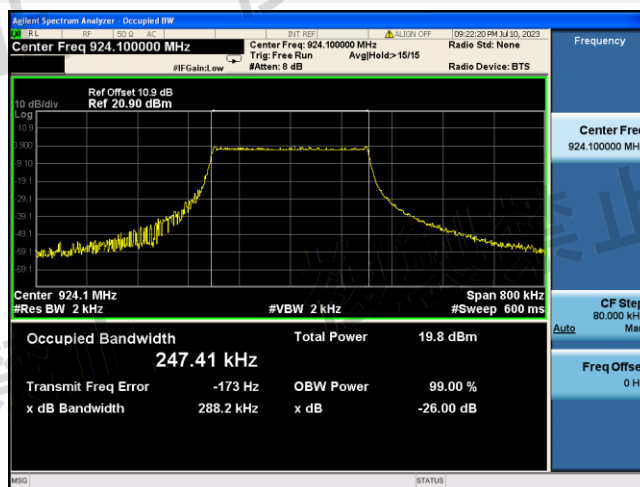
A.2.12. NV Low Channel



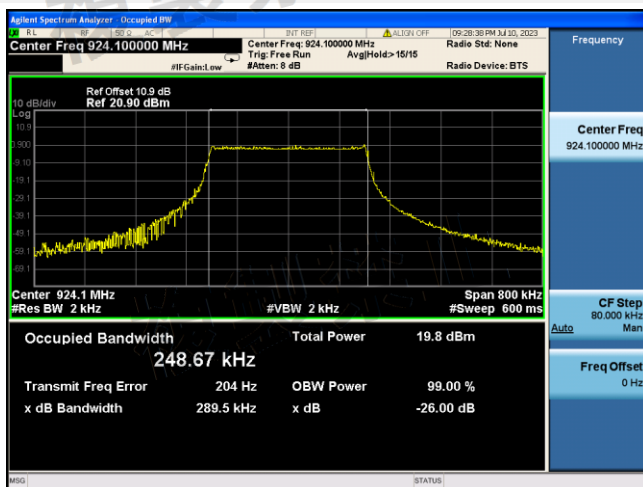
A.2.13. LV Middle Channel



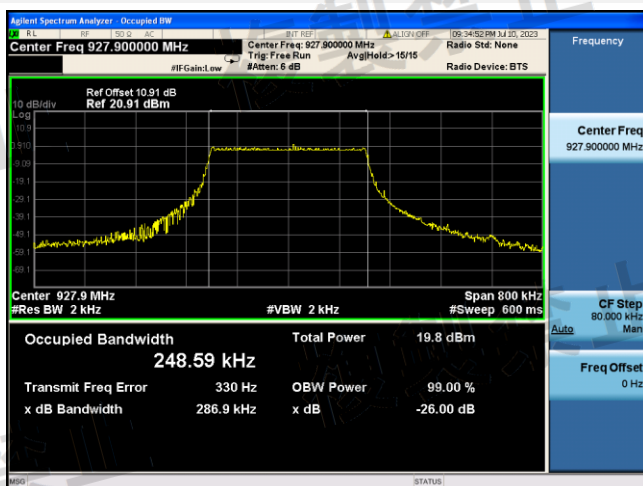
A.2.14. NV Middle Channel



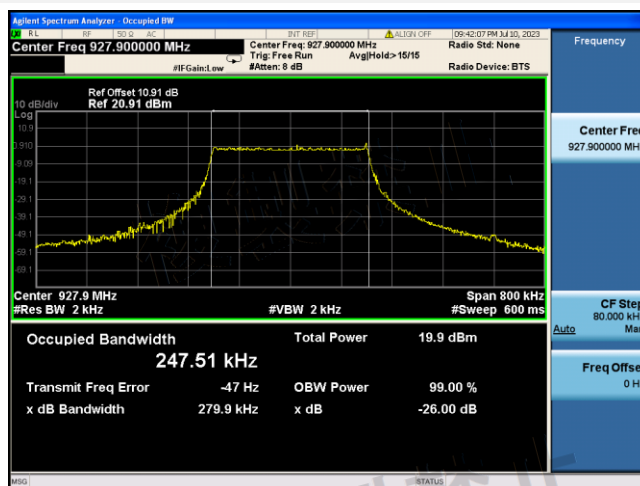
A.2.15. HV Middle Channel



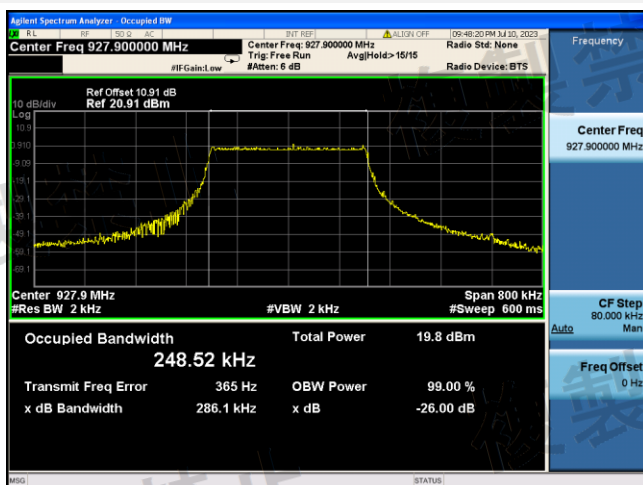
A.2.16. NV High Channel



A.2.17. NV High Channel



A.2.18. HV High Channel



A.3 Antenna Power

Test Data

125 kHz

Test Mode	Test Channel	Test Voltage	Frequency fc (MHz)	Measurement antenna power (dBm)	Measurement antenna power (mW)	Limit (mW)	Refer to Plot	Verdict
LoRa	Low	LV	920.6	7.78	6.00	20	A.3.1	Pass
		NV		7.81	6.04	20	A.3.2	Pass
		HV		7.79	6.01	20	A.3.3	Pass
	Middle	LV	924.2	7.79	6.00	20	A.3.4	Pass
		NV		7.77	5.99	20	A.3.5	Pass
		HV		7.79	6.01	20	A.3.6	Pass
	High	LV	928.0	7.69	5.87	20	A.3.7	Pass
		NV		7.68	5.85	20	A.3.8	Pass
		HV		7.67	5.85	20	A.3.9	Pass

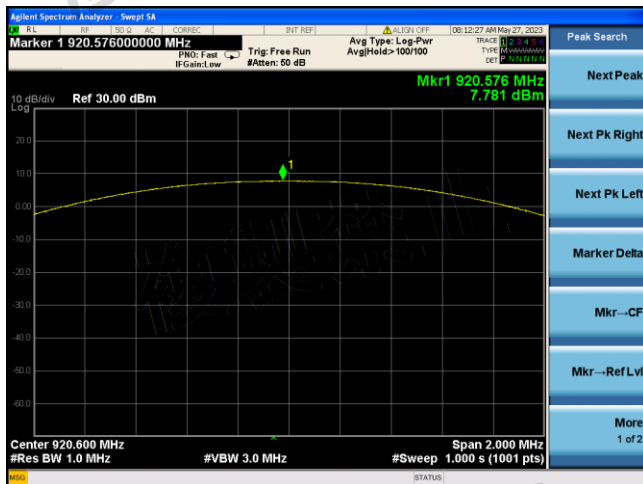
250 kHz

Test Mode	Test Channel	Test Voltage	Frequency fc (MHz)	Measurement antenna power (dBm)	Measurement antenna power (mW)	Limit (mW)	Refer to Plot	Verdict
LoRa	Low	LV	920.7	8.05	6.39	20	A.3.10	Pass
		NV		8.08	6.43	20	A.3.11	Pass
		HV		8.07	6.42	20	A.3.12	Pass
	Middle	LV	924.1	8.04	6.37	20	A.3.13	Pass
		NV		8.05	6.38	20	A.3.14	Pass
		HV		8.04	6.37	20	A.3.15	Pass
	High	LV	927.9	7.99	6.30	20	A.3.16	Pass
		NV		7.99	6.30	20	A.3.17	Pass
		HV		7.96	6.25	20	A.3.18	Pass

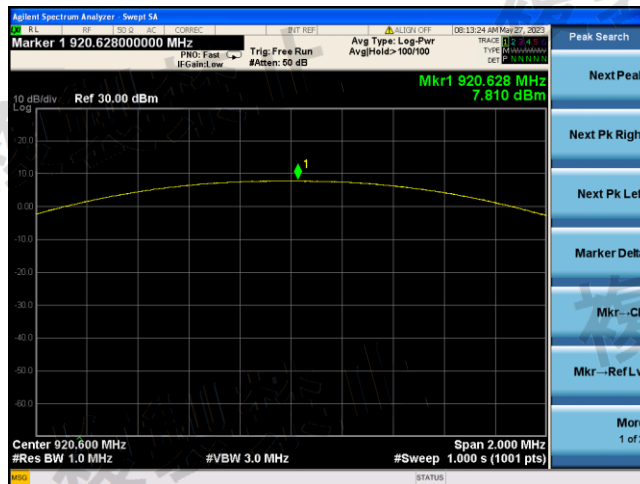
Test Plots

125 kHz

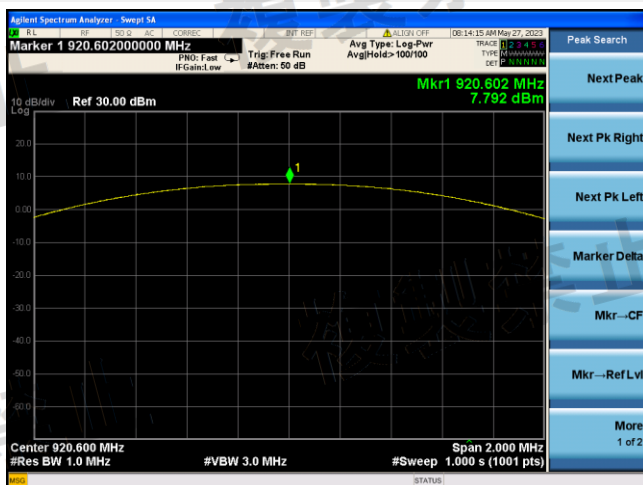
A.3.1. LV Low Channel



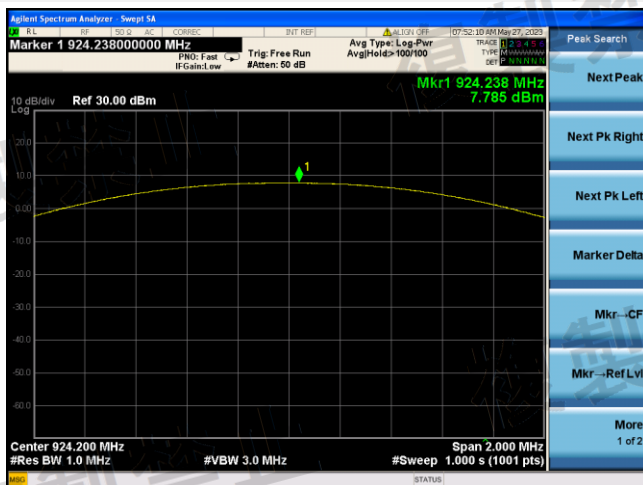
A.3.2. NV Low Channel



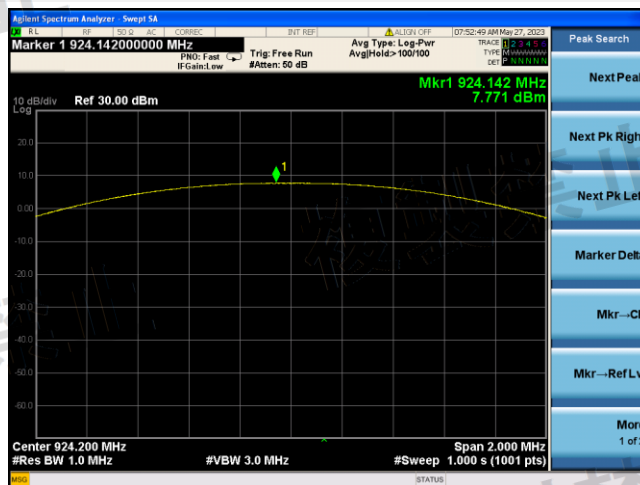
A.3.3. NV Low Channel



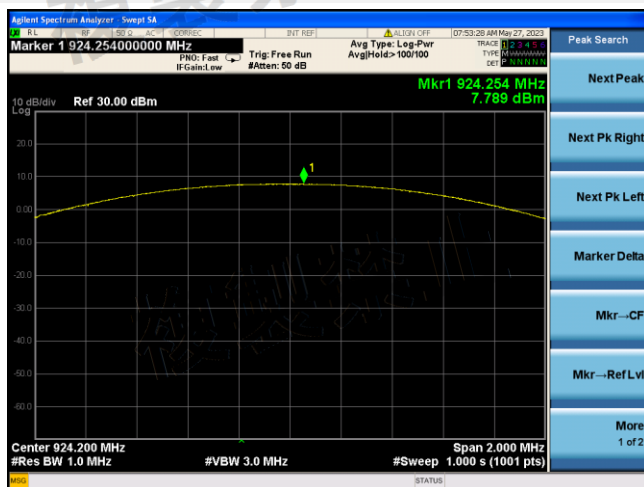
A.3.4. LV Middle Channel



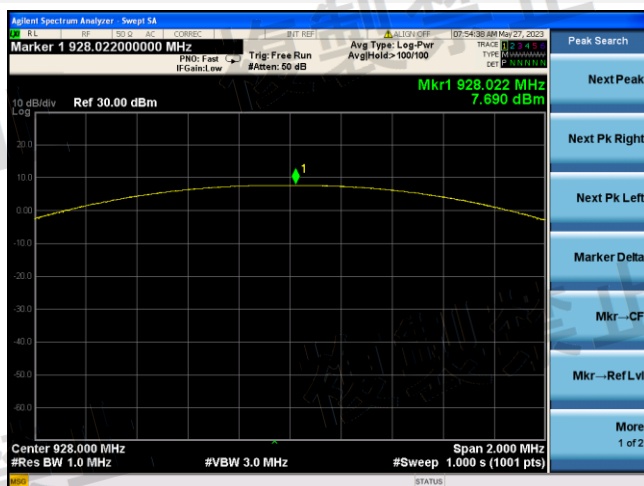
A.3.5. NV Middle Channel



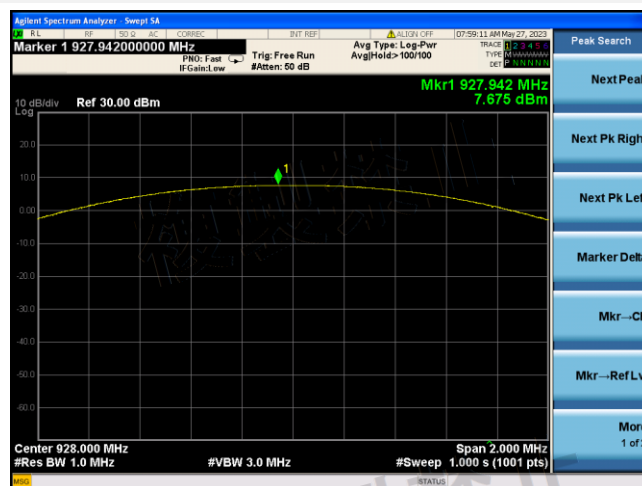
A.3.6. HV Middle Channel



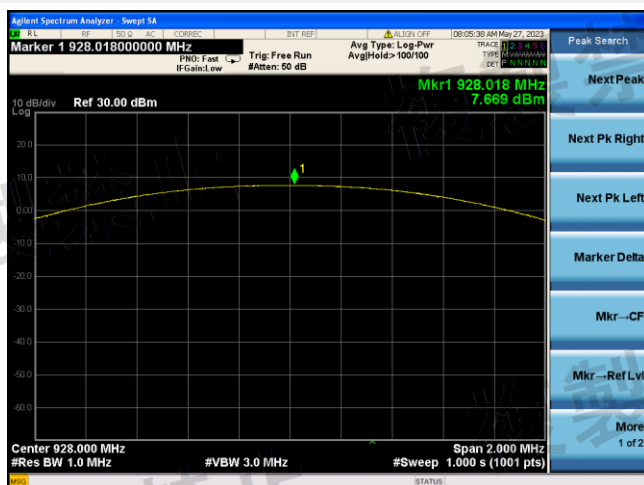
A.3.7. NV High Channel



A.3.8. NV High Channel



A.3.9. HV High Channel

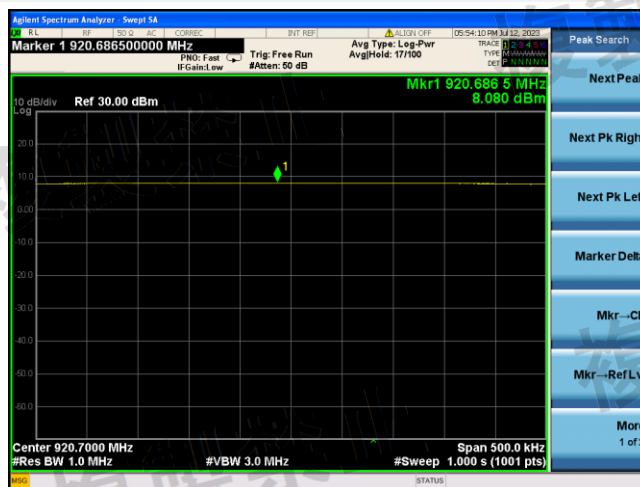


250 kHz

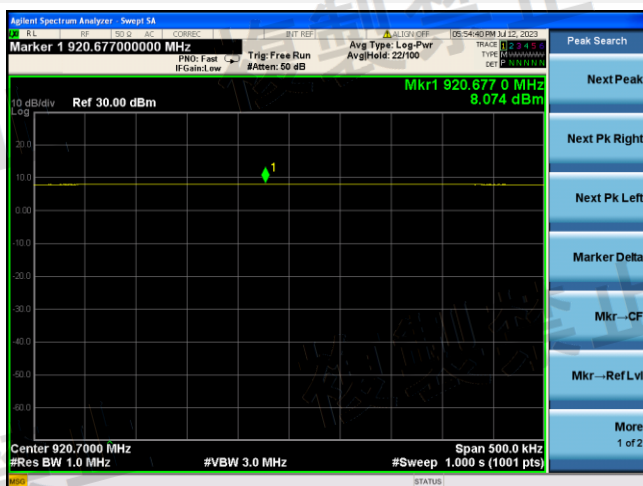
A.3.10. LV Low Channel



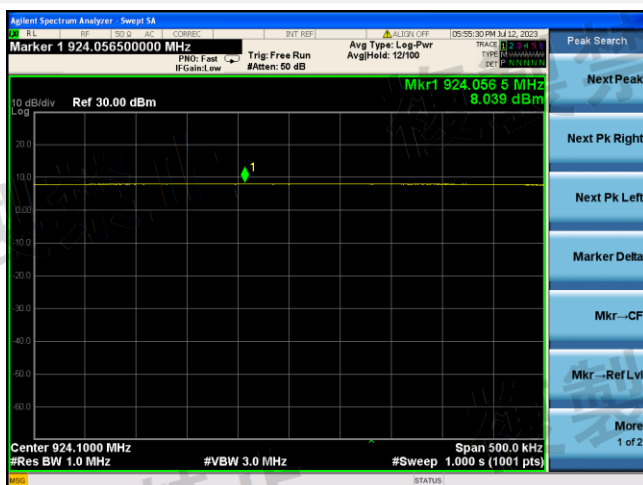
A.3.11. NV Low Channel



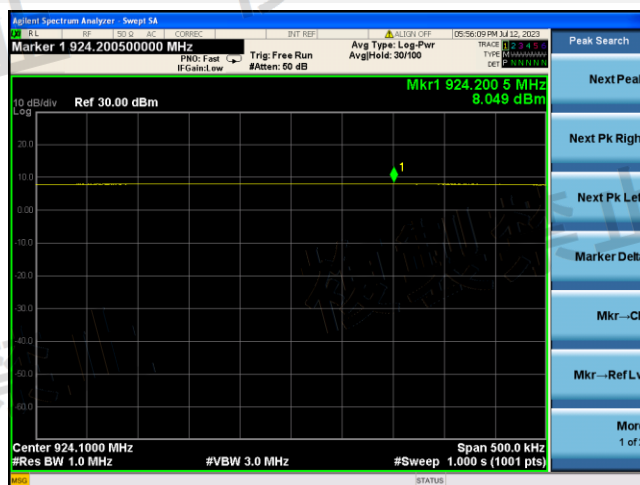
A.3.12. NV Low Channel



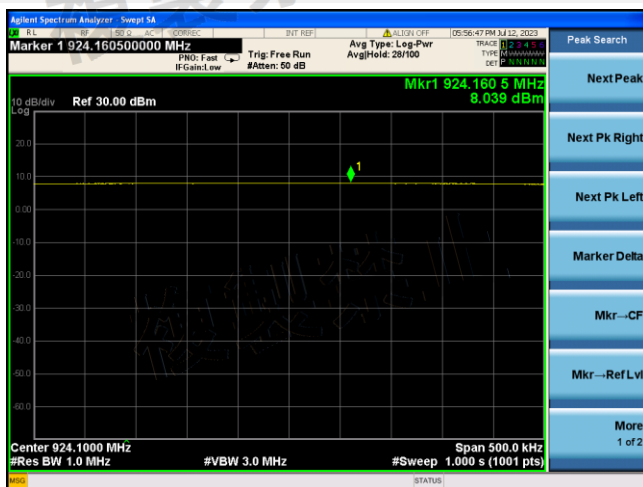
A.3.13. LV Middle Channel



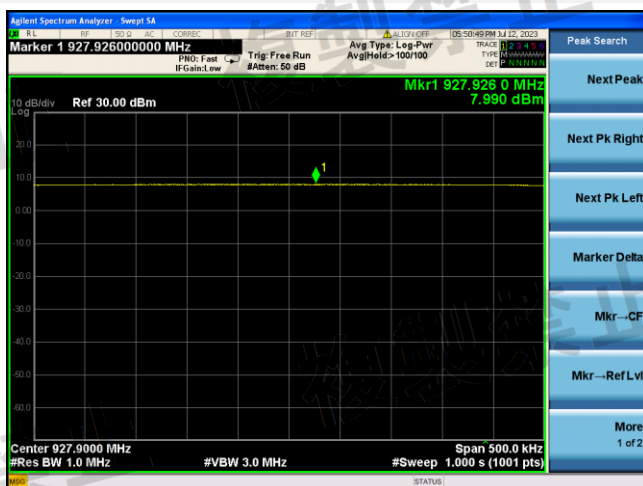
A.3.14. NV Middle Channel



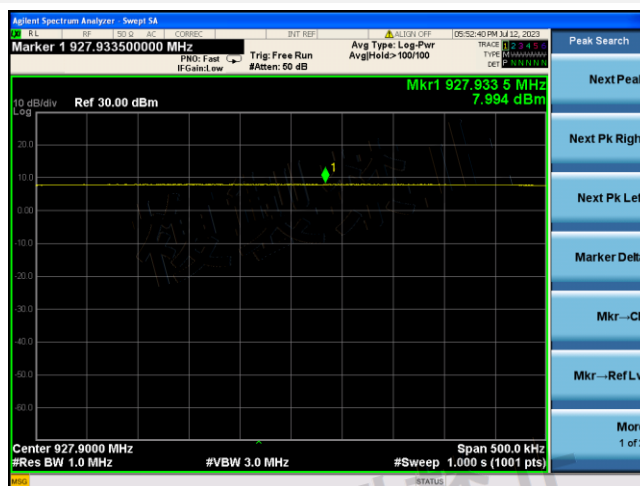
A.3.15. HV Middle Channel



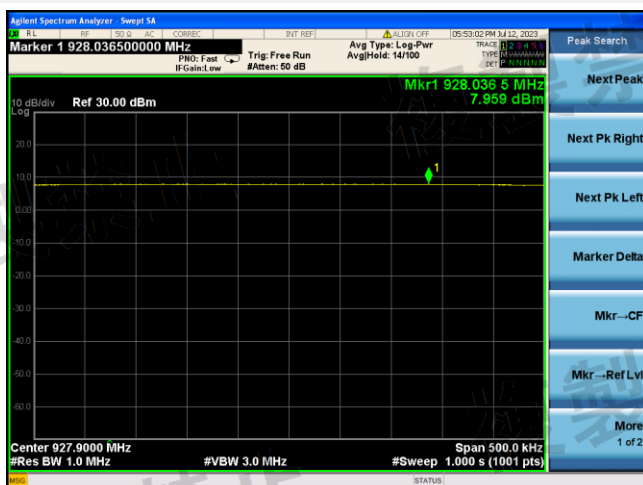
A.3.16. NV High Channel



A.3.17. NV High Channel



A.3.18. HV High Channel



A.4 Permissible values for unwanted emission intensity

Test Data

125 kHz

Mode	Test Voltage	Channel	Test frequency(MHz)	Refer to Plot	Verdict
LoRa	LV	Low	920.6	A.4.1	Pass
	NV			A.4.2	Pass
	HV			A.4.3	Pass
	LV	Middle	924.2	A.4.4	Pass
	NV			A.4.5	Pass
	HV			A.4.6	Pass
	LV	High	928.0	A.4.7	Pass
	NV			A.4.8	Pass
	HV			A.4.9	Pass

