



REPORT No.: SZ23010171W01

# TEST REPORT

**APPLICANT** : Ningbo Tromox Technology Co., Ltd.

**PRODUCT NAME** : Wireless Remote Key

**MODEL NAME** : MX03KEYCA001S01

**BRAND NAME** : TROMOX

**FCC ID** : 2BAAA-MX03KEY

**STANDARD(S)** : 47 CFR Part 15 Subpart C

**RECEIPT DATE** : 2023-02-13

**TEST DATE** : 2023-02-15 to 2023-02-20

**ISSUE DATE** : 2023-03-06

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MORLAB

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Change History		
Version	Date	Reason for change
1.0	2023-03-06	First edition



# 1. Technical Information

**Note:** Provide by applicant.

## 1.1. Applicant and Manufacturer Information

<b>Applicant:</b>	Ningbo Tromox Technology Co., Ltd.
<b>Applicant Address:</b>	1st & 2nd Floors, Building 20, No.36 Xingshun Road, Sino-Italy Ningbo Ecological Park, Yuyao, Ningbo, Zhejiang, China
<b>Manufacturer:</b>	Ningbo Tromox Technology Co., Ltd.
<b>ManufacturerAddress:</b>	1st & 2nd Floors, Building 20, No.36 Xingshun Road, Sino-Italy Ningbo Ecological Park, Yuyao, Ningbo, Zhejiang, China

## 1.2. Equipment Under Test (EUT) Description

<b>Product Name:</b>	Wireless Remote Key
<b>Sample No.:</b>	1#
<b>Hardware Version:</b>	YMXPKE02 V1.2
<b>Software Version:</b>	Pke_Remote_ook_V1.1.hex
<b>Operating Frequency:</b>	433.92MHz
<b>Channel Number:</b>	1
<b>Antenna Type:</b>	PCB Antenna
<b>Antenna Gain:</b>	-9.56dBi

**Note 1:** For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.



### 1.3. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C for the EUT FCC ID Certification:

No	Identity	Document Title
1	47 CFR Part 15(10-1-15 Edition)	Radio Frequency Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Section	Description	Test Date	Test Engineer	Result	Method Determination /Remark
1	15.203	Antenna Requirement	N/A	N/A	PASS	No deviation
2	15.231(a)(1)	The Max Transmission Time	Feb. 16, 2023	Zhong Yanshan	PASS	No deviation
3	15.231(c)	20dB Bandwidth	Feb. 16, 2023	Zhong Yanshan	PASS	No deviation
4	15.207	Conducted Emission	N/A	N/A	N/A <sup>Note1</sup>	N/A
5	15.231(b) 15.209(a)	Radiated Emission	Feb. 20, 2023	Li Hanbin	PASS	No deviation

**Note 1:** Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

**Note 2:** The tests were performed according to the method of measurements prescribed in ANSIC63.10-2013.

**Note 3:** Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.

**Note 4:** When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals.



## 1.4. Environmental Conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15-35
Relative Humidity (%):	30-60
Atmospheric Pressure (kPa):	86-106



## **2. 47 CFR Part 15C Requirements**

### **2.1. Antenna Requirement**

#### **2.1.1. Applicable Standard**

According to FCC 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.

#### **2.1.2. Result: Compliant**

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

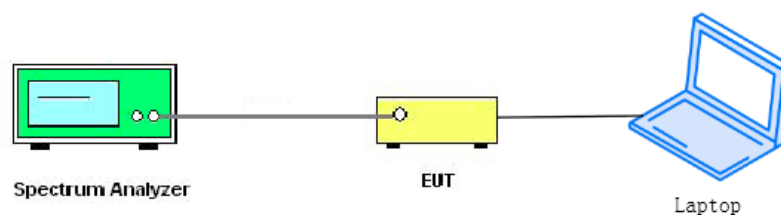
## 2.2. The Max Transmission Time

### 2.2.1. Requirement

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

### 2.2.2. Test Description

#### Test Setup:



### 2.2.3. Test Procedure

Set the SPA Center Frequency=Fundamental frequency,  
Span=0Hz, change the sweep time until get the burst in the screen.  
Set EUT as normal operation and press Transmitter button.  
Set the SPA View. Delta Mark time.