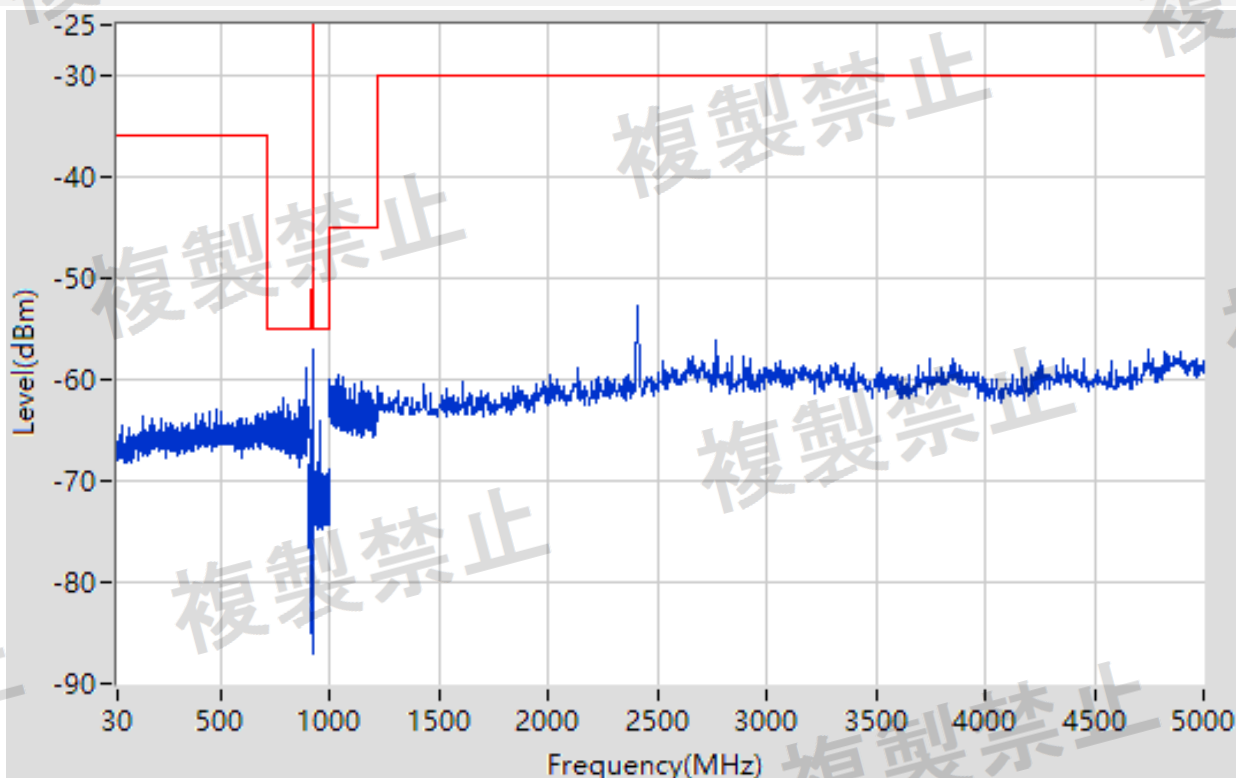
250 kHz

Mode	Test Voltage	Channel	Test frequency(MHz)	Refer to Plot	Verdict
LoRa	LV	Low	920.7	A.4.10	Pass
	NV			A.4.11	Pass
	HV			A.4.12	Pass
	LV	Middle	924.1	A.4.13	Pass
	NV			A.4.14	Pass
	HV			A.4.15	Pass
	LV	High	927.9	A.4.16	Pass
	NV			A.4.17	Pass
	HV			A.4.18	Pass

Test plots

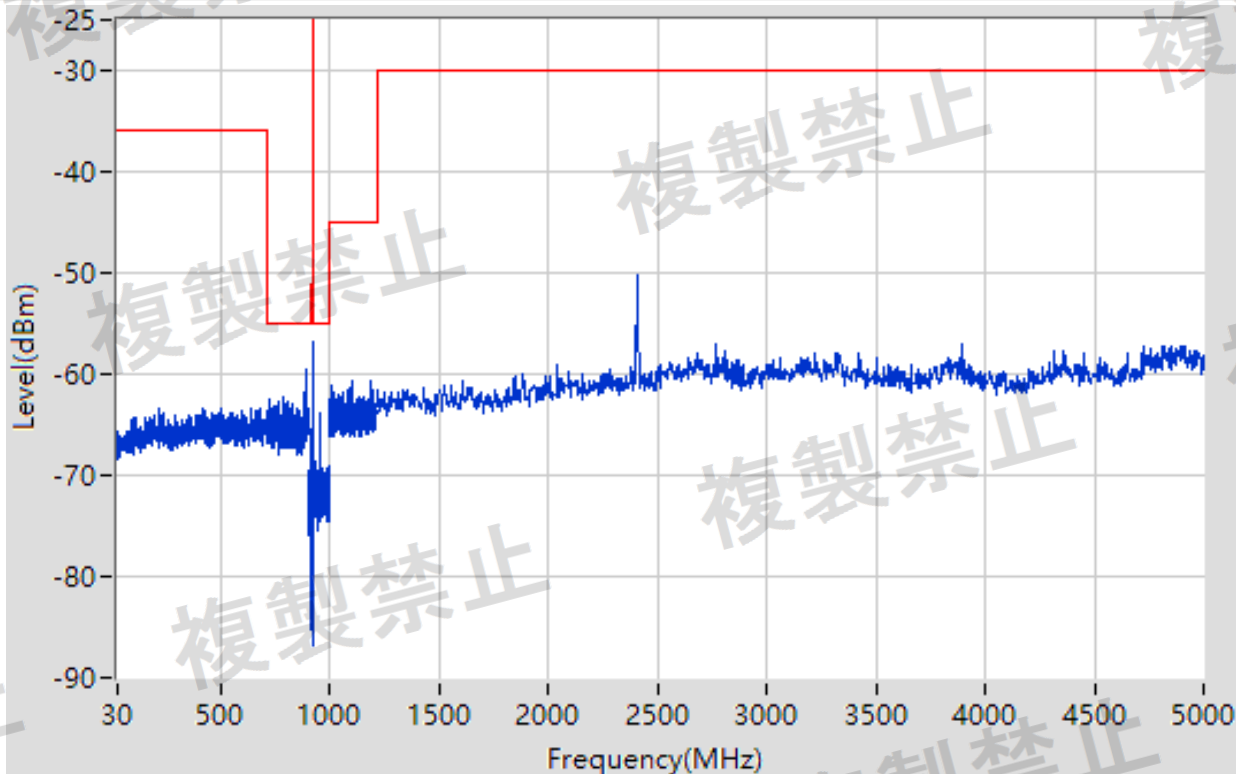
125 kHz

A.4.1 LoRa LV Low Channel



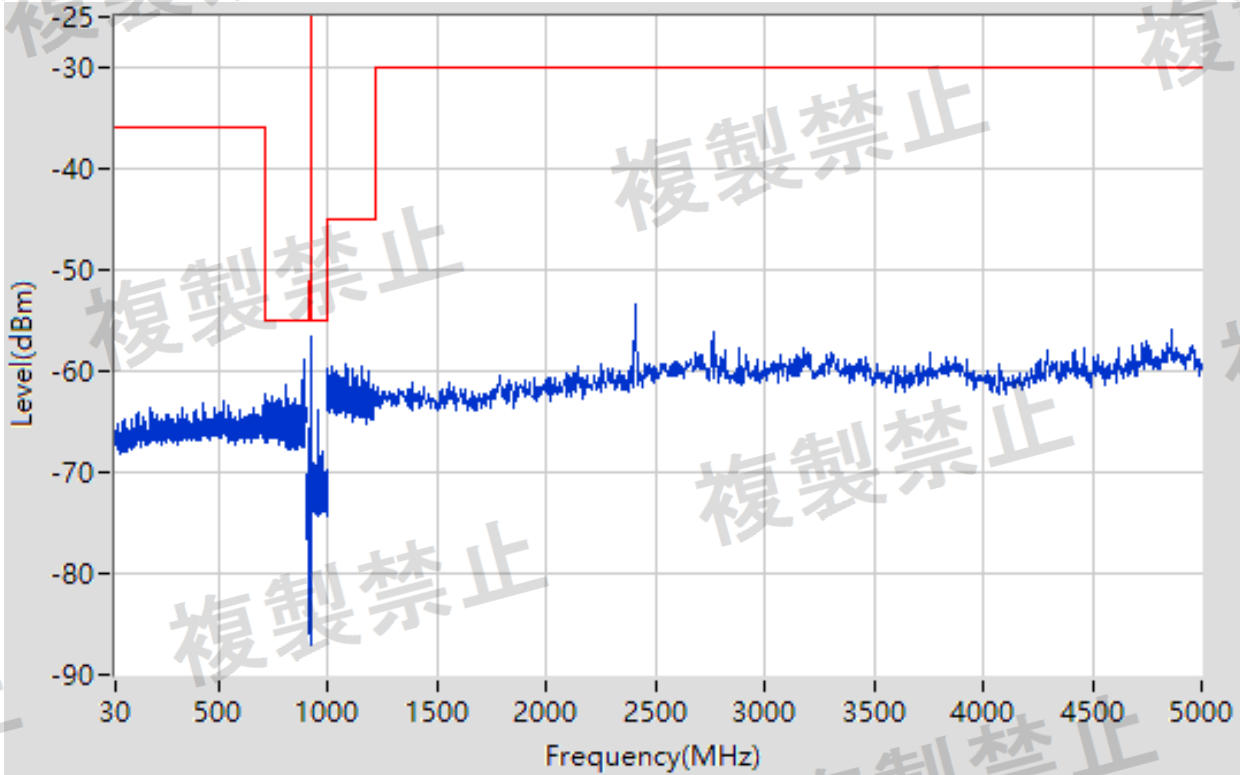
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	478.8	-62.95	-36	Pass	1001
710	900	1	Peak	888.6	-58.78	-55	Pass	1001
900	915	0.1	Peak	914.835	-64.97	-55	Pass	1001
915	920.3	0.003	Peak	920.226	-57.14	-51.2	Pass	1001
920.9	930	0.003	Peak	920.909	-57.97	-51.2	Pass	1001
930	1000	0.1	Peak	952.61	-64.18	-55	Pass	1001
1000	1215	1	Peak	1041.71	-59.47	-45	Pass	1001
1215	5000	1	Peak	2414.845	-52.75	-30	Pass	1001

A.4.2 LoRa NV Low Channel



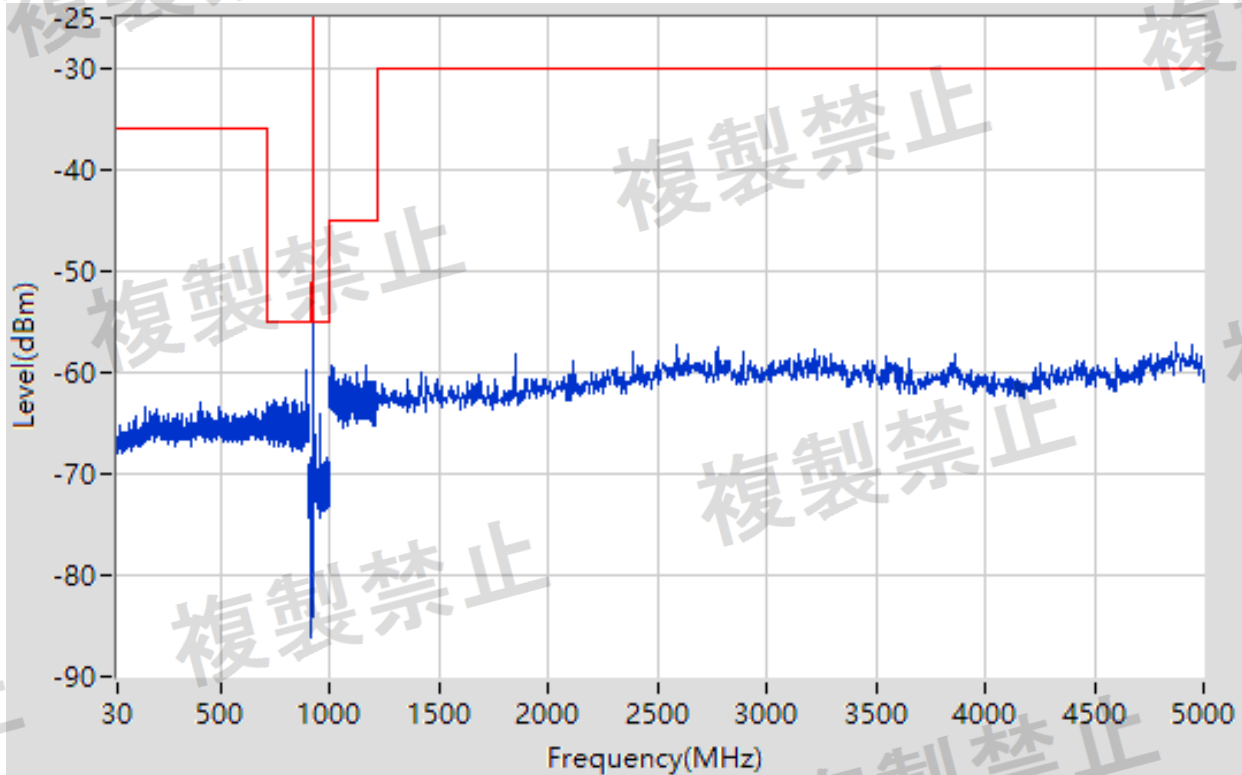
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	642	-63.34	-36	Pass	1001
710	900	1	Peak	888.79	-59.5	-55	Pass	1001
900	915	0.1	Peak	914.895	-65.45	-55	Pass	1001
915	920.3	0.003	Peak	920.289	-56.81	-51.2	Pass	1001
920.9	930	0.003	Peak	920.918	-58.39	-51.2	Pass	1001
930	1000	0.1	Peak	952.61	-63.92	-55	Pass	1001
1000	1215	1	Peak	1099.33	-60.61	-45	Pass	1001
1215	5000	1	Peak	2411.06	-50.16	-30	Pass	1001

A.4.3 LoRa HV Low Channel



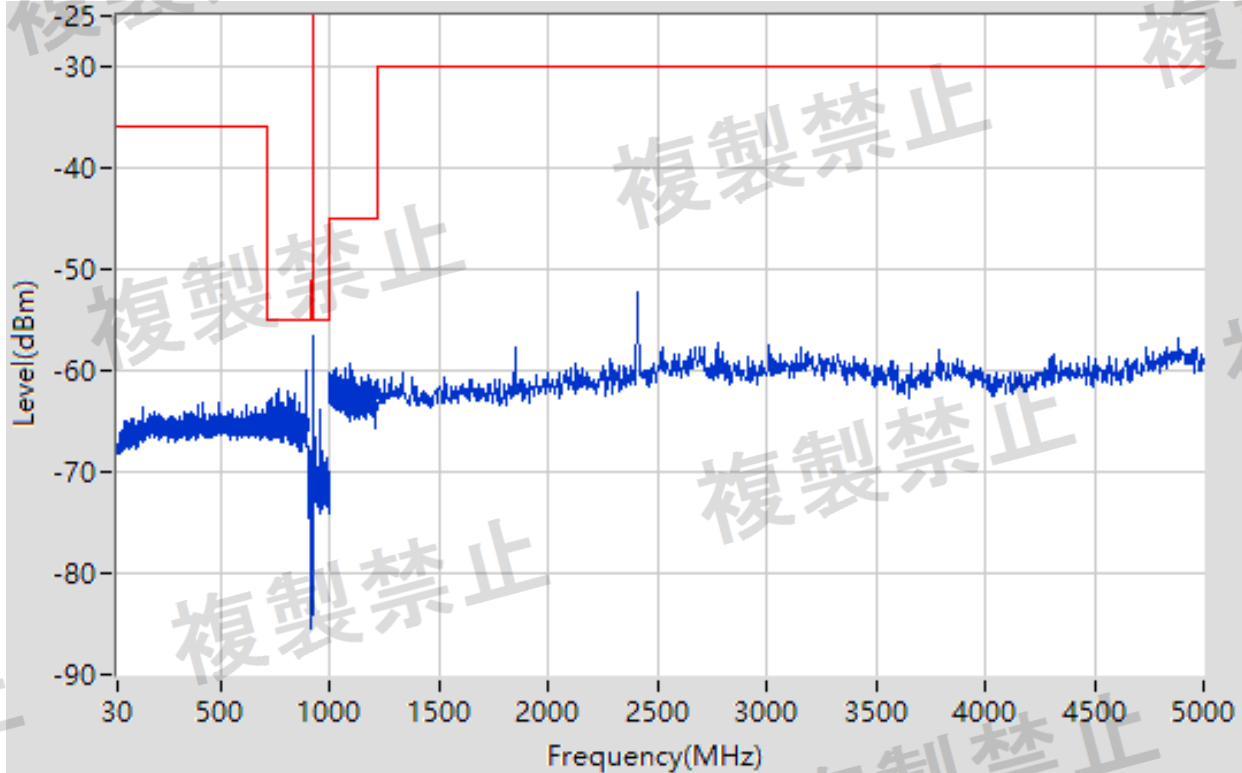
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	520.28	-62.96	-36	Pass	1001
710	900	1	Peak	888.41	-58.82	-55	Pass	1001
900	915	0.1	Peak	914.58	-65.78	-55	Pass	1001
915	920.3	0.003	Peak	920.3	-56.7	-51.2	Pass	1001
920.9	930	0.003	Peak	920.918	-58.18	-51.2	Pass	1001
930	1000	0.1	Peak	952.68	-63.78	-55	Pass	1001
1000	1215	1	Peak	1080.195	-59.28	-45	Pass	1001
1215	5000	1	Peak	2407.275	-53.46	-30	Pass	1001

A.4.4 LoRa LV Middle Channel



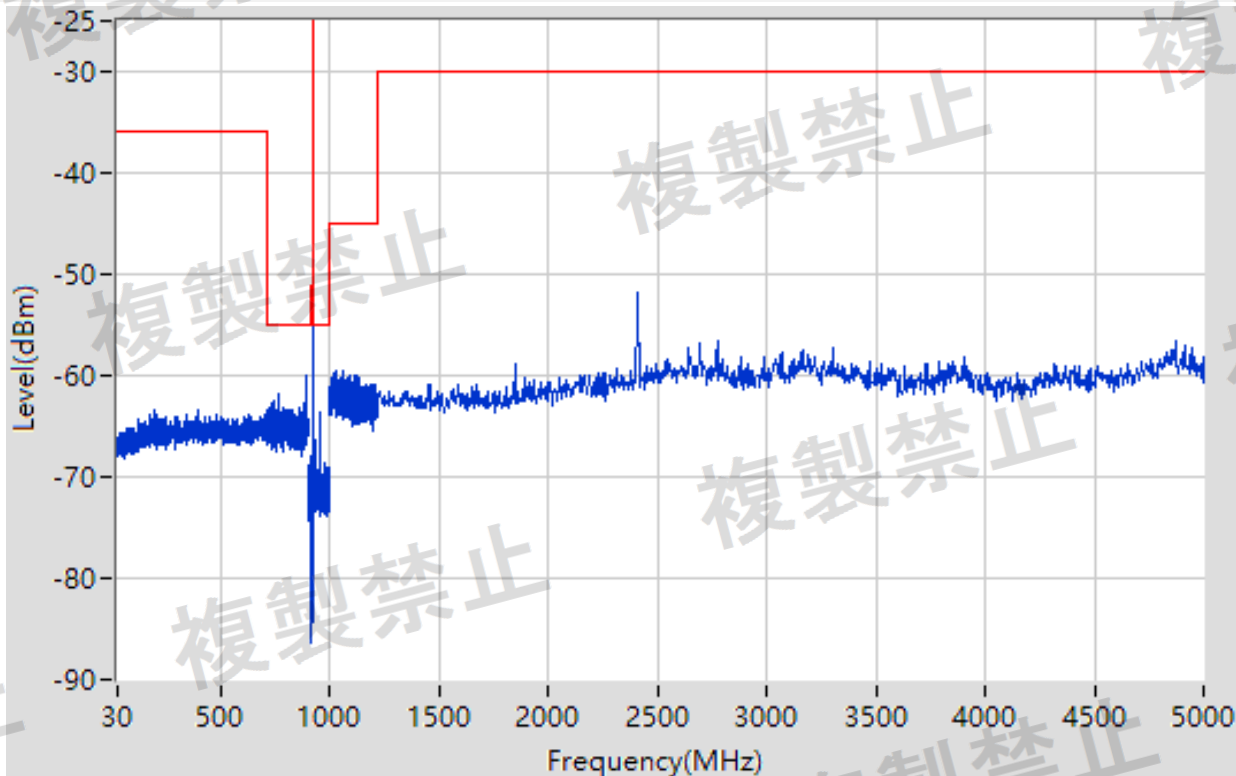
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	408.08	-62.96	-36	Pass	1001
710	900	1	Peak	892.21	-59.68	-55	Pass	1001
900	915	0.1	Peak	913.29	-68.34	-55	Pass	1001
915	923.9	0.003	Peak	923.873	-55.17	-51.2	Pass	1001
924.5	930	0.003	Peak	924.511	-56.36	-51.2	Pass	1001
930	1000	0.1	Peak	956.18	-64.07	-55	Pass	1001
1000	1215	1	Peak	1014.19	-59.21	-45	Pass	1001
1215	5000	1	Peak	4875.095	-57.02	-30	Pass	1001