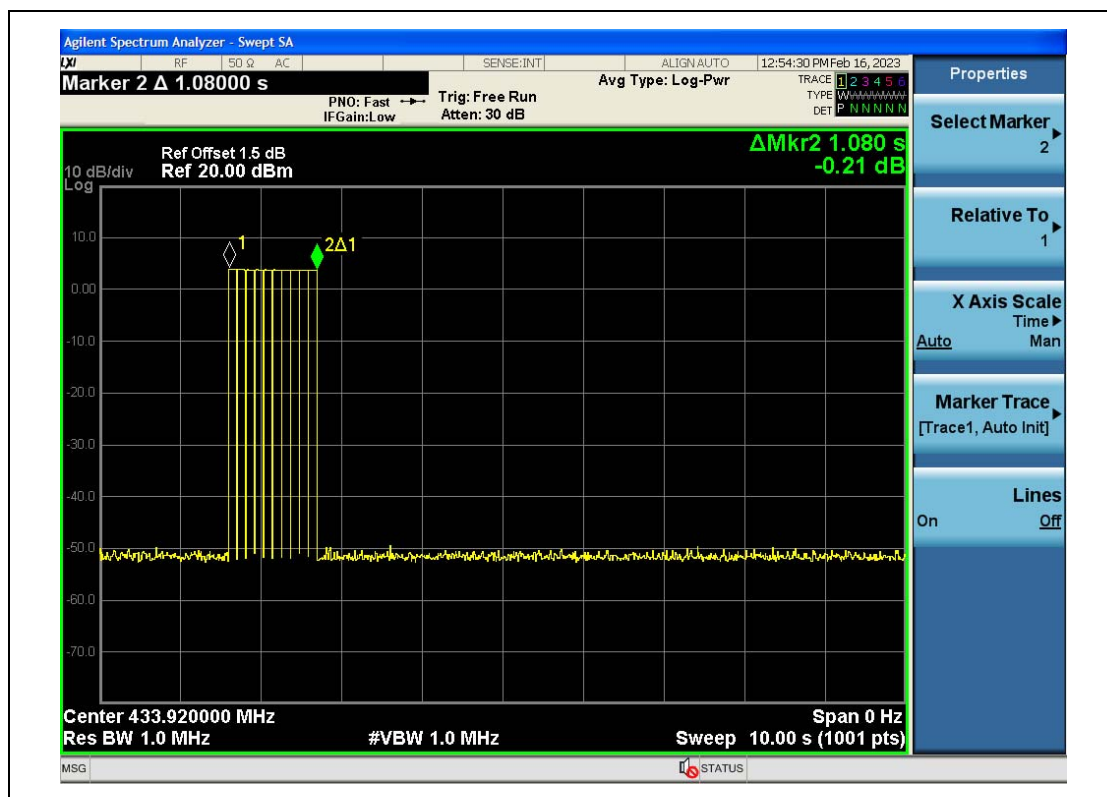
## 2.2.4. Test Result

The frequency(433.92MHz) is selected to perform testing to verify the max transmission time of the EUT.

### A. Test Verdict:

Frequency (MHz)	The max transmission time	Limit	Verdict
433.92	1.08s	≤5s	PASS

### B. Test Plot:



(The max transmission time \_433.92MHz)



## 2.3. 20 dB Bandwidth

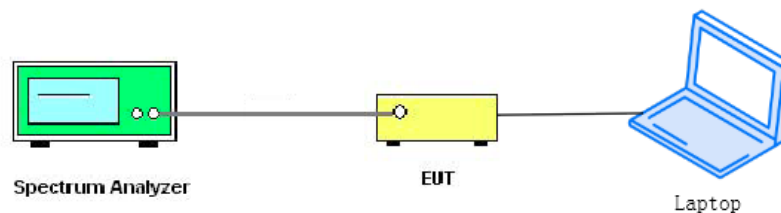
### 2.3.1. Requirement

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

As the center frequency for the device operating is 433.92MHz, thus, the 20dB bandwidth limit is 1085 kHz.

### 2.3.2. Test Description

#### Test Setup:



### 2.3.3. Test Procedure

Set spectrum analyzer's Center Frequency =Fundamental frequency, RBW,VBW and span to applicable value with Peak in Max Hold, A PEAK output reading and 20db Bandwidth function in spectrum analyzer were taken.