A.4.5 LoRa NV Middle Channel



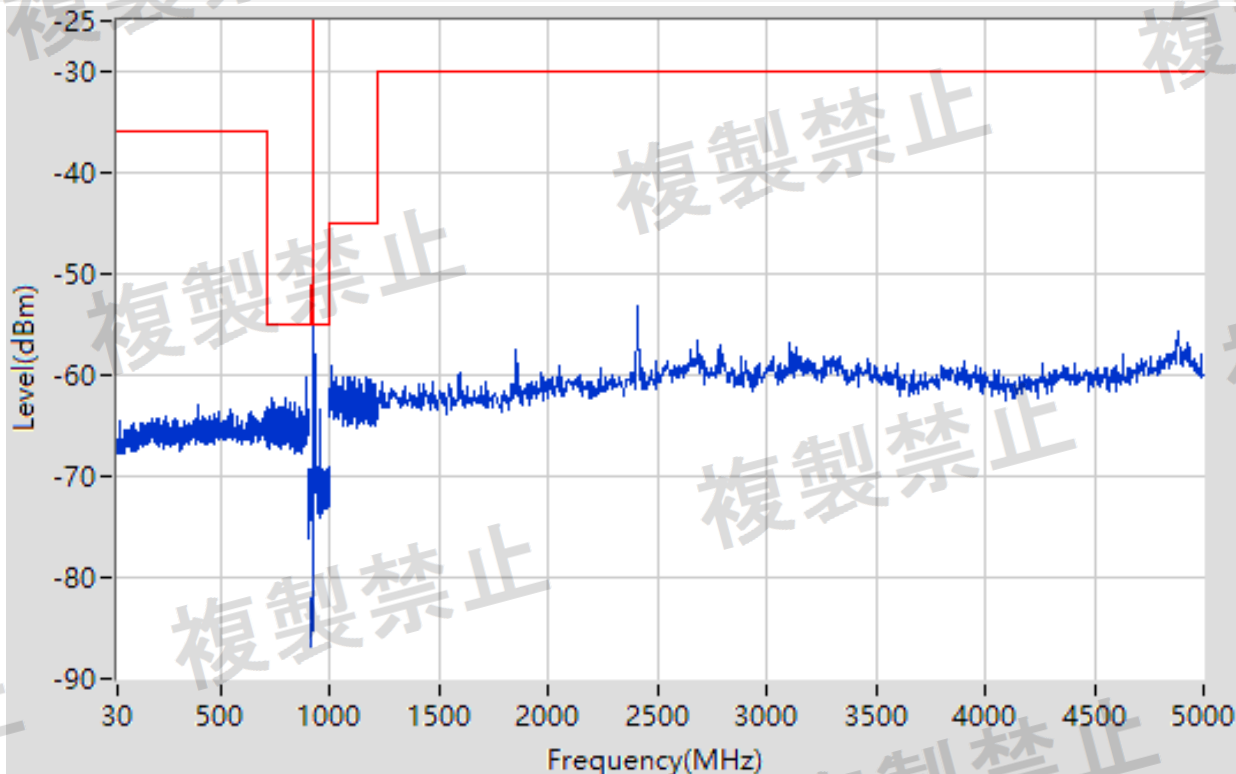
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	491.04	-63.2	-36	Pass	1001
710	900	1	Peak	892.4	-60.1	-55	Pass	1001
900	915	0.1	Peak	907.71	-67.59	-55	Pass	1001
915	923.9	0.003	Peak	923.873	-56.61	-51.2	Pass	1001
924.5	930	0.003	Peak	924.5	-56.6	-51.2	Pass	1001
930	1000	0.1	Peak	956.25	-63.79	-55	Pass	1001
1000	1215	1	Peak	1090.515	-59.39	-45	Pass	1001
1215	5000	1	Peak	2411.06	-52.16	-30	Pass	1001

A.4.6 LoRa HV Middle Channel



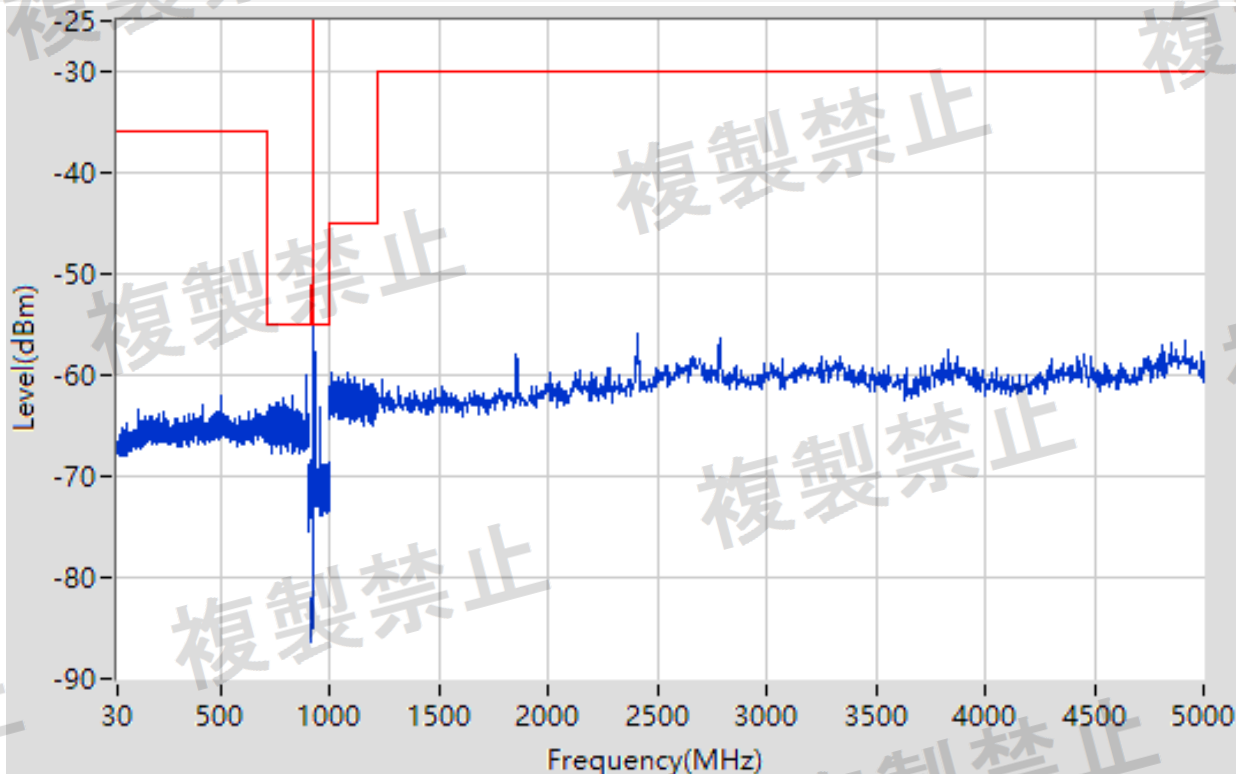
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	396.52	-63.37	-36	Pass	1001
710	900	1	Peak	892.02	-60.01	-55	Pass	1001
900	915	0.1	Peak	914.265	-67.89	-55	Pass	1001
915	923.9	0.003	Peak	923.891	-53.33	-51.2	Pass	1001
924.5	930	0.003	Peak	924.511	-56.81	-51.2	Pass	1001
930	1000	0.1	Peak	956.25	-63.54	-55	Pass	1001
1000	1215	1	Peak	1059.34	-59.43	-45	Pass	1001
1215	5000	1	Peak	2411.06	-51.8	-30	Pass	1001

A.4.7 LoRa LV High Channel



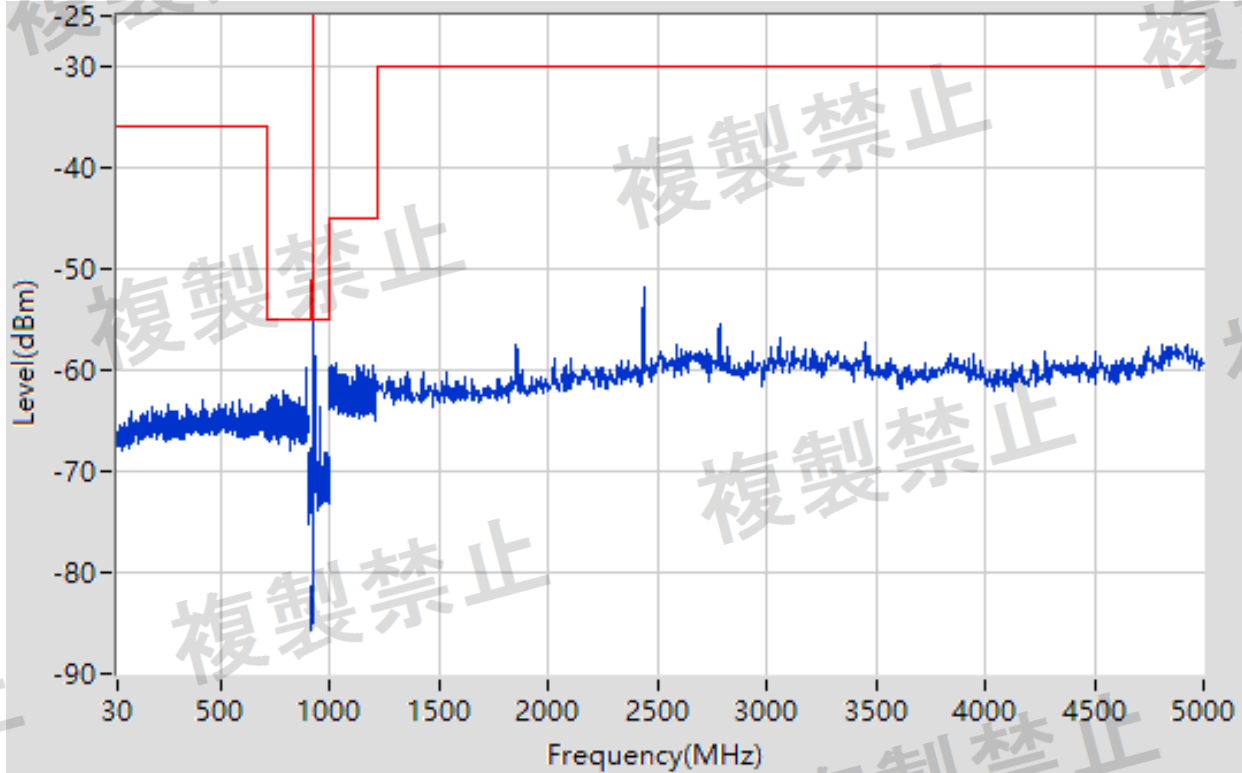
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	401.96	-62.99	-36	Pass	1001
710	900	1	Peak	896.01	-60.33	-55	Pass	1001
900	915	0.1	Peak	908.61	-69.35	-55	Pass	1001
915	927.7	0.003	Peak	927.7	-53.8	-51.2	Pass	1001
928.3	930	0.003	Peak	928.305	-56.4	-51.2	Pass	1001
930	1000	0.1	Peak	930	-57.57	-55	Pass	1001
1000	1215	1	Peak	1013.975	-59.16	-45	Pass	1001
1215	5000	1	Peak	2411.06	-53.24	-30	Pass	1001

A.4.8 LoRa NV High Channel



Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	508.72	-61.97	-36	Pass	1001
710	900	1	Peak	896.01	-59.91	-55	Pass	1001
900	915	0.1	Peak	914.205	-68.35	-55	Pass	1001
915	927.7	0.003	Peak	927.675	-54.27	-51.2	Pass	1001
928.3	930	0.003	Peak	928.307	-56.41	-51.2	Pass	1001
930	1000	0.1	Peak	930	-56.74	-55	Pass	1001
1000	1215	1	Peak	1085.57	-59.75	-45	Pass	1001
1215	5000	1	Peak	2407.275	-56	-30	Pass	1001

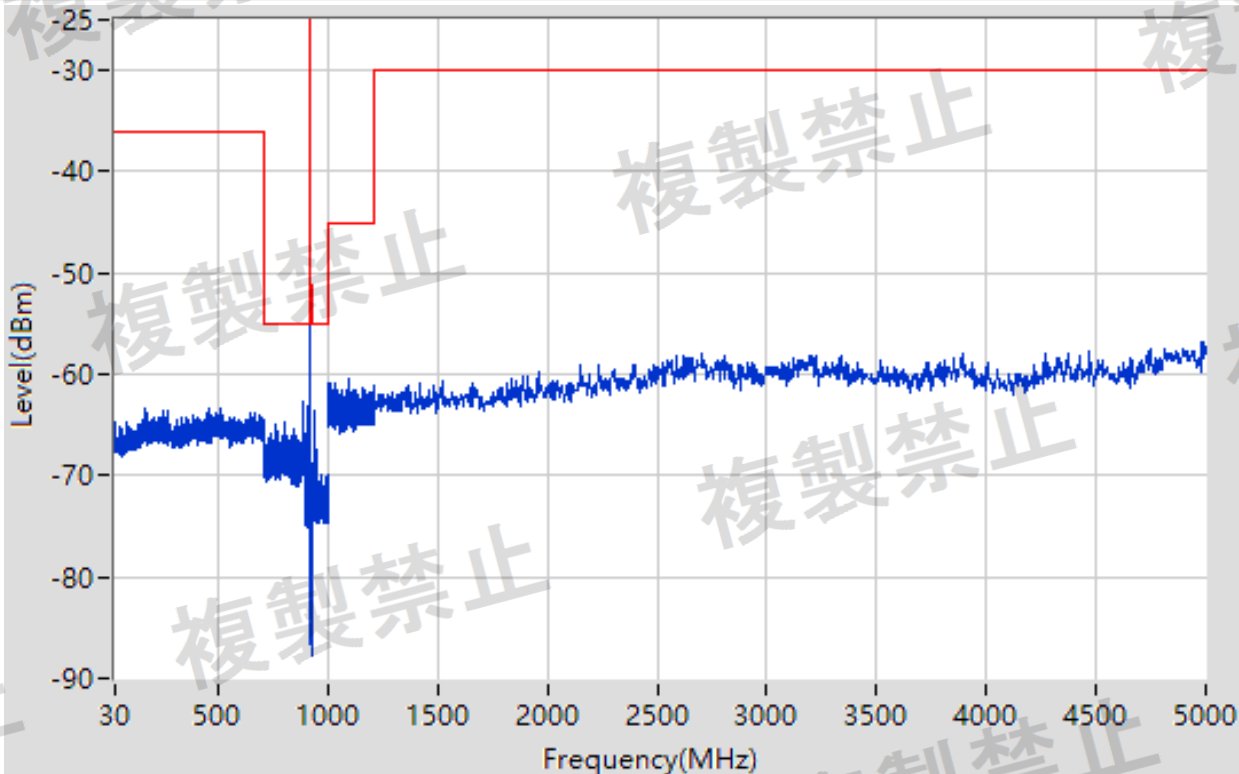
A.4.9 LoRa HV High Channel



Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	415.56	-62.93	-36	Pass	1001
710	900	1	Peak	895.82	-59.74	-55	Pass	1001
900	915	0.1	Peak	914.16	-67.8	-55	Pass	1001
915	927.7	0.003	Peak	927.7	-53.69	-51.2	Pass	1001
928.3	930	0.003	Peak	928.309	-54.27	-51.2	Pass	1001
930	1000	0.1	Peak	930.21	-57.06	-55	Pass	1001
1000	1215	1	Peak	1027.09	-59.41	-45	Pass	1001
1215	5000	1	Peak	2437.555	-51.85	-30	Pass	1001

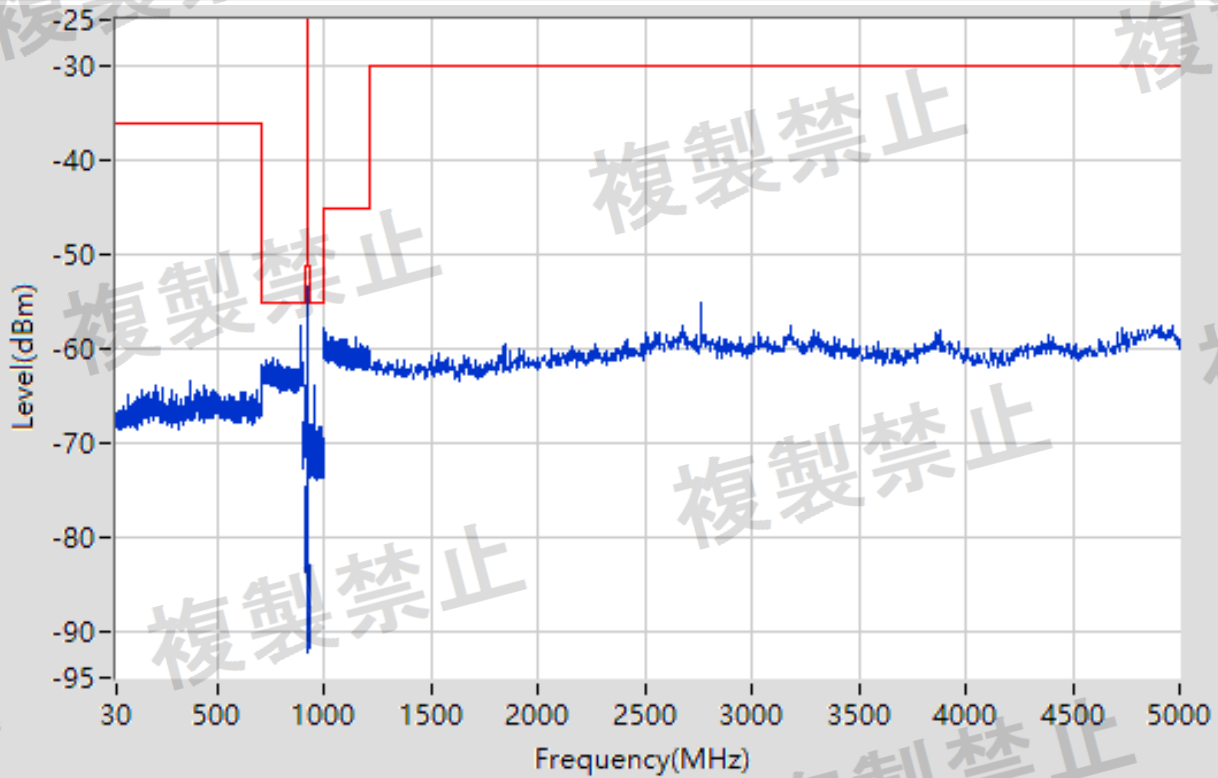
250 kHz

A.4.10 LoRa LV Low Channel



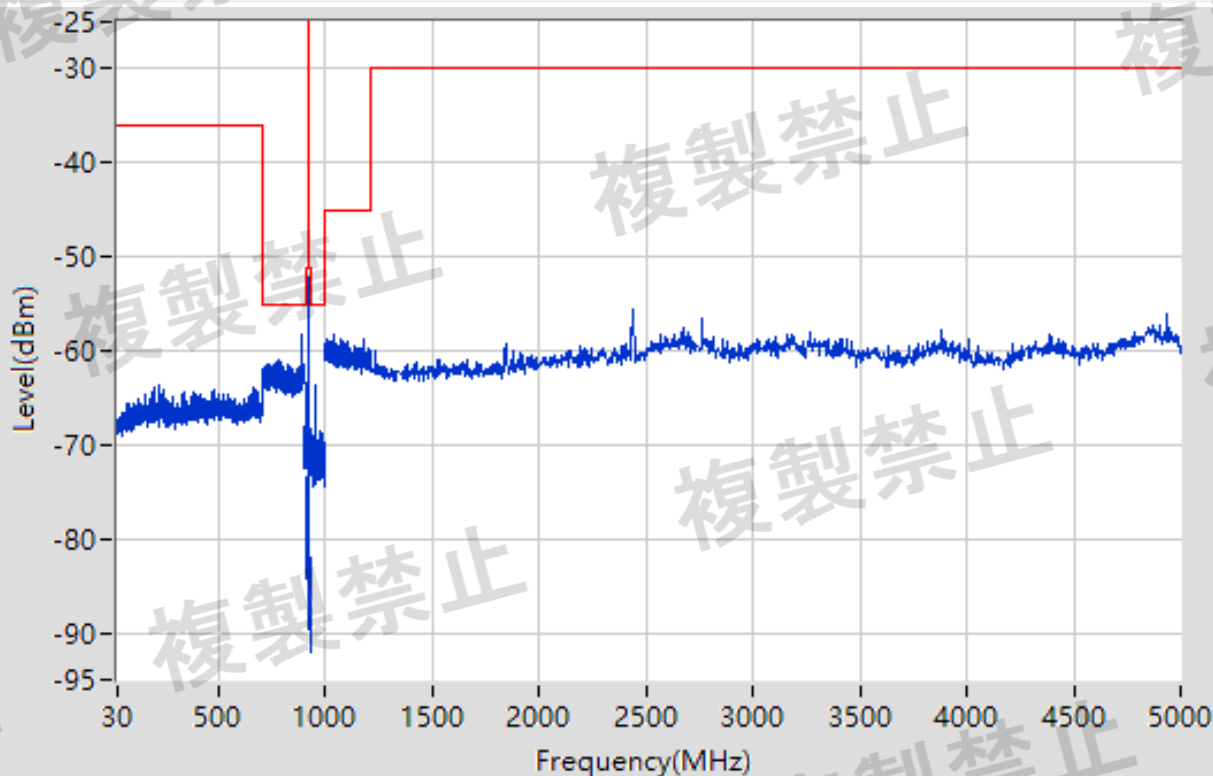
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	463.16	-63.33	-36	Pass	1001
710	900	1	Peak	888.79	-62.74	-55	Pass	1001
900	915	0.1	Peak	905.025	-63.1	-55	Pass	1001
915	920.4	0.003	Peak	920.351	-53.33	-51.2	Pass	1001
921	930	0.003	Peak	921	-52.6	-51.2	Pass	1001
930	1000	0.1	Peak	936.23	-63.65	-55	Pass	1001
1000	1215	1	Peak	1091.805	-60.33	-45	Pass	1001
1215	5000	1	Peak	4981.075	-56.76	-30	Pass	1001

A.4.11 LoRa NV Low Channel



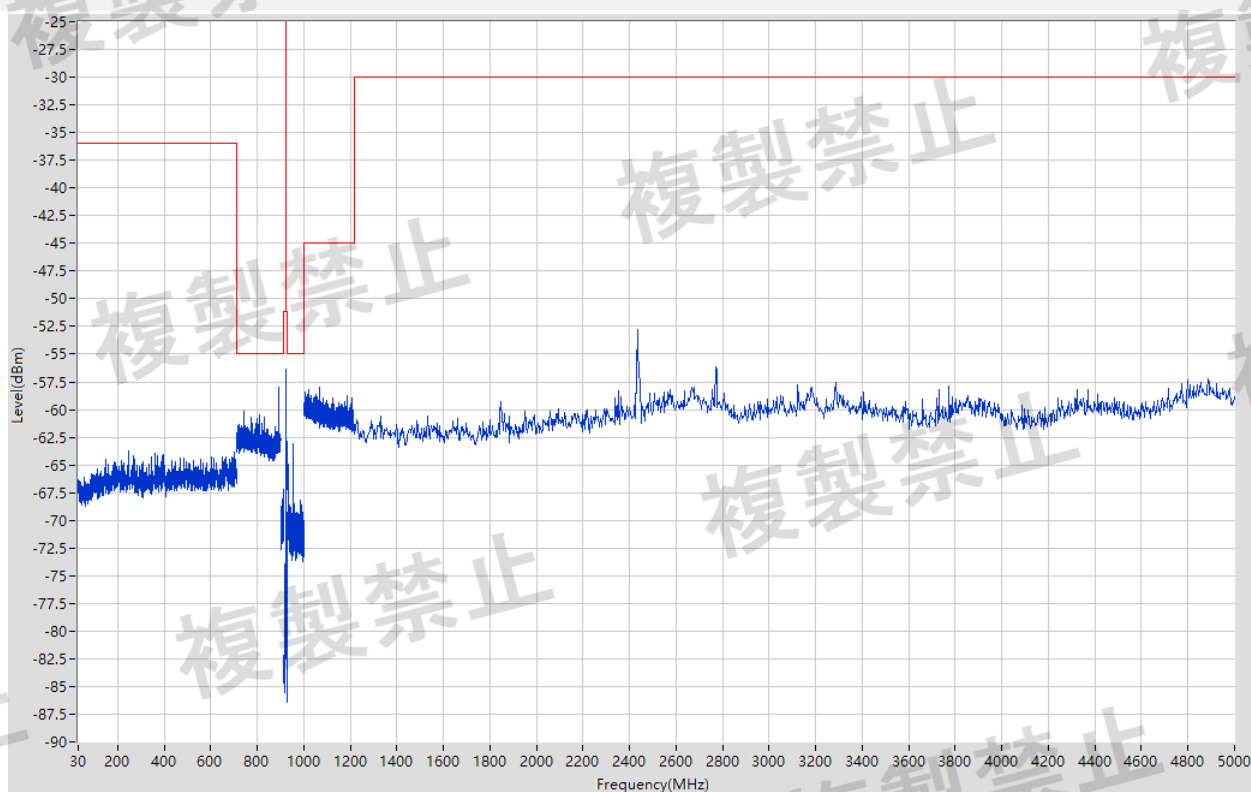
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	377.48	-63.52	-36	Pass	1001
710	900	1	Peak	888.79	-57.63	-55	Pass	1001
900	915	0.1	Peak	914.82	-63.88	-55	Pass	1001
915	920.3	0.003	Peak	920.274	-53.45	-51.2	Pass	1001
921.1	930	0.003	Peak	921.1	-56.93	-51.2	Pass	1001
930	1000	0.1	Peak	952.61	-63.87	-55	Pass	1001
1000	1215	1	Peak	1003.01	-57.7	-45	Pass	1001
1215	5000	1	Peak	2763.065	-55.21	-30	Pass	1001

A.4.12 LoRa HV Low Channel



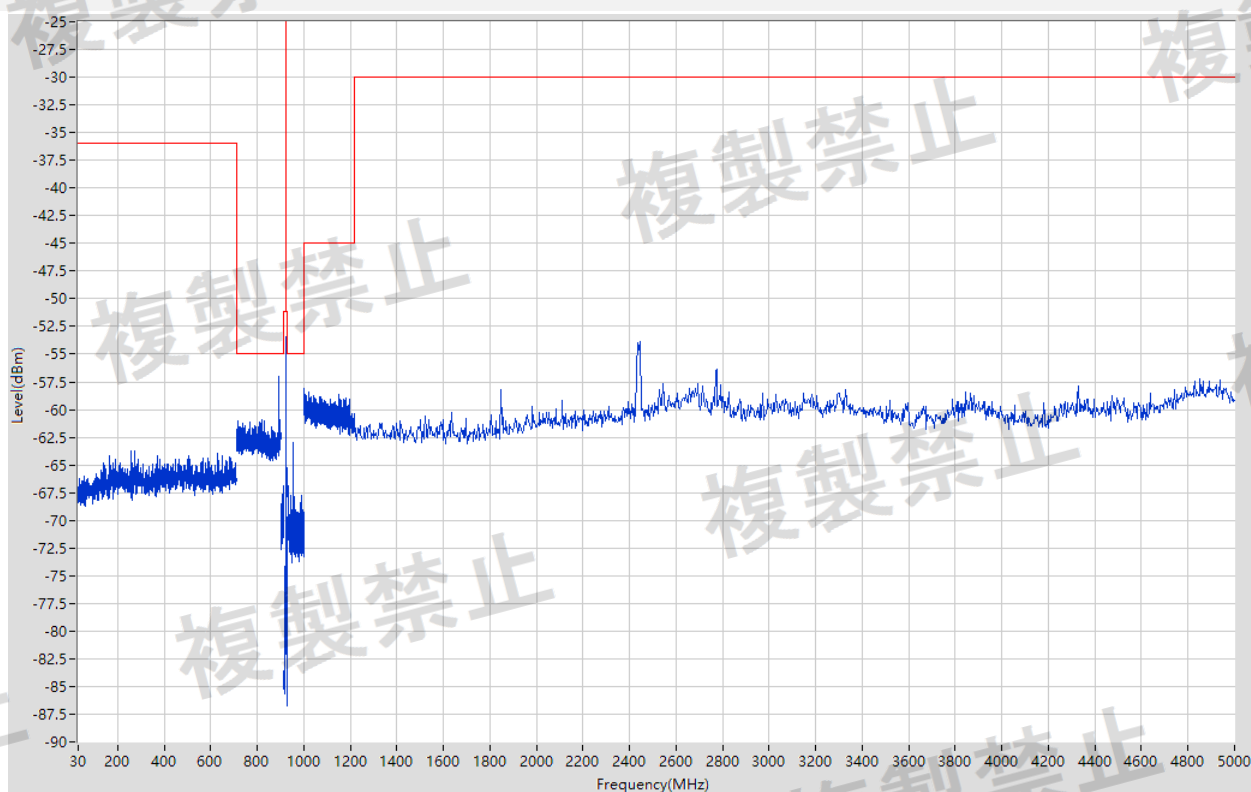
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	227.2	-63.62	-36	Pass	1001
710	900	1	Peak	888.98	-58.25	-55	Pass	1001
900	915	0.1	Peak	915	-63.52	-55	Pass	1001
915	920.3	0.003	Peak	920.3	-52.08	-51.2	Pass	1001
921.1	930	0.003	Peak	921.145	-57.22	-51.2	Pass	1001
930	1000	0.1	Peak	952.68	-63.6	-55	Pass	1001
1000	1215	1	Peak	1039.345	-58.32	-45	Pass	1001
1215	5000	1	Peak	2441.34	-55.63	-30	Pass	1001

A.4.13 LoRa LV Middle Channel



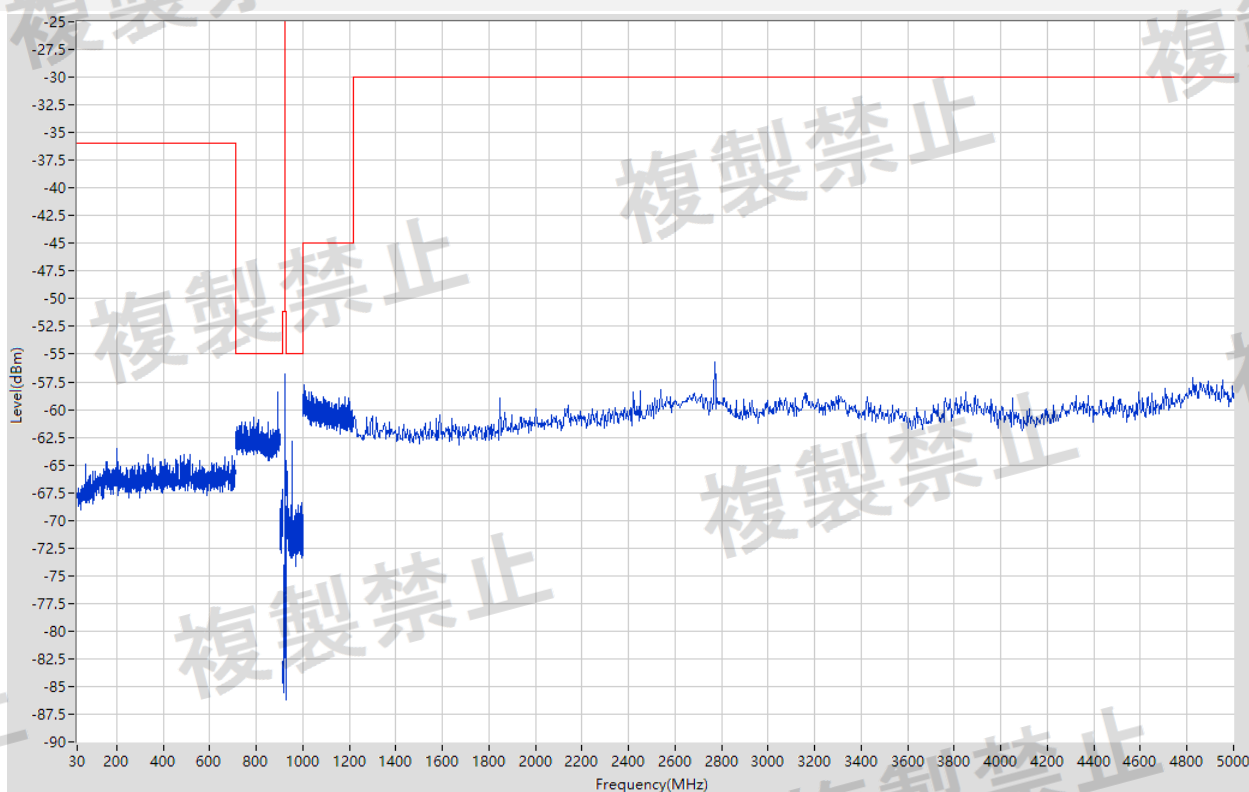
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	248.28	-63.77	-36	Pass	1001
710	900	1	Peak	892.21	-58.01	-55	Pass	1001
900	915	0.1	Peak	911.76	-67.22	-55	Pass	1001
915	923.7	0.003	Peak	923.7	-56.4	-51.2	Pass	1001
924.5	930	0.003	Peak	924.517	-57.01	-51.2	Pass	1001
930	1000	0.1	Peak	930.21	-62.88	-55	Pass	1001
1000	1215	1	Peak	1069.23	-57.96	-45	Pass	1001
1215	5000	1	Peak	2433.77	-52.76	-30	Pass	1001

A.4.14 LoRa NV Middle Channel



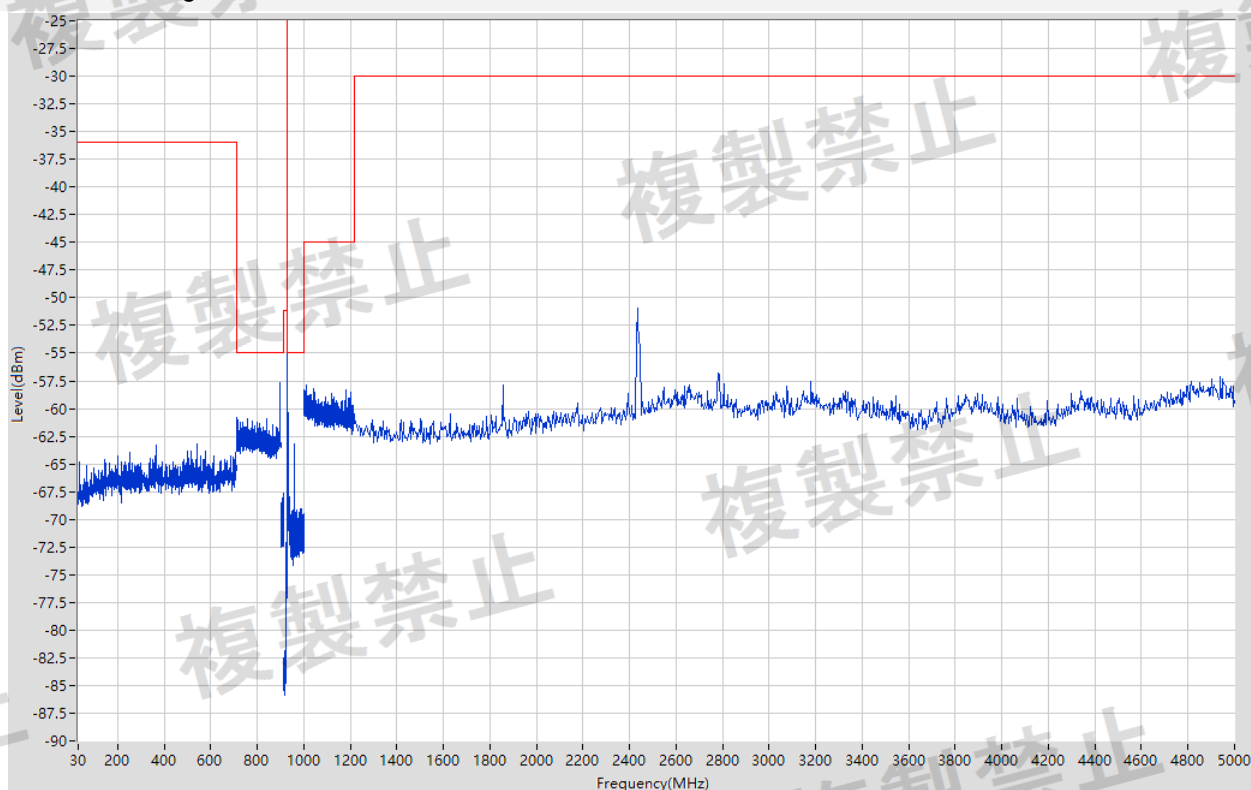
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	270.04	-63.75	-36	Pass	1001
710	900	1	Peak	892.02	-57.01	-55	Pass	1001
900	915	0.1	Peak	913.05	-66.94	-55	Pass	1001
915	923.7	0.003	Peak	923.7	-56.36	-51.2	Pass	1001
924.5	930	0.003	Peak	924.5	-53.4	-51.2	Pass	1001
930	1000	0.1	Peak	956.25	-63.01	-55	Pass	1001
1000	1215	1	Peak	1000.215	-58.13	-45	Pass	1001
1215	5000	1	Peak	2445.125	-53.91	-30	Pass	1001

A.4.15 LoRa HV Middle Channel



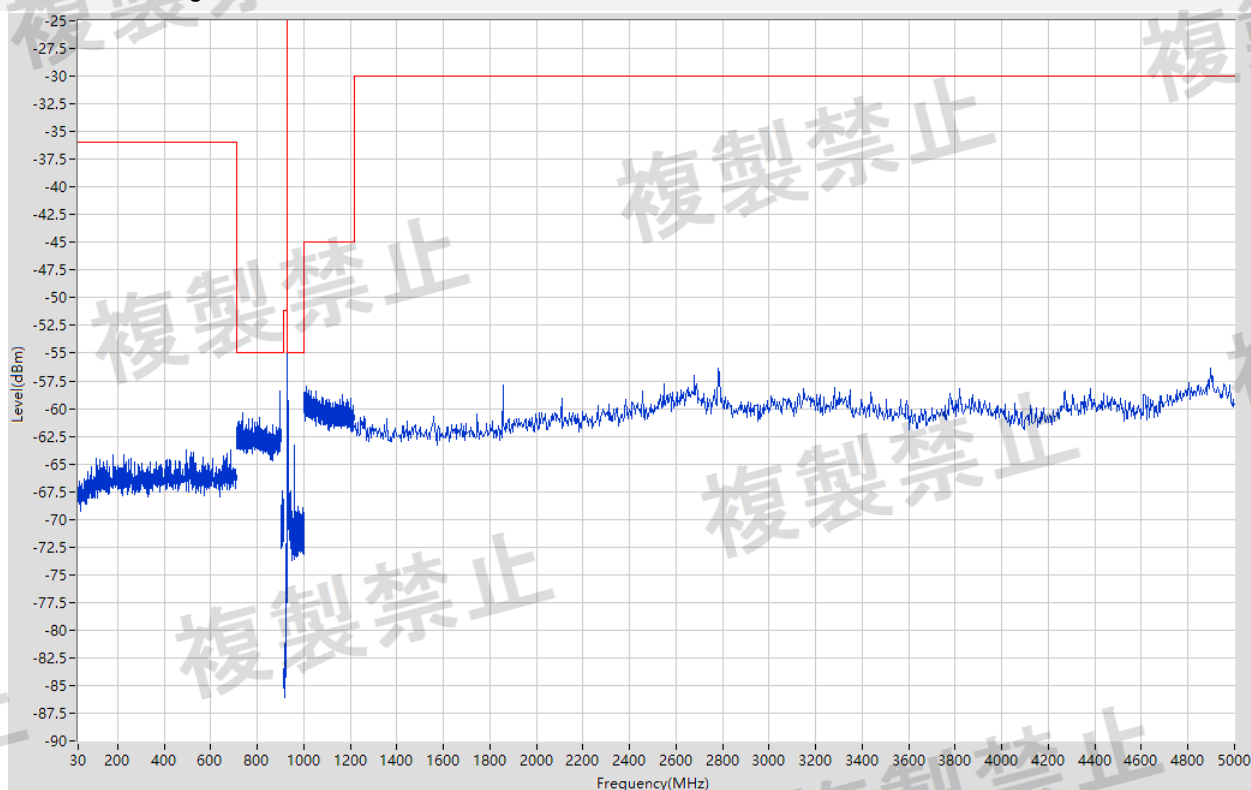
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	197.96	-63.5	-36	Pass	1001
710	900	1	Peak	892.02	-58.4	-55	Pass	1001
900	915	0.1	Peak	913.26	-67.23	-55	Pass	1001
915	923.7	0.003	Peak	923.683	-56.79	-51.2	Pass	1001
924.5	930	0.003	Peak	924.544	-57.9	-51.2	Pass	1001
930	1000	0.1	Peak	956.04	-62.92	-55	Pass	1001
1000	1215	1	Peak	1005.375	-57.83	-45	Pass	1001
1215	5000	1	Peak	2770.635	-55.71	-30	Pass	1001

A.4.16 LoRa LV High Channel



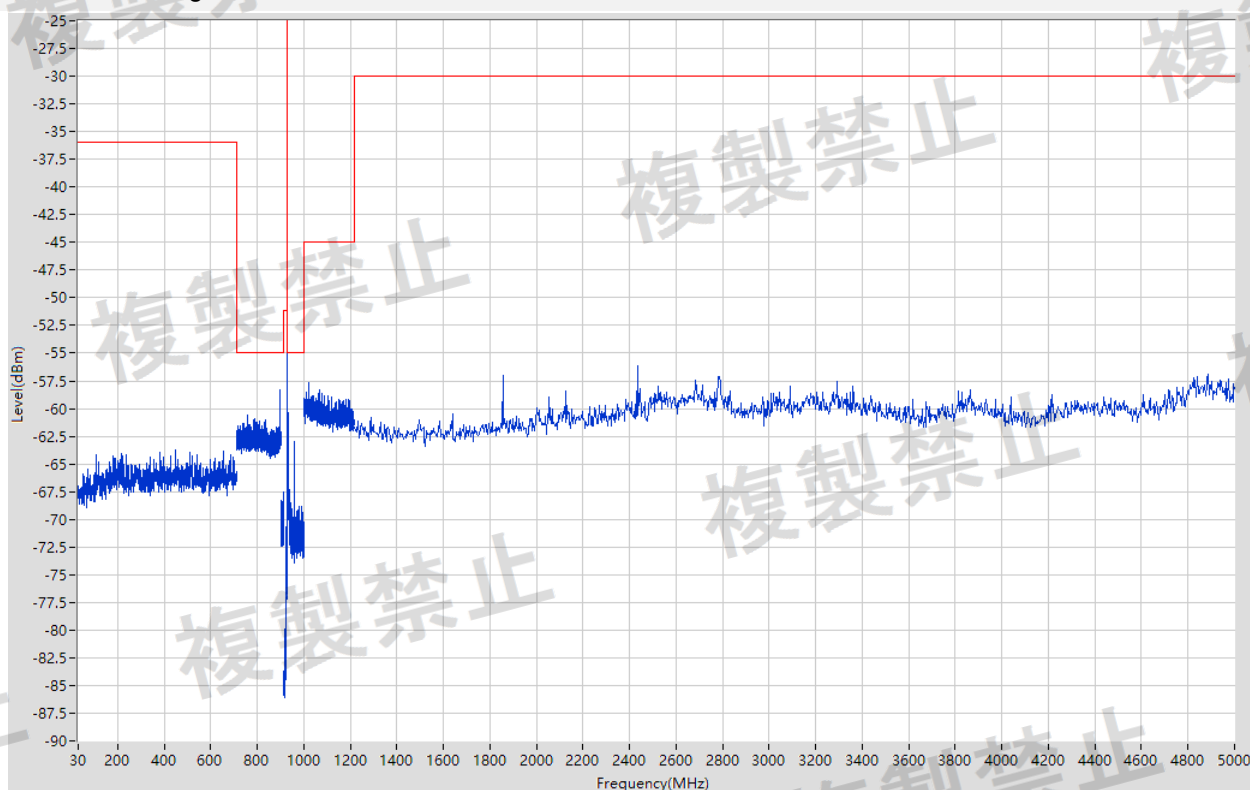
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	538.64	-63.2	-36	Pass	1001
710	900	1	Peak	896.2	-57.69	-55	Pass	1001
900	915	0.1	Peak	913.995	-67.7	-55	Pass	1001
915	927.5	0.003	Peak	927.5	-51.44	-51.2	Pass	1001
928.3	930	0.003	Peak	928.303	-56.25	-51.2	Pass	1001
930	1000	0.1	Peak	930	-55.77	-55	Pass	1001
1000	1215	1	Peak	1011.825	-57.92	-45	Pass	1001
1215	5000	1	Peak	2433.77	-50.91	-30	Pass	1001

A.4.17 LoRa NV High Channel



Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	492.4	-63.72	-36	Pass	1001
710	900	1	Peak	896.01	-58.39	-55	Pass	1001
900	915	0.1	Peak	909.195	-67.48	-55	Pass	1001
915	927.5	0.003	Peak	927.488	-52.1	-51.2	Pass	1001
928.3	930	0.003	Peak	928.319	-57.2	-51.2	Pass	1001
930	1000	0.1	Peak	930.14	-57.81	-55	Pass	1001
1000	1215	1	Peak	1010.965	-57.99	-45	Pass	1001
1215	5000	1	Peak	2781.99	-56.34	-30	Pass	1001

A.4.18 LoRa HV High Channel



Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	450.24	-63.71	-36	Pass	1001
710	900	1	Peak	895.63	-58.33	-55	Pass	1001
900	915	0.1	Peak	912.615	-67.59	-55	Pass	1001
915	927.5	0.003	Peak	927.5	-52.48	-51.2	Pass	1001
928.3	930	0.003	Peak	928.319	-57.44	-51.2	Pass	1001
930	1000	0.1	Peak	930.28	-57.35	-55	Pass	1001
1000	1215	1	Peak	1021.07	-57.68	-45	Pass	1001
1215	5000	1	Peak	2433.77	-56.16	-30	Pass	1001