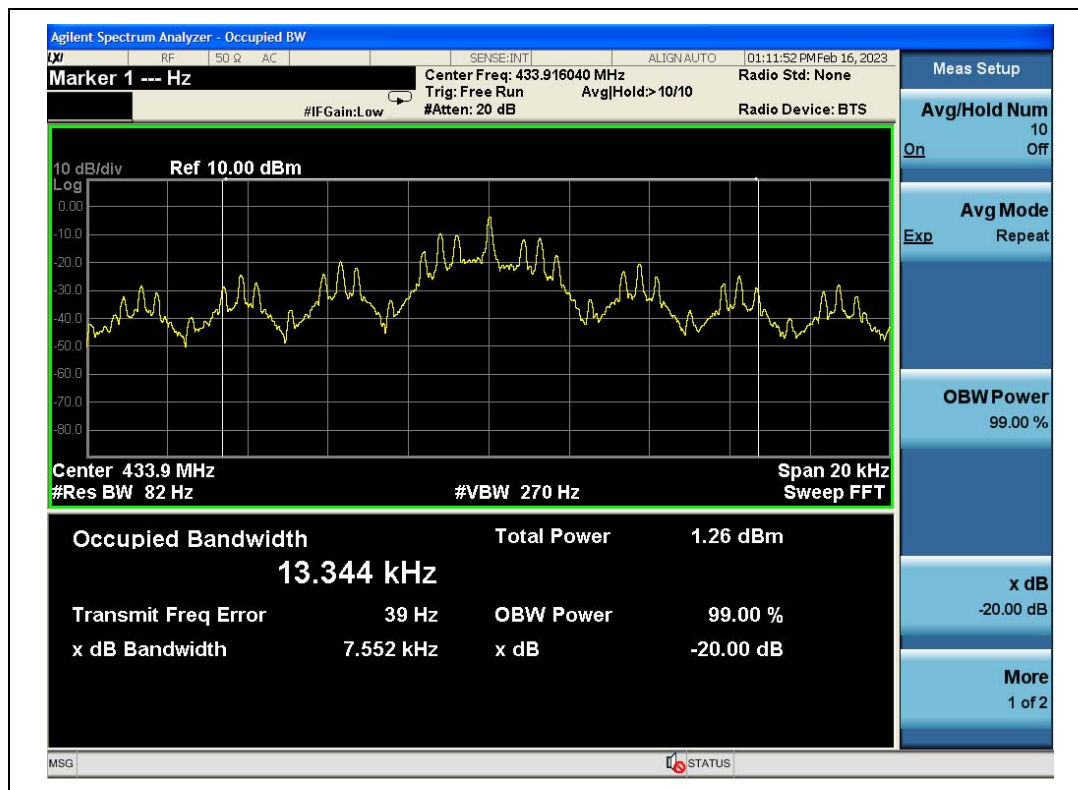
### 2.3.4. Test Result

The frequency (433.92MHz) is selected to perform testing to verify the 20dB bandwidth of the EUT.

#### A. Test Verdict:

Frequency (MHz)	20 dB Bandwidth (kHz)	Limits(MHz)	Verdict
433.92	7.552	≤1.085	PASS

#### B. Test Plot:



(Bandwidth\_433.92MHz)

## 2.4. Conducted Emission

### 2.4.1. Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50 $\mu$ H/50 $\Omega$  line impedance stabilization network (LISN).

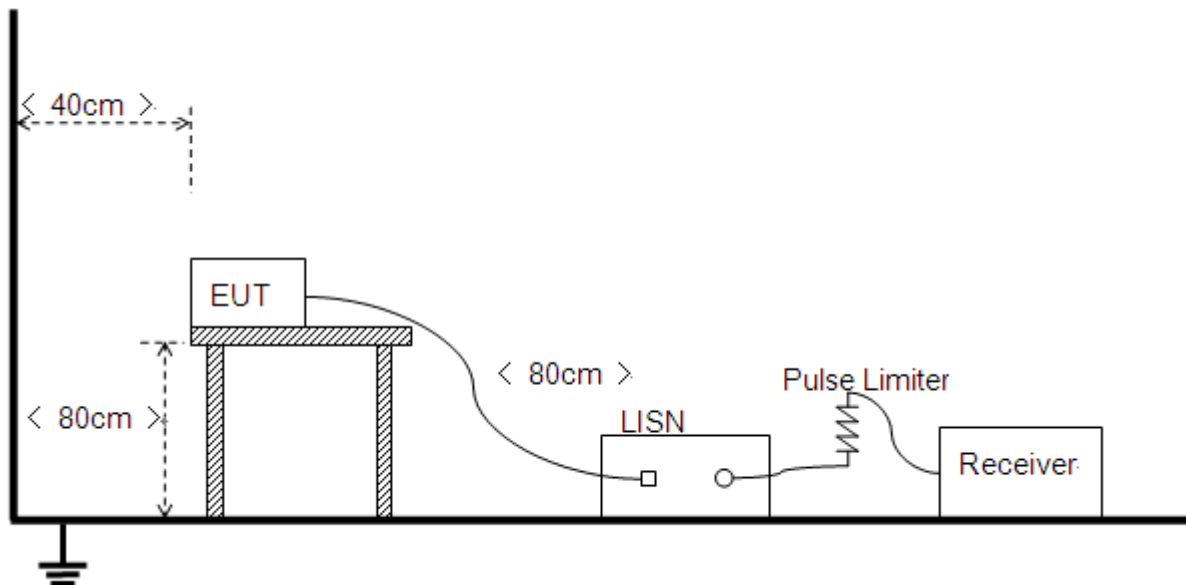
Frequency Range (MHz)	Conducted Limit (dB $\mu$ V)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