A.5 Antenna Power Error Measurement

Test Result

125 kHz

Manufacturer declares the conducted power density = 10.00 mW

Test Channel	Frequency (MHz)	Test Voltage	Antenna Power (dBm)	Antenna Power (mW)	Antenna Power Error (%)	Verdict
Low	920.6	LV	7.78	6.00	-40.01%	Pass
		NV	7.81	6.04	-39.61%	Pass
		HV	7.79	6.01	-39.85%	Pass
Middle	924.2	LV	7.79	6.00	-39.95%	Pass
		NV	7.77	5.99	-40.15%	Pass
		HV	7.79	6.01	-39.90%	Pass
High	928.0	LV	7.69	5.87	-41.25%	Pass
		NV	7.68	5.85	-41.45%	Pass
		HV	7.67	5.85	-41.53%	Pass

EIRP Antenna Power

Channel	Test Voltage	Measured EIRP (dBm)	Limit (dBm)	Verdict
Low	LV	7.33	16	Pass
	NV	7.36		Pass
	HV	7.34		Pass
Middle	LV	7.34		Pass
	NV	7.32		Pass
	HV	7.34		Pass
High	LV	7.24		Pass
	NV	7.23		Pass
	HV	7.22		Pass

250 kHz

Manufacturer declares the conducted power density = 10.00 mW

Test Channel	Frequency (MHz)	Test Voltage	Antenna Power (dBm)	Antenna Power (mW)	Antenna Power Error (%)	Verdict
Low	920.7	LV	8.05	6.39	-36.13%	Pass
		NV	8.08	6.43	-35.73%	Pass
		HV	8.07	6.42	-35.82%	Pass
Middle	924.1	LV	8.04	6.37	-36.34%	Pass
		NV	8.05	6.38	-36.19%	Pass
		HV	8.04	6.37	-36.34%	Pass
High	927.9	LV	7.99	6.30	-37.05%	Pass
		NV	7.99	6.30	-36.99%	Pass
		HV	7.96	6.25	-37.50%	Pass

EIRP Antenna Power

Channel	Test Voltage	Measured EIRP (dBm)	Limit (dBm)	Verdict
Low	LV	7.60	16	Pass
	NV	7.63		Pass
	HV	7.62		Pass
Middle	LV	7.59		Pass
	NV	7.60		Pass
	HV	7.59		Pass
High	LV	7.54		Pass
	NV	7.54		Pass
	HV	7.51		Pass

A.6 Limit on secondary radiated emission(receiver)

Test Data

125 kHz

Mode	Test Voltage	Channel	Test frequency(MHz)	Refer to Plot	Verdict
LoRa	LV	Low	920.6	A.6.1	Pass
	NV			A.6.2	Pass
	HV			A.6.3	Pass
	LV	Middle	924.2	A.6.4	Pass
	NV			A.6.5	Pass
	HV			A.6.6	Pass
	LV	High	928.0	A.6.7	Pass
	NV			A.6.8	Pass
	HV			A.6.9	Pass

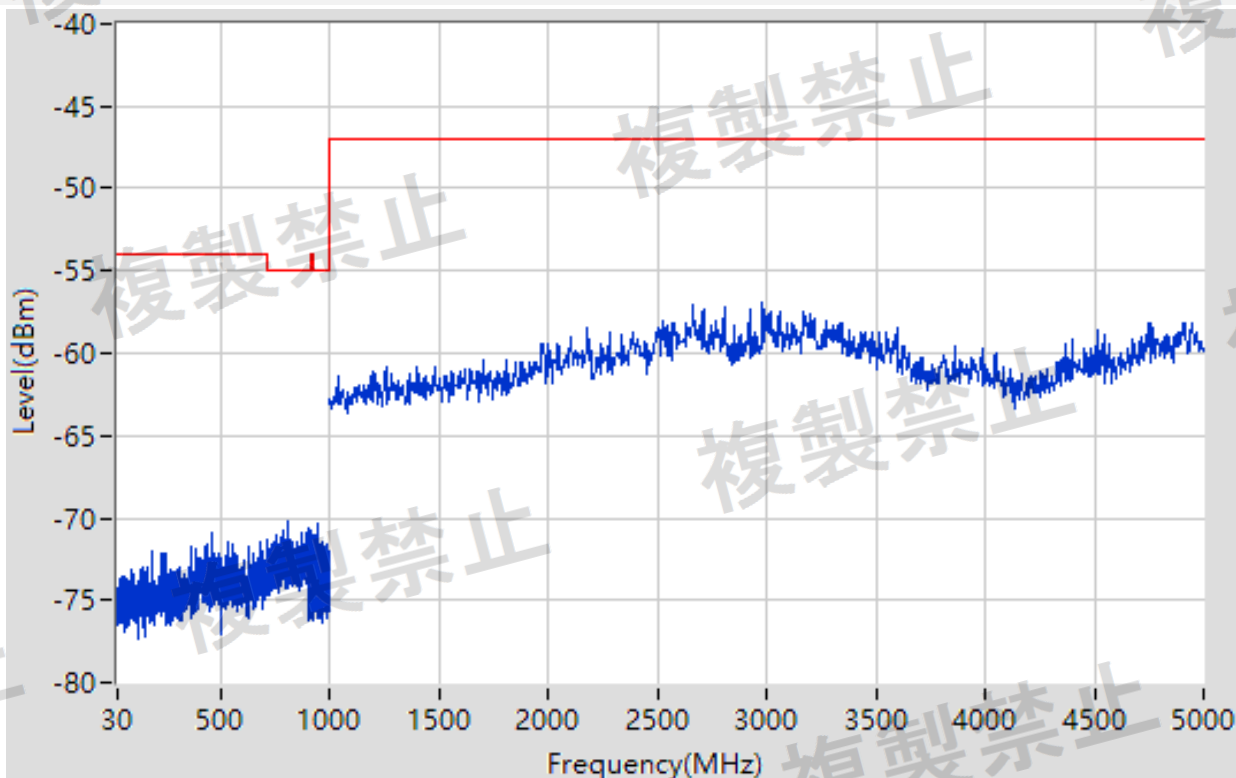
250 kHz

Mode	Test Voltage	Channel	Test frequency(MHz)	Refer to Plot	Verdict
LoRa	LV	Low	920.7	A.6.10	Pass
	NV			A.6.11	Pass
	HV			A.6.12	Pass
	LV	Middle	924.1	A.6.13	Pass
	NV			A.6.14	Pass
	HV			A.6.15	Pass
	LV	High	927.9	A.6.16	Pass
	NV			A.6.17	Pass
	HV			A.6.18	Pass

Test Plots

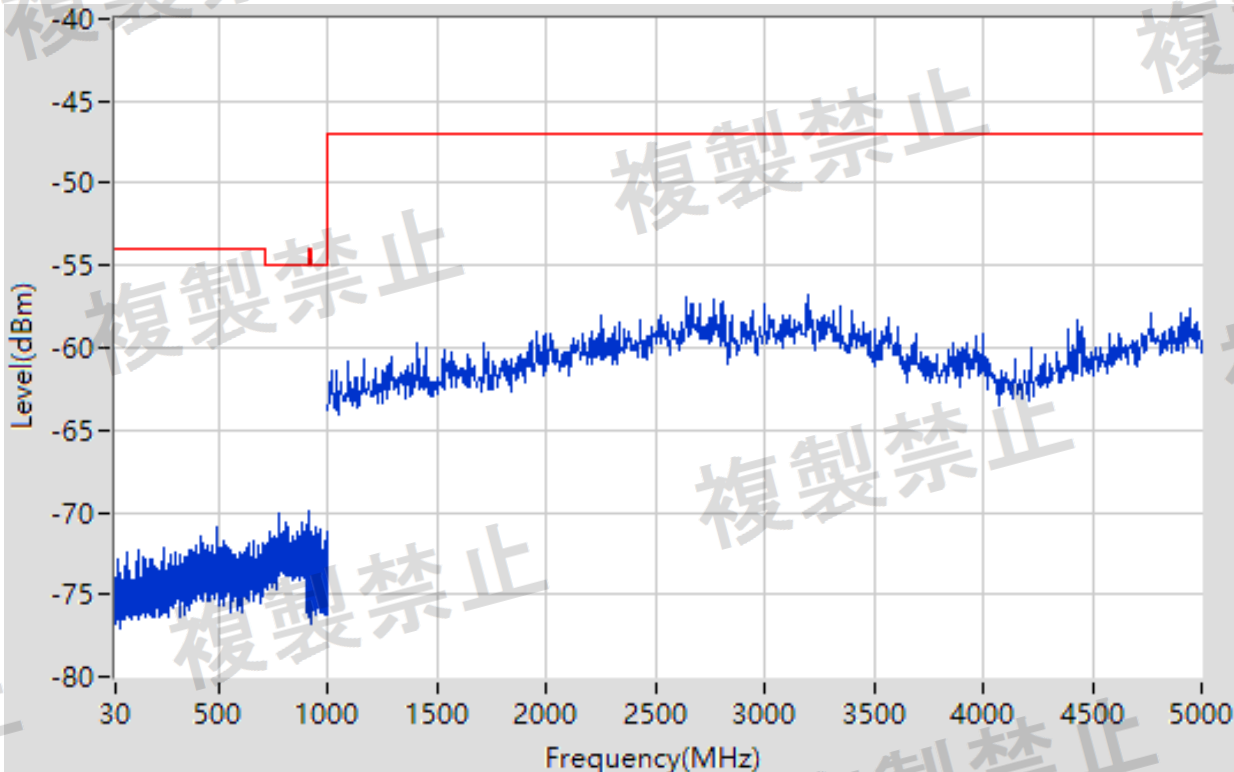
125 kHz

A.6.1 LoRa LV Low Channel



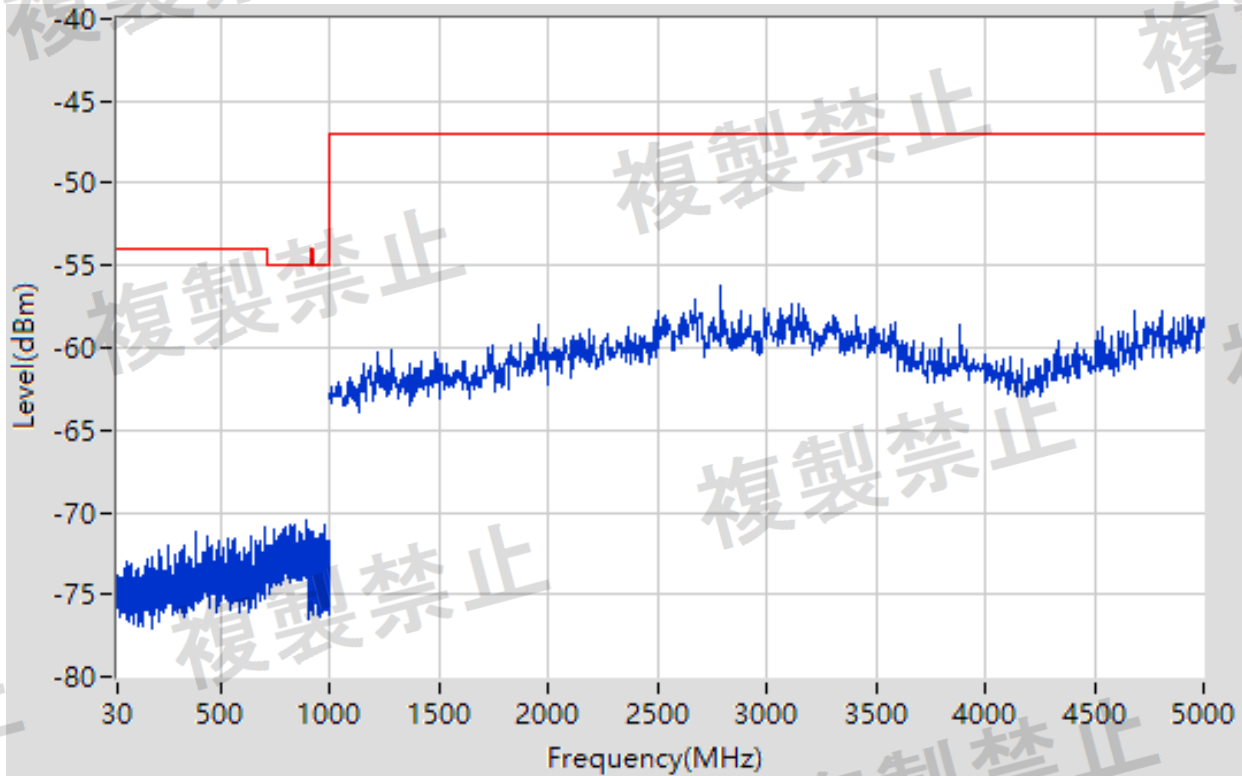
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	463.84	-70.93	-54	Pass	1001
710	900	1	Peak	814.12	-70.15	-55	Pass	1001
900	915	0.1	Peak	909.09	-70.59	-55	Pass	1001
915	930	0.1	Peak	915.12	-70.76	-54	Pass	1001
930	1000	0.1	Peak	950.37	-70.35	-55	Pass	1001
1000	5000	1	Peak	2980	-56.91	-47	Pass	1001

A.6.2 LoRa NV Low Channel



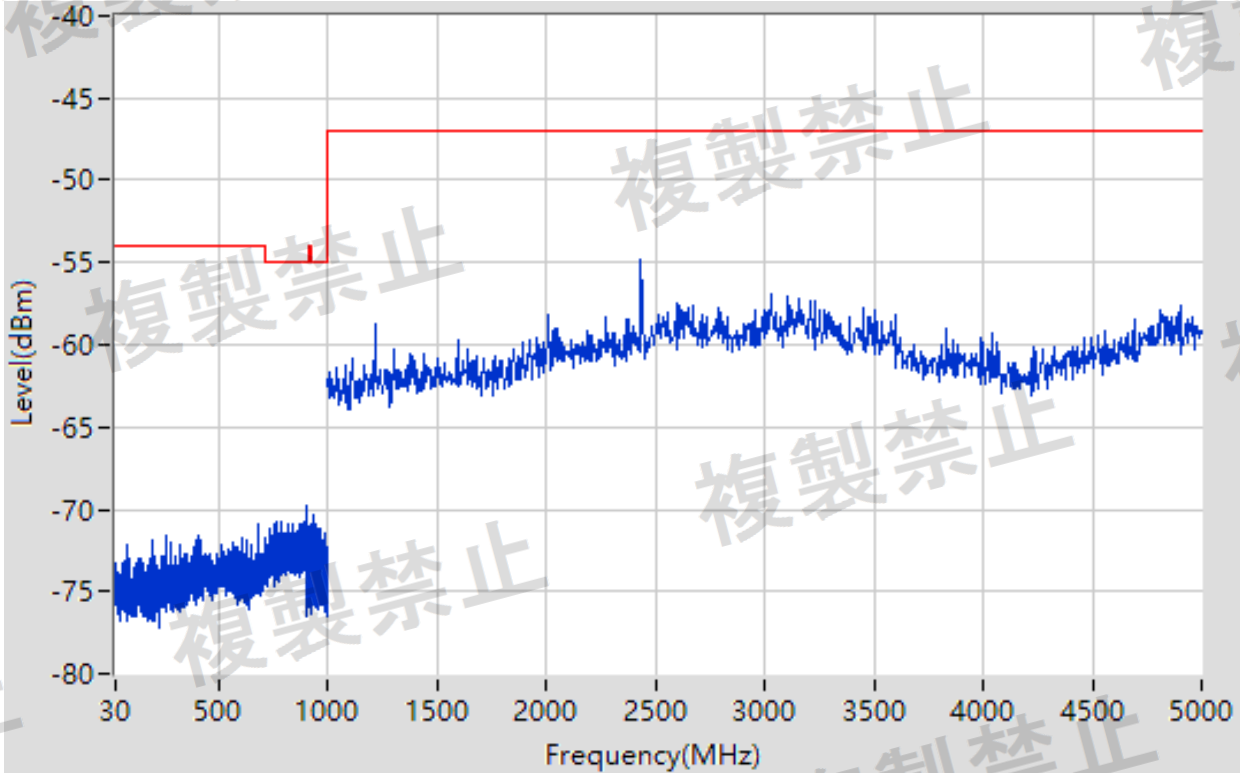
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	491.72	-70.84	-54	Pass	1001
710	900	1	Peak	776.31	-70.02	-55	Pass	1001
900	915	0.1	Peak	911.01	-69.98	-55	Pass	1001
915	930	0.1	Peak	919.44	-70.7	-54	Pass	1001
930	1000	0.1	Peak	945.96	-70.93	-55	Pass	1001
1000	5000	1	Peak	3204	-56.78	-47	Pass	1001

A.6.3 LoRa HV Low Channel



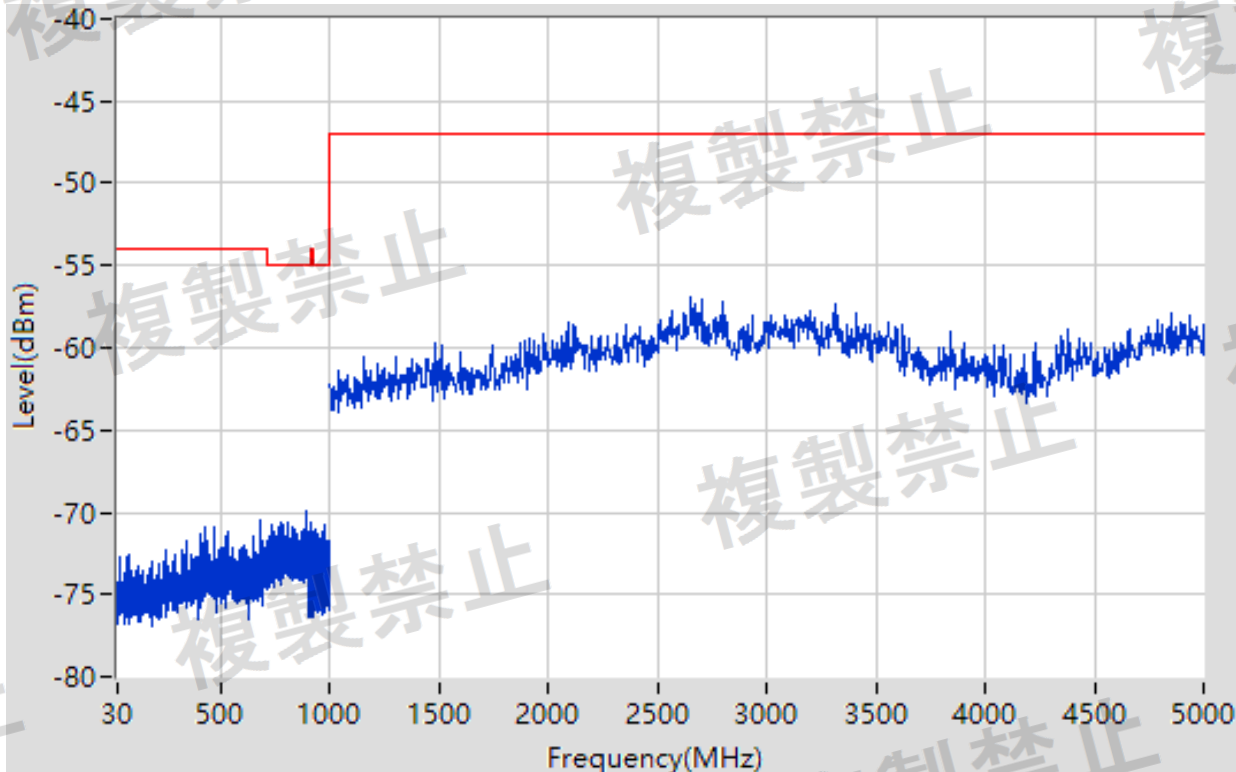
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	708.64	-70.89	-54	Pass	1001
710	900	1	Peak	896.01	-70.42	-55	Pass	1001
900	915	0.1	Peak	903.45	-71.06	-55	Pass	1001
915	930	0.1	Peak	929.01	-71.13	-54	Pass	1001
930	1000	0.1	Peak	977.04	-70.78	-55	Pass	1001
1000	5000	1	Peak	2792	-56.19	-47	Pass	1001

A.6.4 LoRa LV Middle Channel



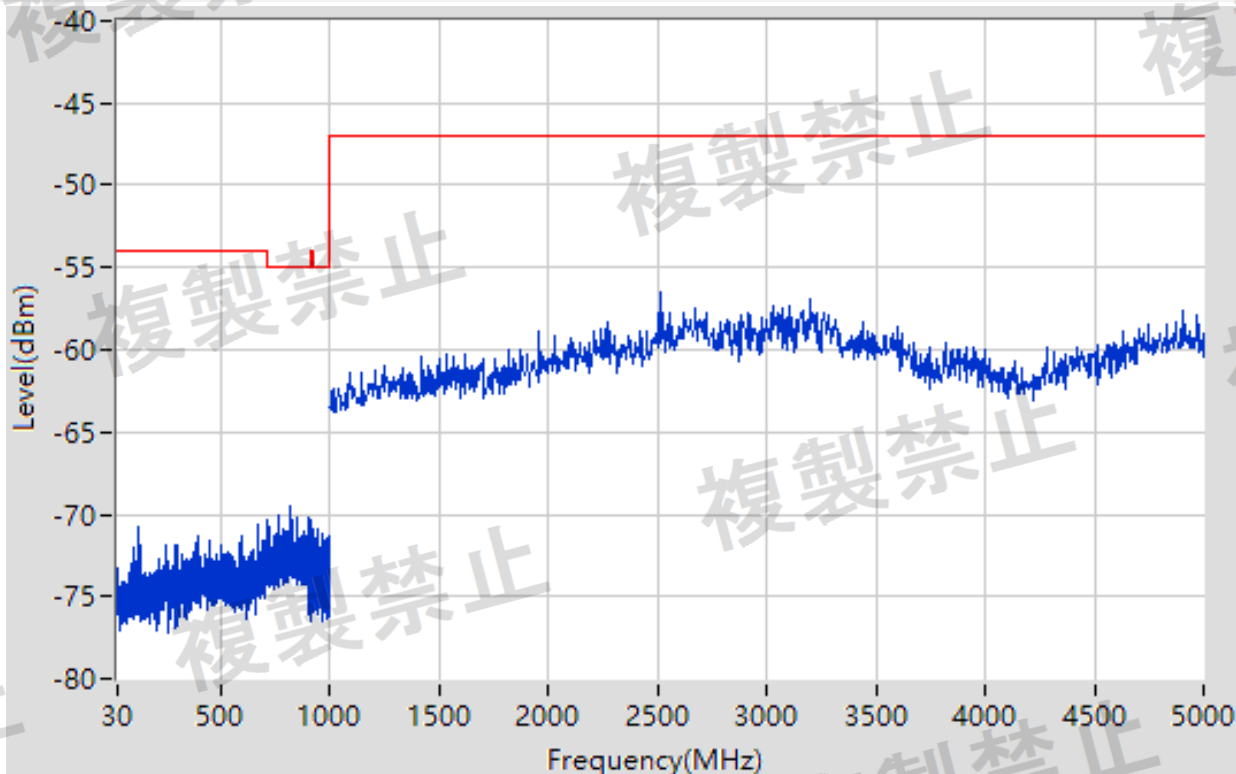
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	683.48	-70.84	-54	Pass	1001
710	900	1	Peak	896.39	-70.71	-55	Pass	1001
900	915	0.1	Peak	901.08	-69.78	-55	Pass	1001
915	930	0.1	Peak	928.185	-70.9	-54	Pass	1001
930	1000	0.1	Peak	939.31	-70.3	-55	Pass	1001
1000	5000	1	Peak	2436	-54.89	-47	Pass	1001

A.6.5 LoRa NV Middle Channel



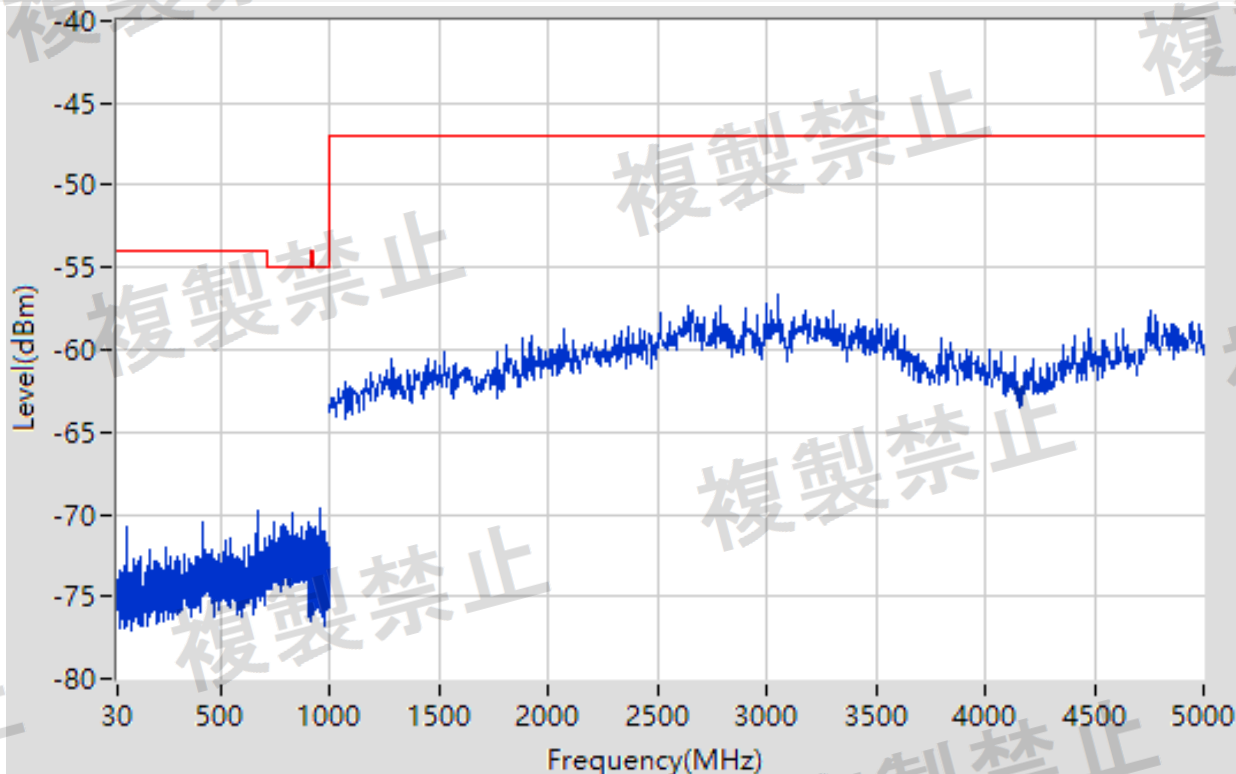
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	682.12	-70.44	-54	Pass	1001
710	900	1	Peak	893.54	-69.88	-55	Pass	1001
900	915	0.1	Peak	911.22	-70.88	-55	Pass	1001
915	930	0.1	Peak	915.48	-70.69	-54	Pass	1001
930	1000	0.1	Peak	973.47	-70.83	-55	Pass	1001
1000	5000	1	Peak	2656	-56.97	-47	Pass	1001

A.6.6 LoRa HV Middle Channel



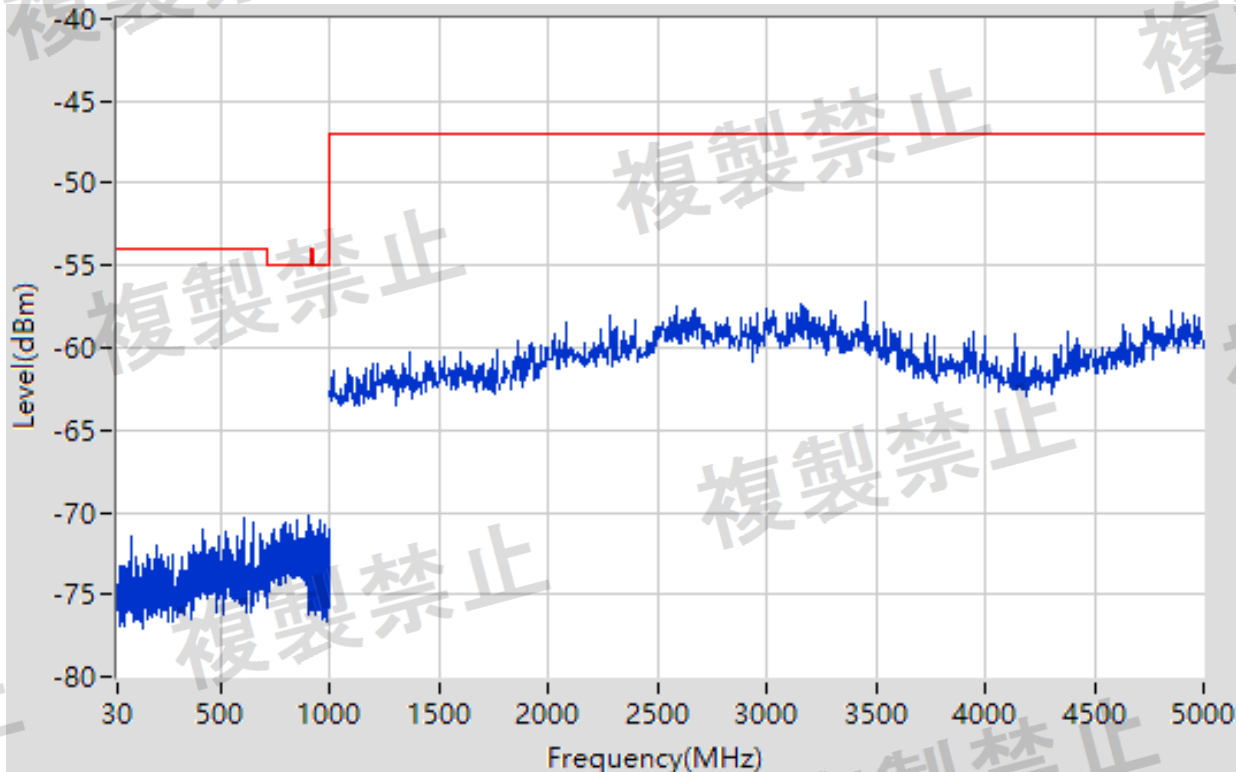
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	670.56	-70.64	-54	Pass	1001
710	900	1	Peak	820.39	-69.5	-55	Pass	1001
900	915	0.1	Peak	901.695	-70.17	-55	Pass	1001
915	930	0.1	Peak	918.81	-70.78	-54	Pass	1001
930	1000	0.1	Peak	945.19	-70.87	-55	Pass	1001
1000	5000	1	Peak	2516	-56.52	-47	Pass	1001

A.6.7 LoRa LV High Channel



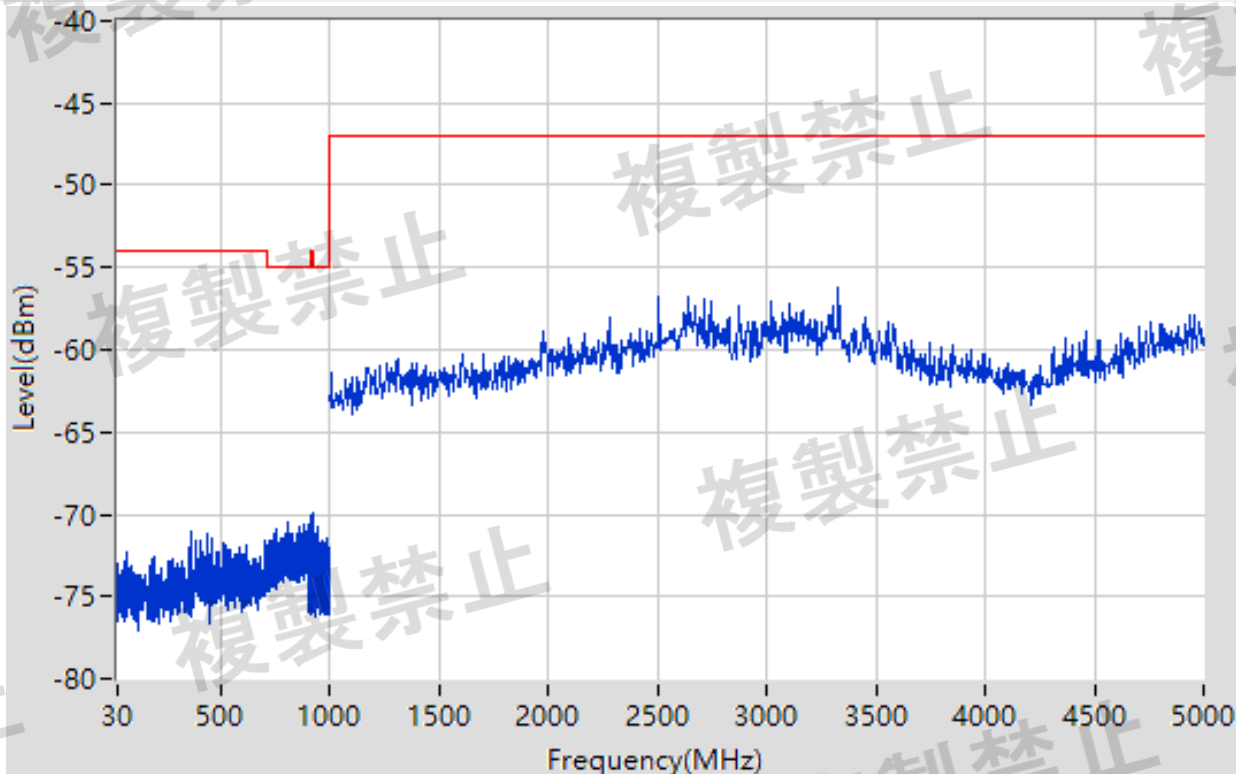
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	667.16	-69.74	-54	Pass	1001
710	900	1	Peak	828.94	-69.87	-55	Pass	1001
900	915	0.1	Peak	903.225	-70.45	-55	Pass	1001
915	930	0.1	Peak	927.675	-70.86	-54	Pass	1001
930	1000	0.1	Peak	956.39	-69.59	-55	Pass	1001
1000	5000	1	Peak	3056	-56.58	-47	Pass	1001

A.6.8 LoRa NV High Channel



Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	613.44	-70.35	-54	Pass	1001
710	900	1	Peak	854.21	-70.51	-55	Pass	1001
900	915	0.1	Peak	908.715	-70.24	-55	Pass	1001
915	930	0.1	Peak	918.255	-70.83	-54	Pass	1001
930	1000	0.1	Peak	953.66	-70.54	-55	Pass	1001
1000	5000	1	Peak	3448	-57.19	-47	Pass	1001

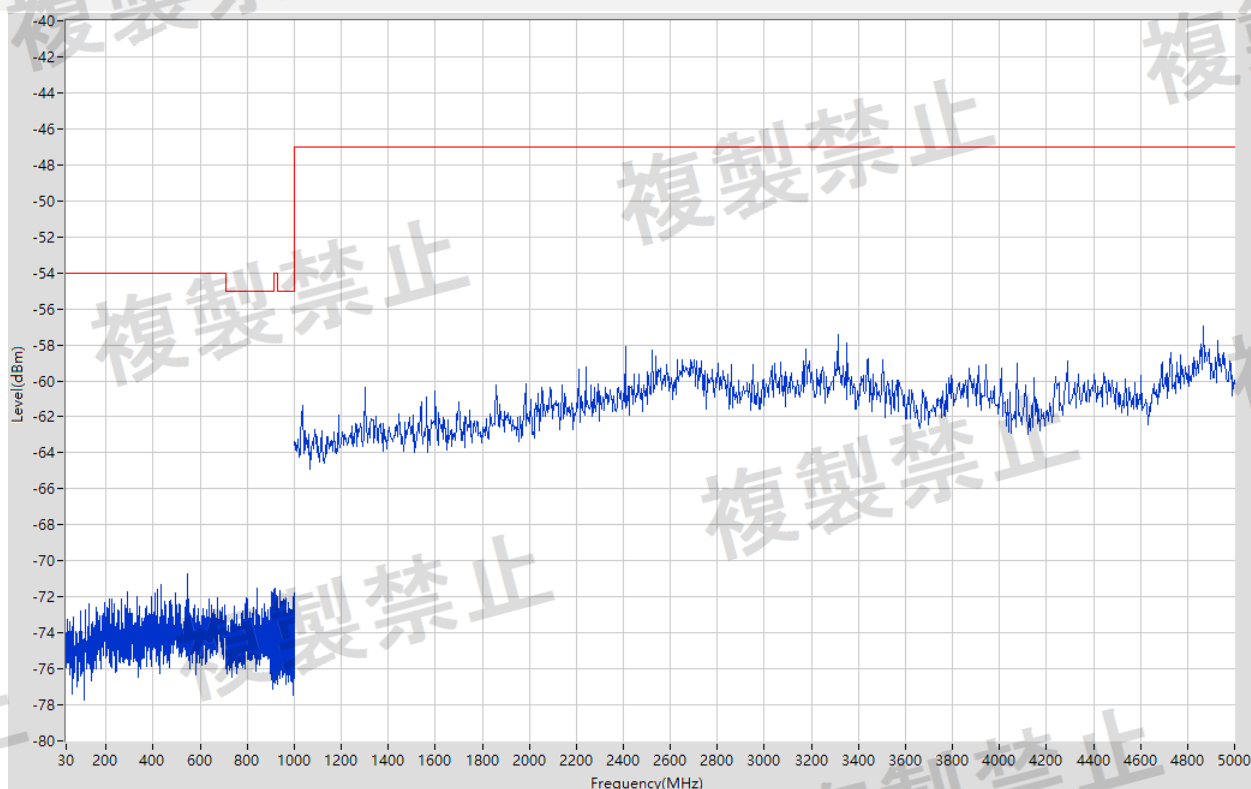
A.6.9 LoRa HV High Channel



Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	368.64	-71.07	-54	Pass	1001
710	900	1	Peak	811.08	-70.48	-55	Pass	1001
900	915	0.1	Peak	915	-70.04	-55	Pass	1001
915	930	0.1	Peak	924.345	-69.99	-54	Pass	1001
930	1000	0.1	Peak	942.95	-70.76	-55	Pass	1001
1000	5000	1	Peak	3328	-56.28	-47	Pass	1001

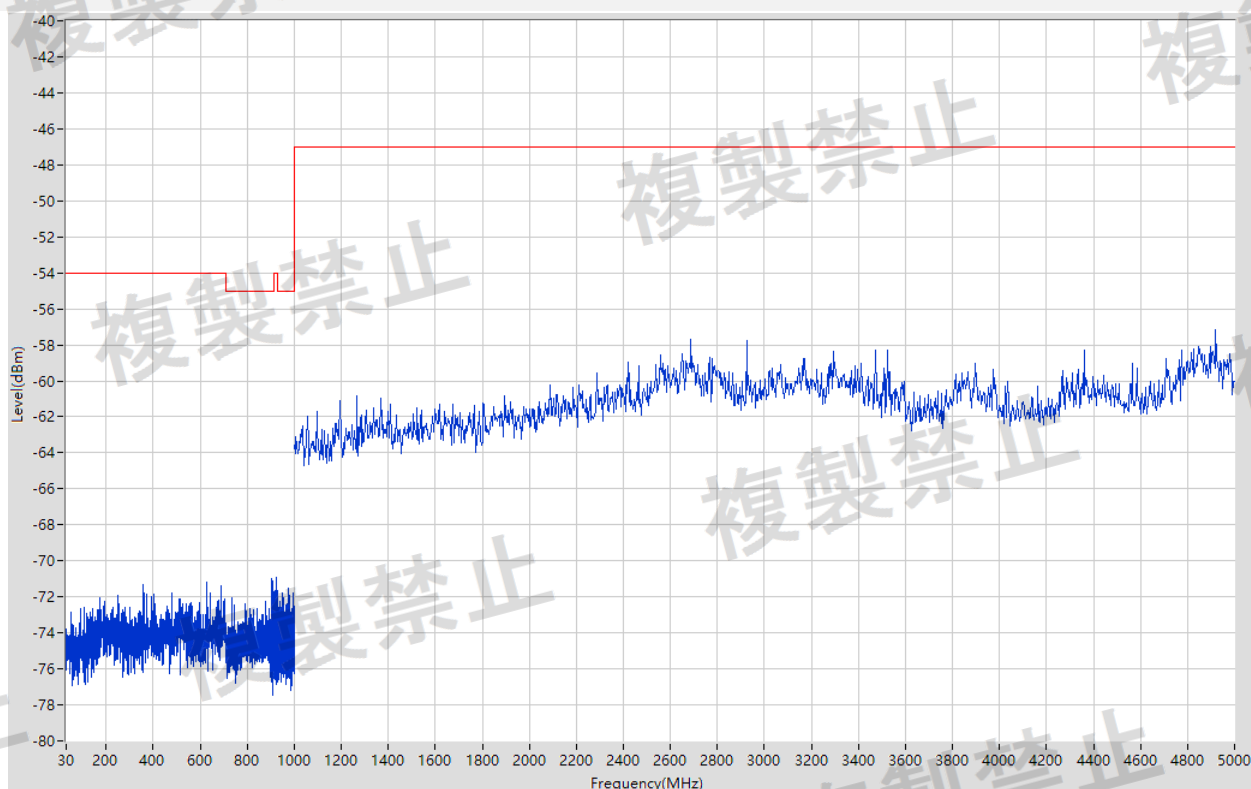
250 kHz

A.6.10 LoRa LV Low Channel



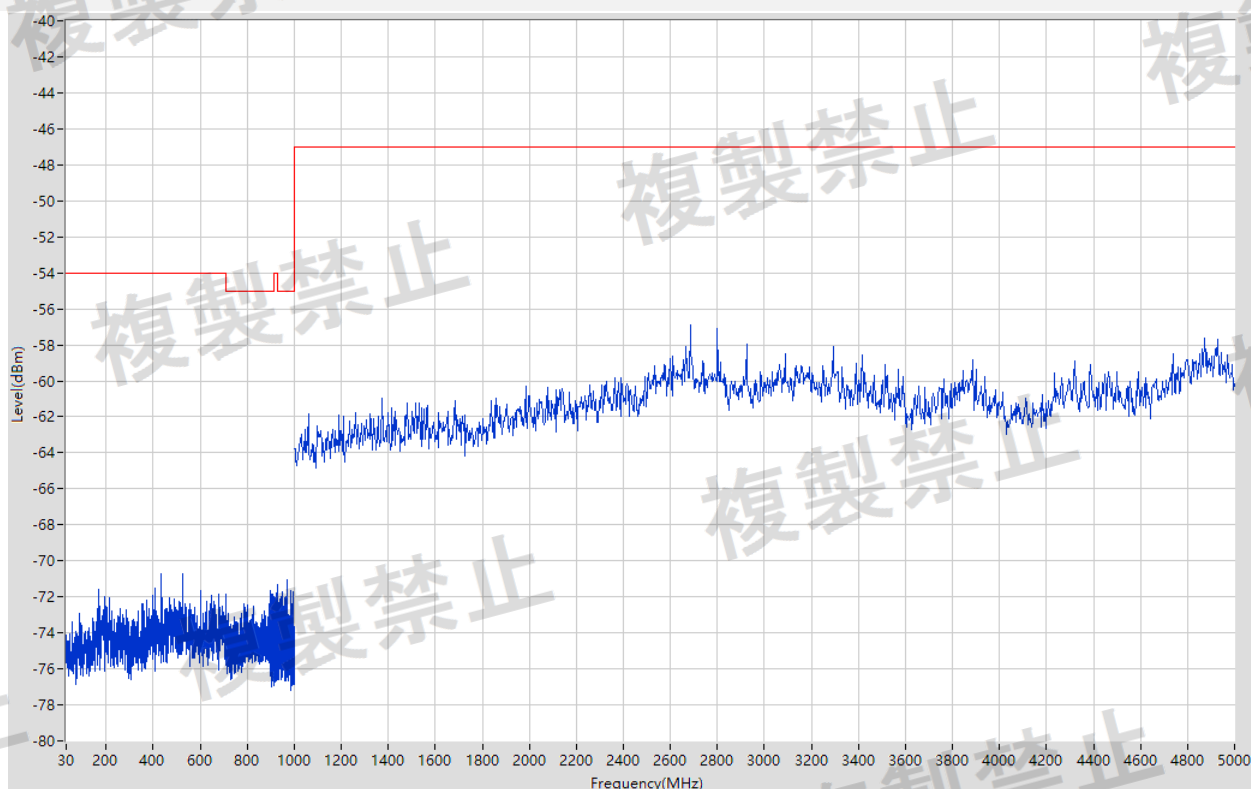
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	547.48	-70.71	-54	Pass	1001
710	900	1	Peak	842.05	-71.53	-55	Pass	1001
900	915	0.1	Peak	913.05	-71.6	-55	Pass	1001
915	930	0.1	Peak	916.74	-71.51	-54	Pass	1001
930	1000	0.1	Peak	937.42	-71.68	-55	Pass	1001
1000	5000	1	Peak	4868	-56.97	-47	Pass	1001

A.6.11 LoRa NV Low Channel



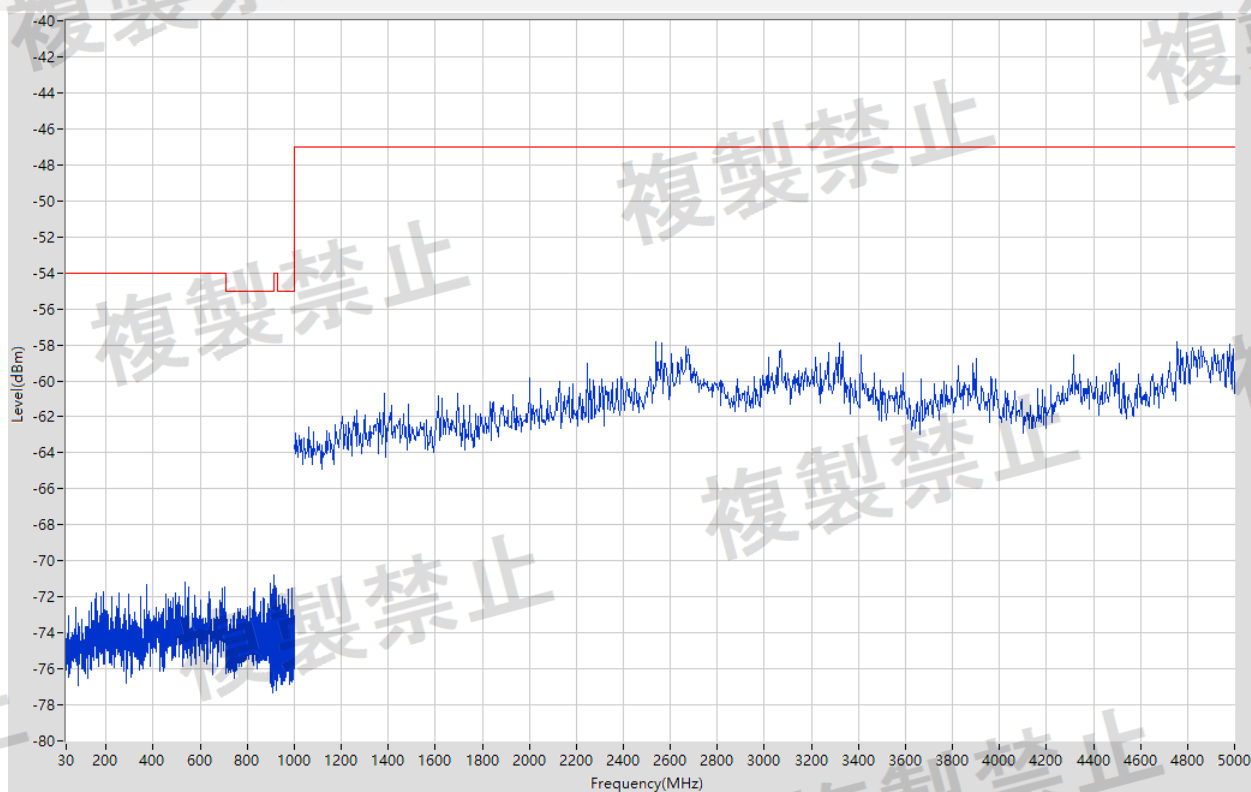
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	629.76	-71.17	-54	Pass	1001
710	900	1	Peak	732.61	-72.04	-55	Pass	1001
900	915	0.1	Peak	902.88	-70.99	-55	Pass	1001
915	930	0.1	Peak	926.04	-70.89	-54	Pass	1001
930	1000	0.1	Peak	976.34	-71.52	-55	Pass	1001
1000	5000	1	Peak	4920	-57.17	-47	Pass	1001

A.6.12 LoRa HV Low Channel



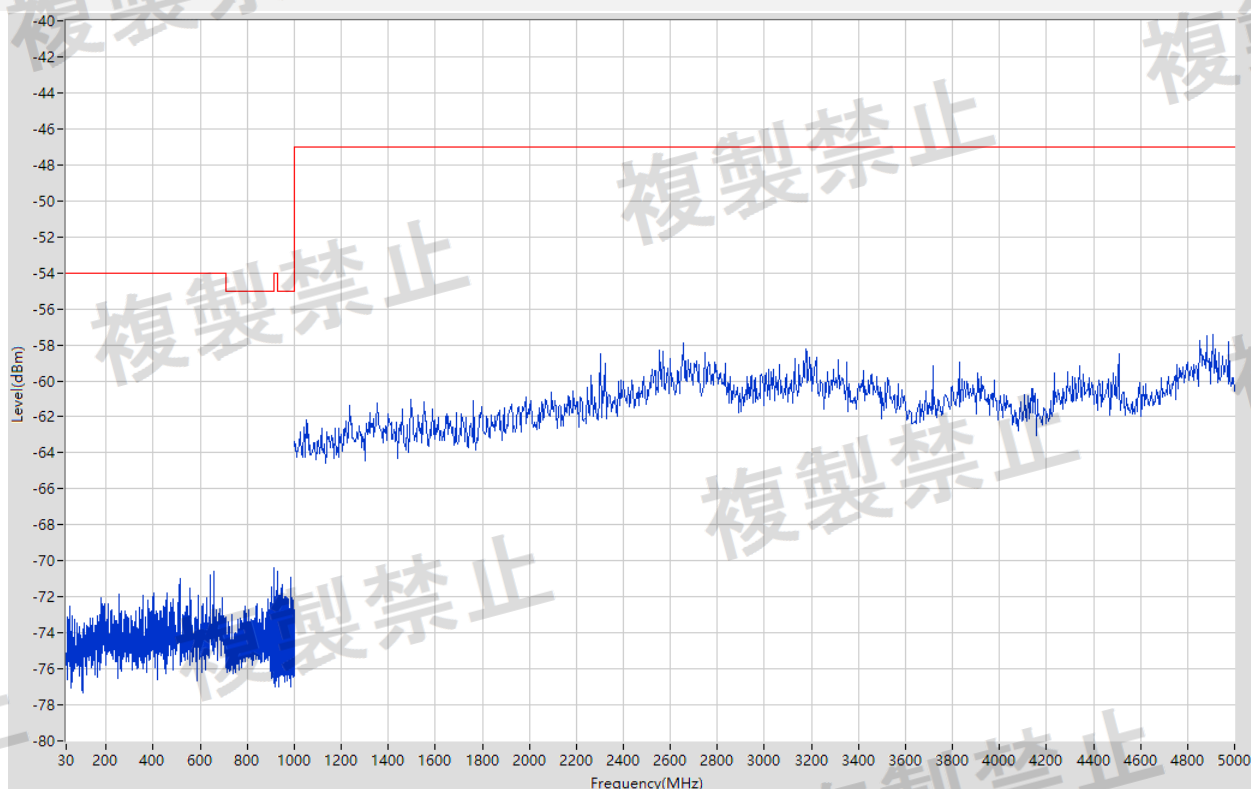
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	524.36	-70.7	-54	Pass	1001
710	900	1	Peak	891.64	-72.37	-55	Pass	1001
900	915	0.1	Peak	900.825	-71.68	-55	Pass	1001
915	930	0.1	Peak	929.55	-71.31	-54	Pass	1001
930	1000	0.1	Peak	968.99	-71.07	-55	Pass	1001
1000	5000	1	Peak	2684	-56.87	-47	Pass	1001

A.6.13 LoRa LV Middle Channel



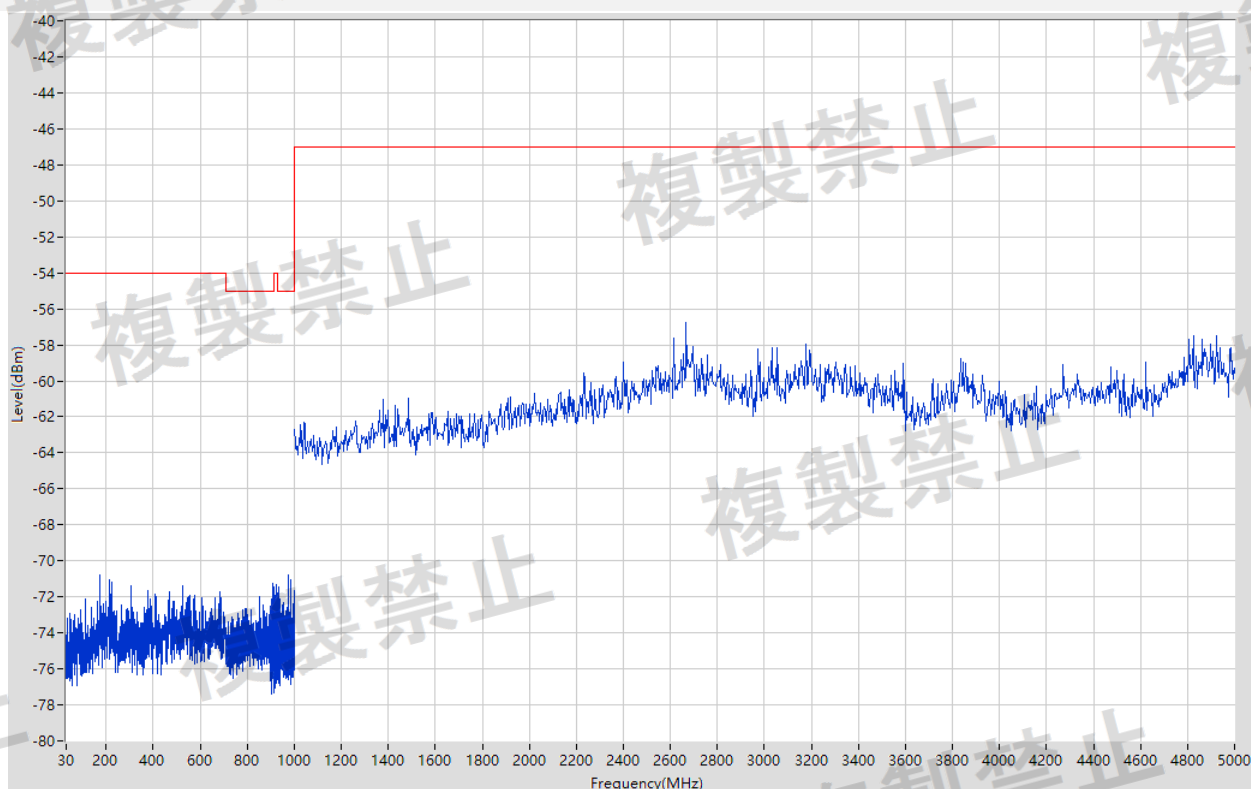
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	537.28	-71.16	-54	Pass	1001
710	900	1	Peak	830.27	-71.54	-55	Pass	1001
900	915	0.1	Peak	900.48	-71.27	-55	Pass	1001
915	930	0.1	Peak	915.81	-70.79	-54	Pass	1001
930	1000	0.1	Peak	991.53	-71.52	-55	Pass	1001
1000	5000	1	Peak	4756	-57.8	-47	Pass	1001

A.6.14 LoRa NV Middle Channel



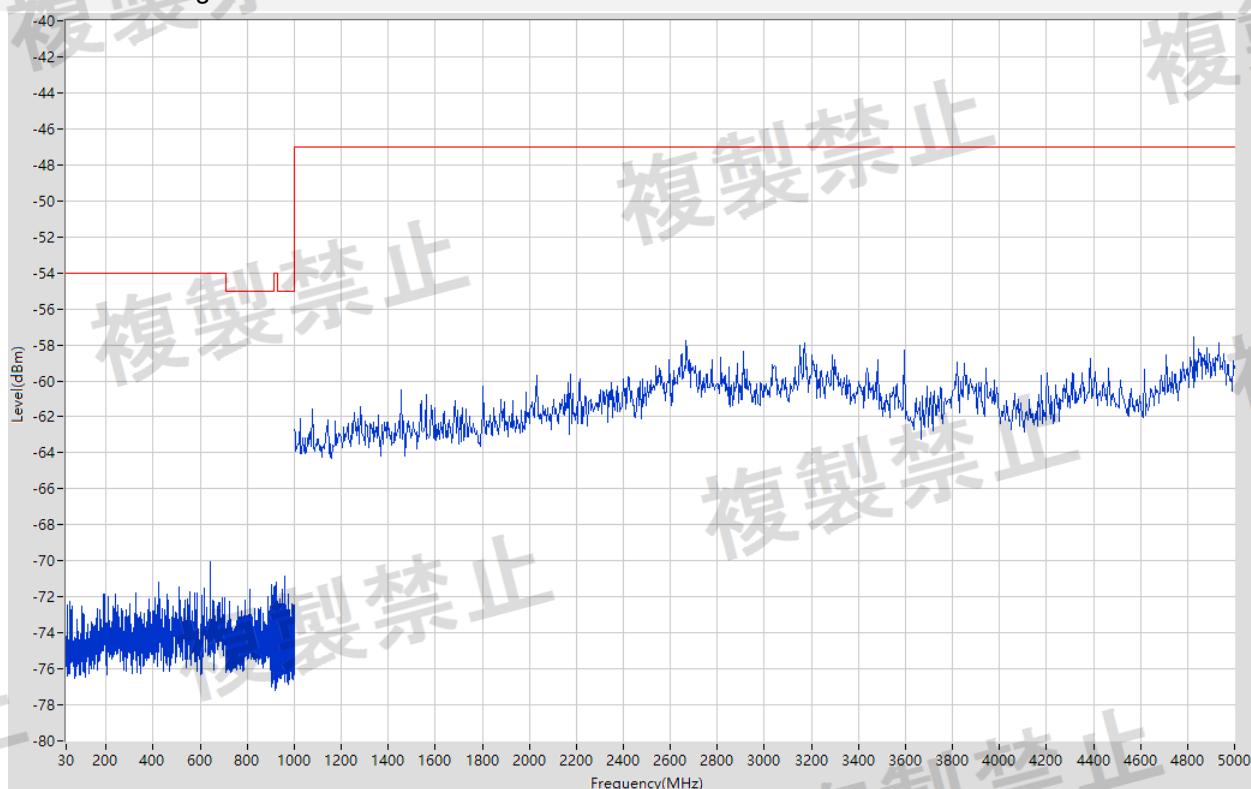
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	656.96	-70.6	-54	Pass	1001
710	900	1	Peak	885.94	-72.13	-55	Pass	1001
900	915	0.1	Peak	913.47	-70.42	-55	Pass	1001
915	930	0.1	Peak	927.645	-70.59	-54	Pass	1001
930	1000	0.1	Peak	986.35	-70.93	-55	Pass	1001
1000	5000	1	Peak	4908	-57.44	-47	Pass	1001

A.6.15 LoRa HV Middle Channel



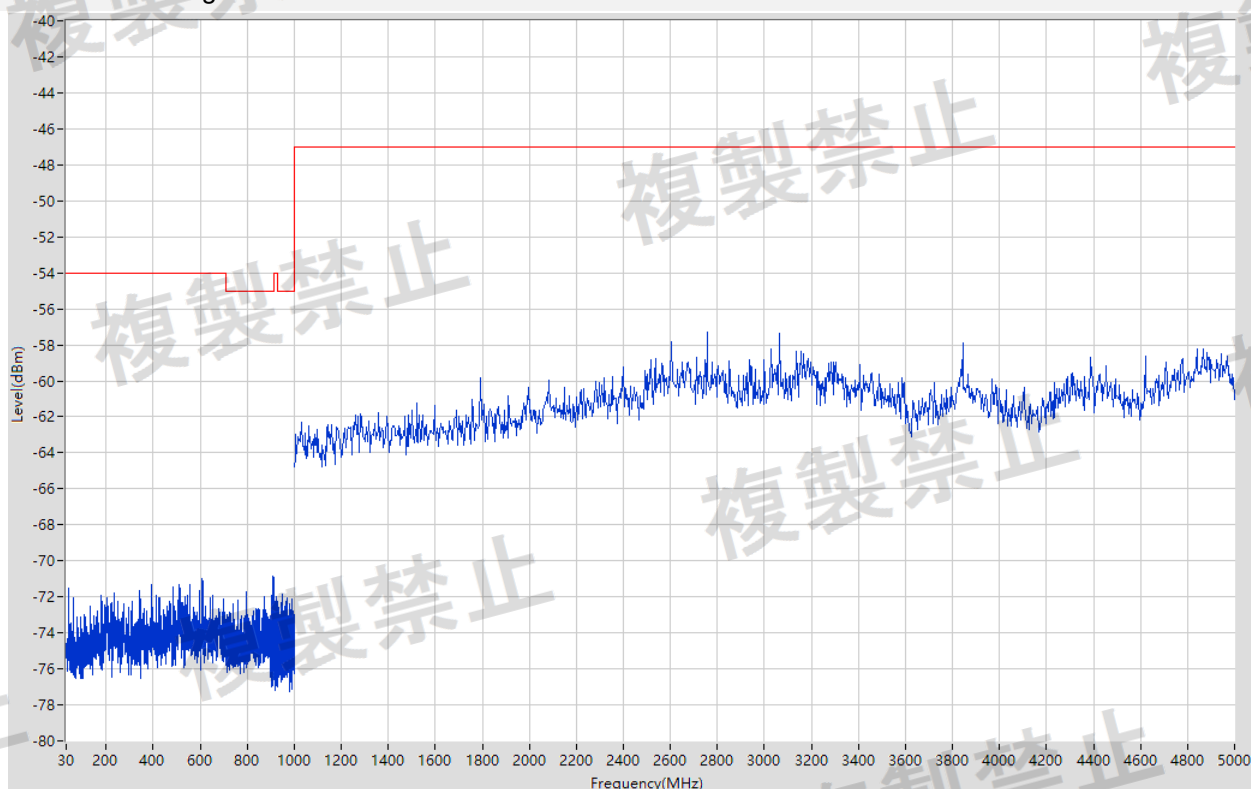
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	173.48	-70.8	-54	Pass	1001
710	900	1	Peak	852.88	-71.97	-55	Pass	1001
900	915	0.1	Peak	908.835	-71.25	-55	Pass	1001
915	930	0.1	Peak	923.52	-71.29	-54	Pass	1001
930	1000	0.1	Peak	972.98	-70.77	-55	Pass	1001
1000	5000	1	Peak	2668	-56.73	-47	Pass	1001

A.6.16 LoRa LV High Channel



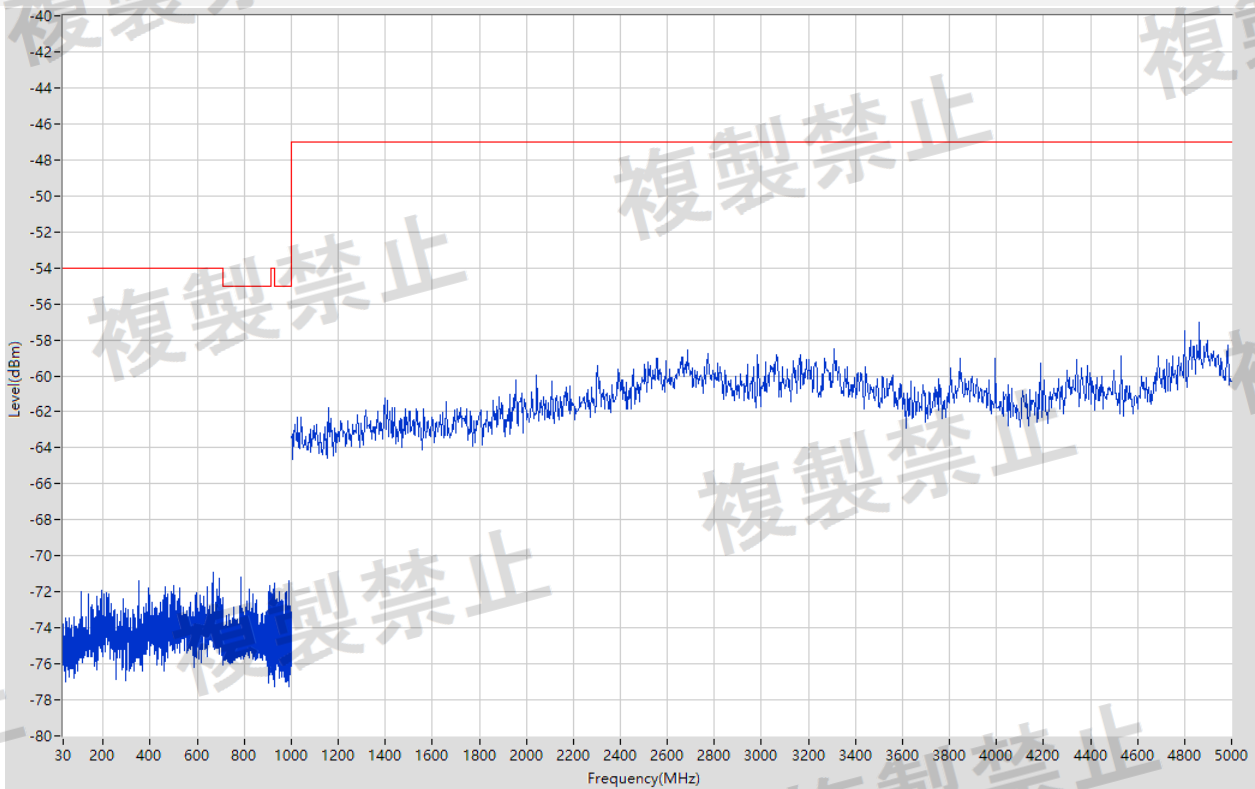
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	642	-70.05	-54	Pass	1001
710	900	1	Peak	812.03	-71.59	-55	Pass	1001
900	915	0.1	Peak	903.705	-71.3	-55	Pass	1001
915	930	0.1	Peak	924.72	-71.17	-54	Pass	1001
930	1000	0.1	Peak	958.07	-70.88	-55	Pass	1001
1000	5000	1	Peak	4828	-57.55	-47	Pass	1001

A.6.17 LoRa NV High Channel



Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	606.64	-70.97	-54	Pass	1001
710	900	1	Peak	795.69	-71.71	-55	Pass	1001
900	915	0.1	Peak	908.22	-70.86	-55	Pass	1001
915	930	0.1	Peak	915.945	-71.48	-54	Pass	1001
930	1000	0.1	Peak	948.62	-71.87	-55	Pass	1001
1000	5000	1	Peak	2756	-57.31	-47	Pass	1001

A.6.18 LoRa HV High Channel



Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	710	0.1	Peak	669.2	-70.92	-54	Pass	1001
710	900	1	Peak	784.86	-71.21	-55	Pass	1001
900	915	0.1	Peak	908.19	-71.66	-55	Pass	1001
915	930	0.1	Peak	928.32	-71.5	-54	Pass	1001
930	1000	0.1	Peak	992.3	-71.38	-55	Pass	1001
1000	5000	1	Peak	4864	-57.03	-47	Pass	1001

A.7 Adjacent channel leakage power

Test Data

125 kHz

Test Mode	Test Channel	Test Voltage	The edge of channel	Measurement Power(dBm)	Limit (dBm)	Verdict
LoRa	Low	LV	Left	-44.85	-15.0	Pass
			Right	-41.01	-15.0	Pass
		NV	Left	-44.83	-15.0	Pass
			Right	-41.02	-15.0	Pass
		HV	Left	-44.72	-15.0	Pass
			Right	-40.94	-15.0	Pass
	Middle	LV	Left	-44.69	-15.0	Pass
			Right	-41.08	-15.0	Pass
		NV	Left	-44.73	-15.0	Pass
			Right	-41.13	-15.0	Pass
		HV	Left	-44.73	-15.0	Pass
			Right	-41.07	-15.0	Pass
	High	LV	Left	-42.42	-15.0	Pass
			Right	-40.28	-15.0	Pass
		NV	Left	-42.35	-15.0	Pass
			Right	-40.24	-15.0	Pass
		HV	Left	-42.37	-15.0	Pass
			Right	-40.31	-15.0	Pass

250 kHz

Test Mode	Test Channel	Test Voltage	The edge of channel	Measurement Power(dBm)	Limit (dBm)	Verdict
LoRa	Low	LV	Left	-46.13	-15.0	Pass
			Right	-42.00	-15.0	Pass
		NV	Left	-46.29	-15.0	Pass
			Right	-41.99	-15.0	Pass
		HV	Left	-46.16	-15.0	Pass
			Right	-42.04	-15.0	Pass
	Middle	LV	Left	-46.31	-15.0	Pass
			Right	-42.08	-15.0	Pass
		NV	Left	-46.24	-15.0	Pass
			Right	-42.11	-15.0	Pass
		HV	Left	-46.29	-15.0	Pass
			Right	-42.16	-15.0	Pass
	High	LV	Left	-43.09	-15.0	Pass
			Right	-40.56	-15.0	Pass
		NV	Left	-43.19	-15.0	Pass
			Right	-40.48	-15.0	Pass
		HV	Left	-43.07	-15.0	Pass
			Right	-40.52	-15.0	Pass

A.8 Transmission time control equipment

Test Data

125 kHz

Test Mode	Test Channel	Test Voltage	Test TX on time(s)	Test TX off time (ms)	Limit on time (s)	Limit off time (ms)	Refer to Plot	Verdict
LoRa	Low	LV	0.3708	121.20	<0.4	>2.00	A.8.1	Pass
		NV	0.3708	120.90	<0.4	>2.00	A.8.2	Pass
		HV	0.3708	120.90	<0.4	>2.00	A.8.3	Pass
	Middle	LV	0.3708	120.90	<0.4	>2.00	A.8.4	Pass
		NV	0.3708	120.90	<0.4	>2.00	A.8.5	Pass
		HV	0.3708	120.90	<0.4	>2.00	A.8.6	Pass
	High	LV	0.3708	121.20	<0.4	>2.00	A.8.7	Pass
		NV	0.3708	121.20	<0.4	>2.00	A.8.8	Pass
		HV	0.3708	120.90	<0.4	>2.00	A.8.9	Pass

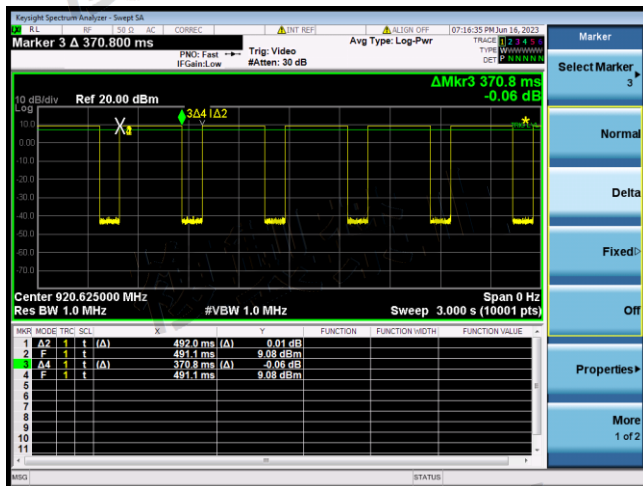
250 kHz

Test Mode	Test Channel	Test Voltage	Test TX on time(s)	Test TX off time (ms)	Limit on time (s)	Limit off time (ms)	Refer to Plot	Verdict
LoRa	Low	LV	0.3066	185.40	<0.4	>2.00	A.8.10	Pass
		NV	0.3069	185.40	<0.4	>2.00	A.8.11	Pass
		HV	0.3066	185.40	<0.4	>2.00	A.8.12	Pass
	Middle	LV	0.3066	185.40	<0.4	>2.00	A.8.13	Pass
		NV	0.3069	185.40	<0.4	>2.00	A.8.14	Pass
		HV	0.3066	185.40	<0.4	>2.00	A.8.15	Pass
	High	LV	0.3066	185.40	<0.4	>2.00	A.8.16	Pass
		NV	0.3066	185.40	<0.4	>2.00	A.8.17	Pass
		HV	0.3066	185.40	<0.4	>2.00	A.8.18	Pass

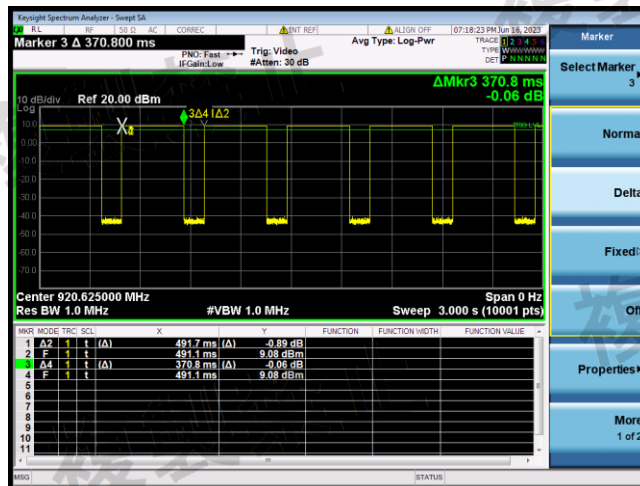
Test Plots

125 kHz

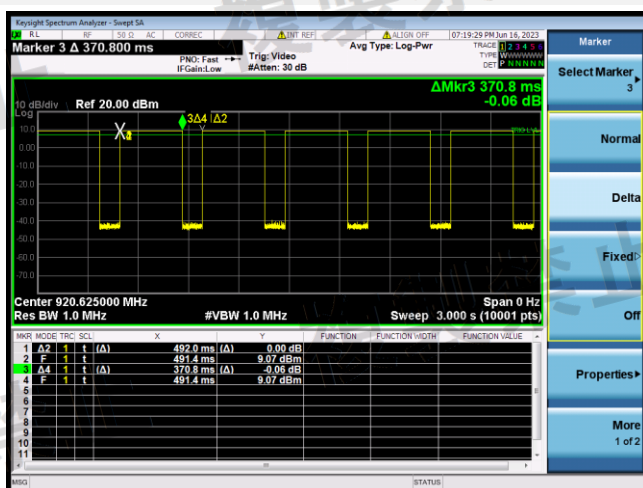
A.8.1. LV Low Channel



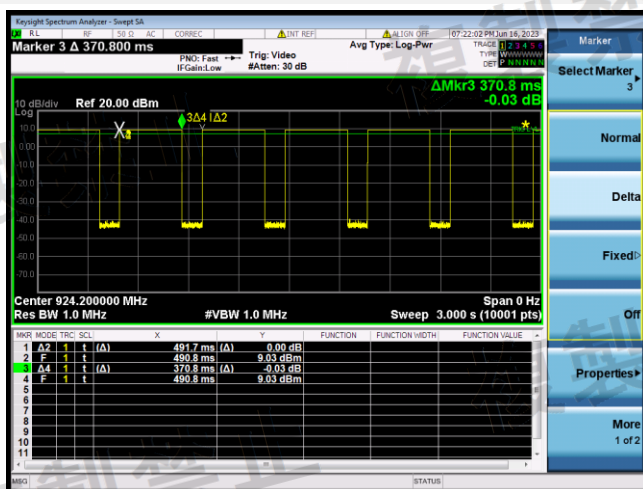
A.8.2. NV Low Channel



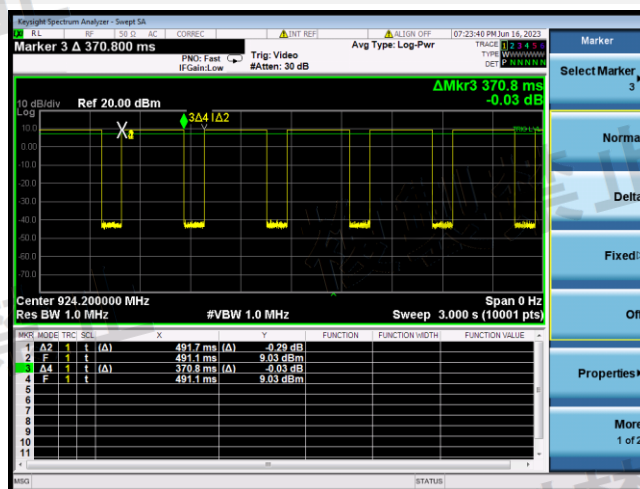
A.8.3. NV Low Channel



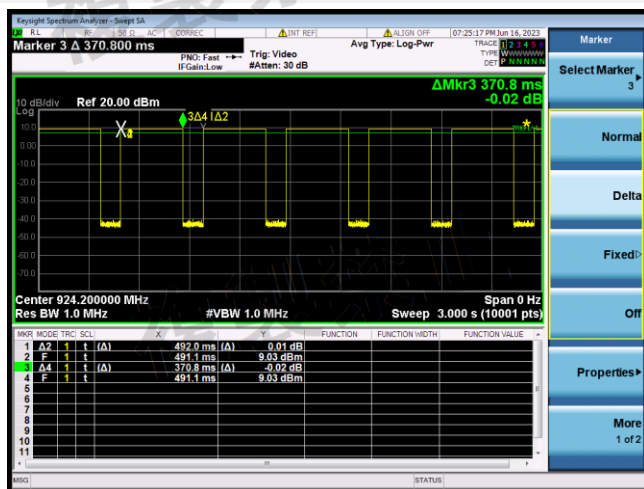
A.8.4. LV Middle Channel



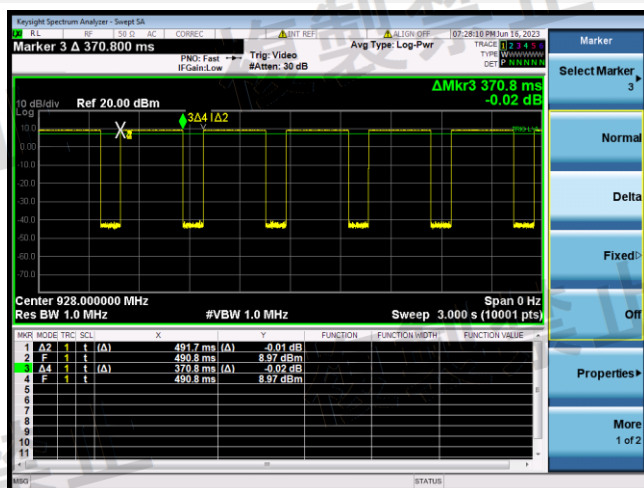
A.8.5. NV Middle Channel



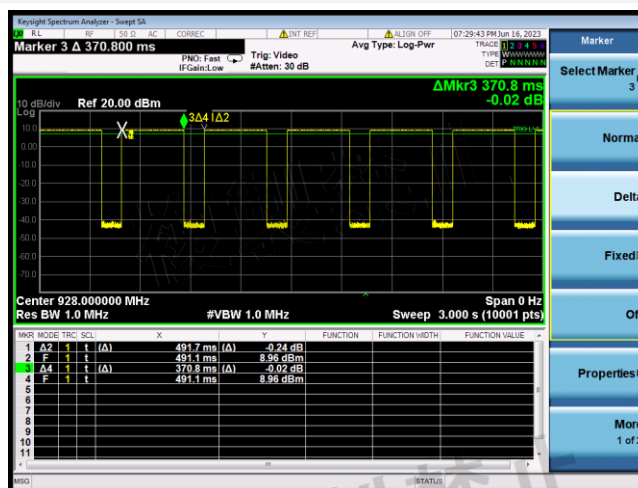
A.8.6. HV Middle Channel



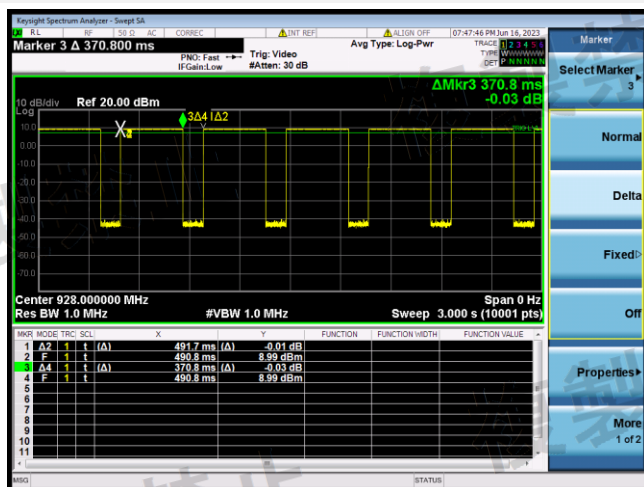
A.8.7. NV High Channel



A.8.8. NV High Channel

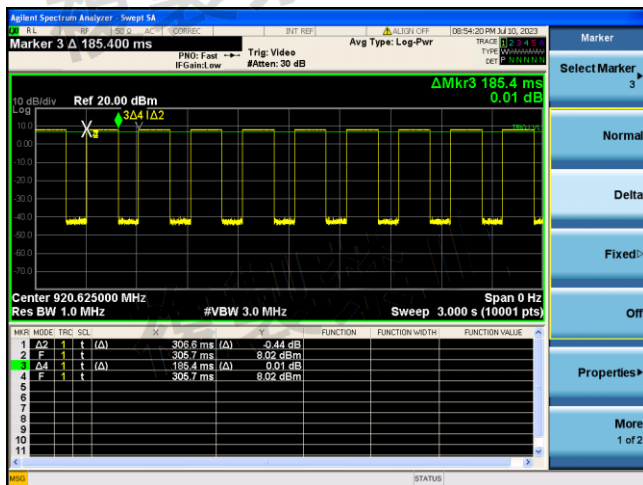


A.8.9. HV High Channel

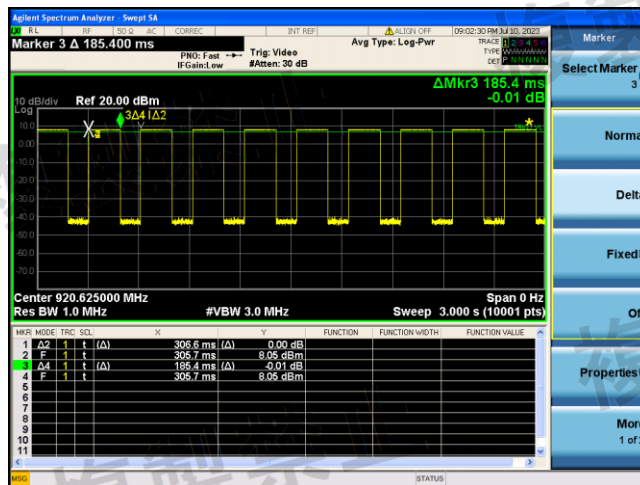


250 kHz

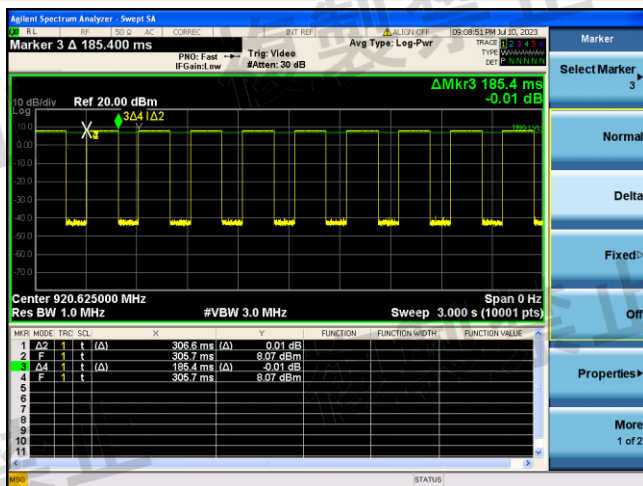
A.8.10. LV Low Channel



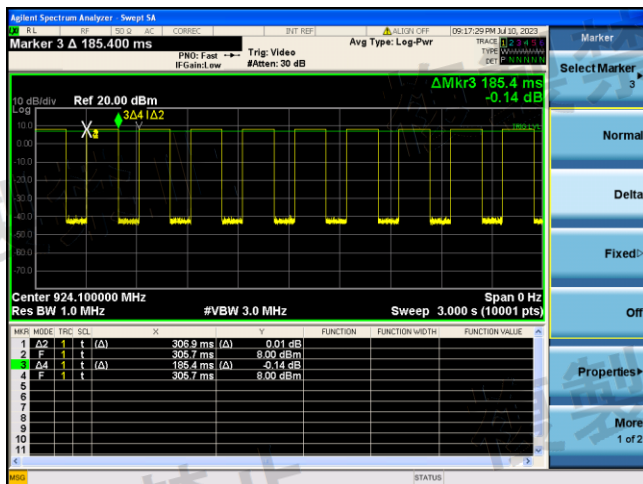
A.8.11. NV Low Channel



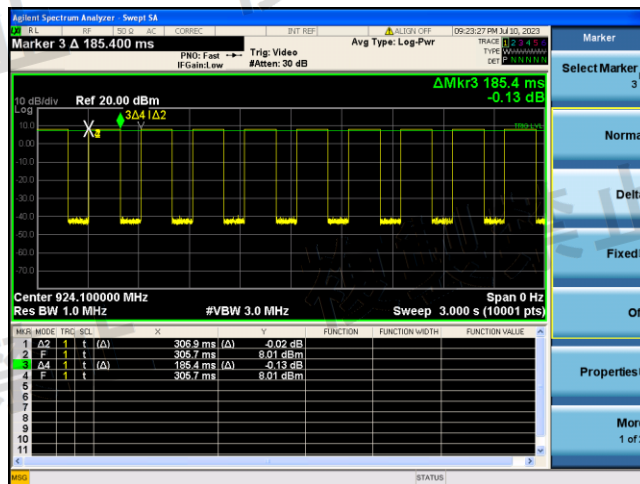
A.8.12. NV Low Channel



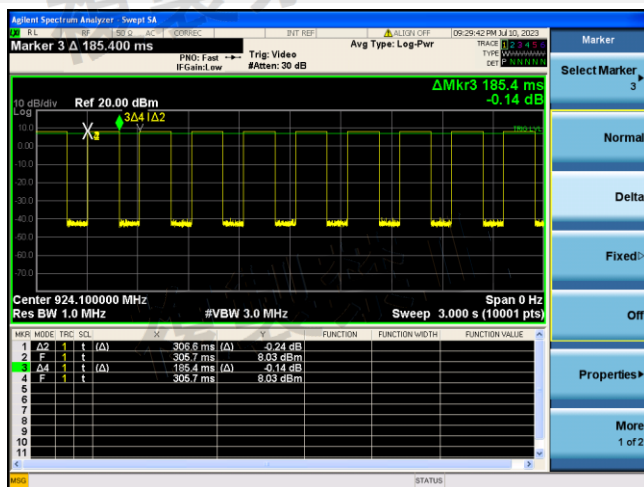
A.8.13. LV Middle Channel



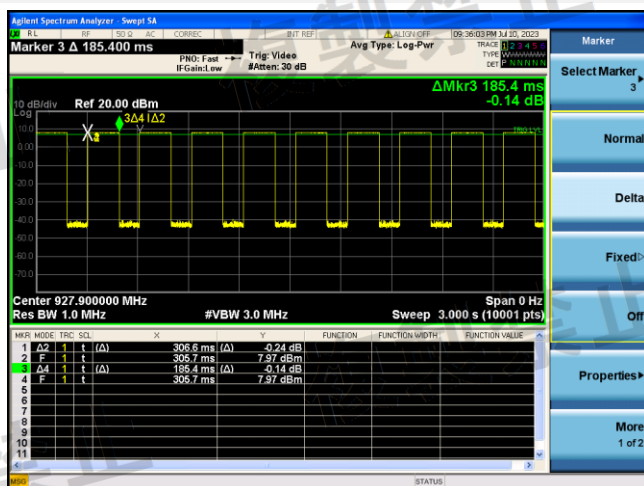
A.8.14. NV Middle Channel



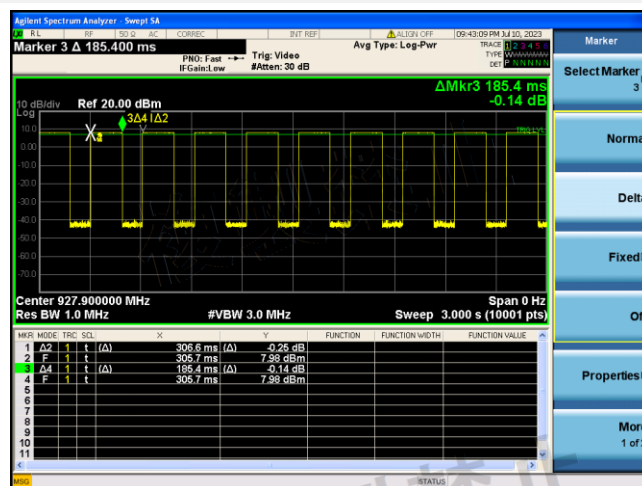
A.8.15. HV Middle Channel



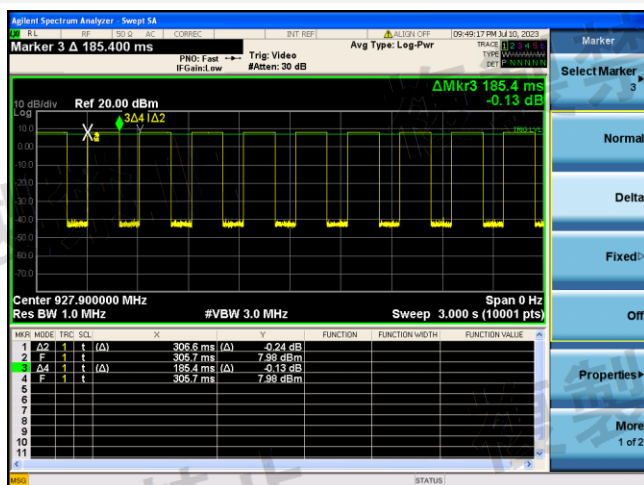
A.8.16. NV High Channel



A.8.17. NV High Channel



A.8.18. HV High Channel

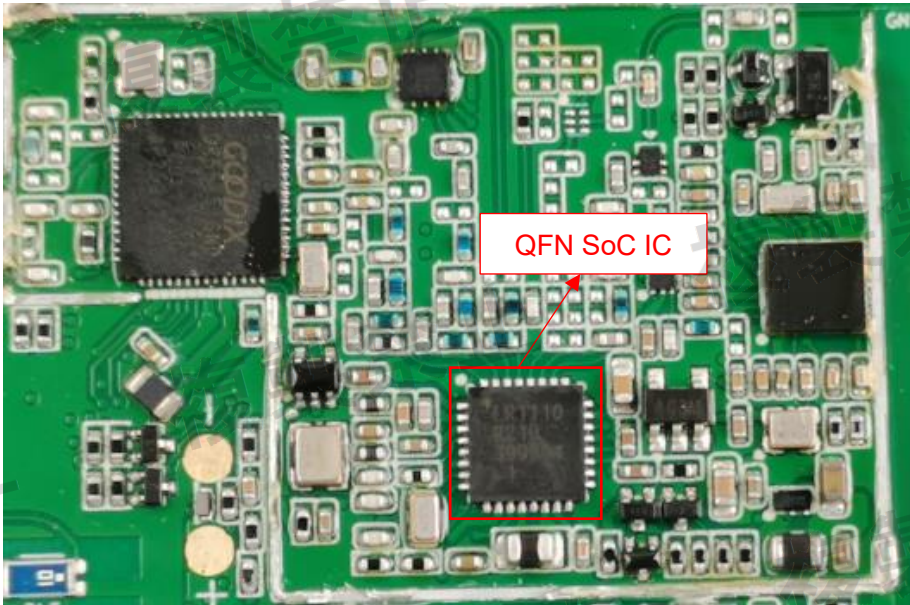


A.9 Carrier sense

Test Mode	Channel	Test Voltage	Test Result (ID Code)	Verdict
LoRa	Low	LV	GOOD	Pass
		NV	GOOD	Pass
		HV	GOOD	Pass
	Middle	LV	GOOD	Pass
		NV	GOOD	Pass
		HV	GOOD	Pass
	High	LV	GOOD	Pass
		NV	GOOD	Pass
		HV	GOOD	Pass

A.10 Construction Protection Confirmation Method

The RF and modulation portions are protected against illegal modification as following method:

Protected Method	Description
Structure protection	The RF Module is QFN SoC IC, can't be easily modified
Reference Photo	
	

ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ2351327-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ2351327-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ2351327-AI.PDF”.

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