Note:

- (a) The lower limit shall apply at the band edges.
- (b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

### 2.4.2. Test Description

#### Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10: 2013.



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### 2.4.3. Test Result

This test case does not apply this kind of EUT.

## 2.5. Radiated Emission

### 2.5.1. Requirement

According to FCC section 15.247(d), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ )	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

FCC Part 15.231(b)

Fundamental frequency(MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission(microvolts/meter)
40.66-40.70	2250	225
70-130	1250	125
130-174	1250 to 3750	125 to 375
174-260	3750	375
260-47	3750 to 12500	375 to 1250
Above 470	12500	1250

**Note 1:** For Above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.

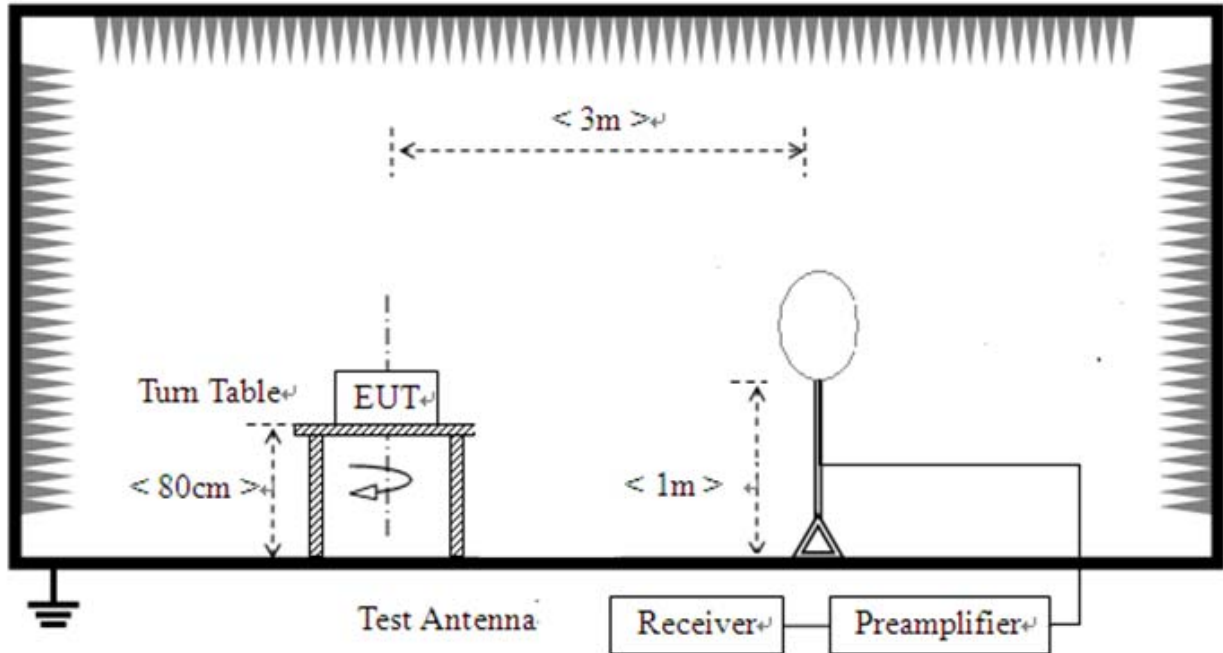
**Note 2:** For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK)

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table).

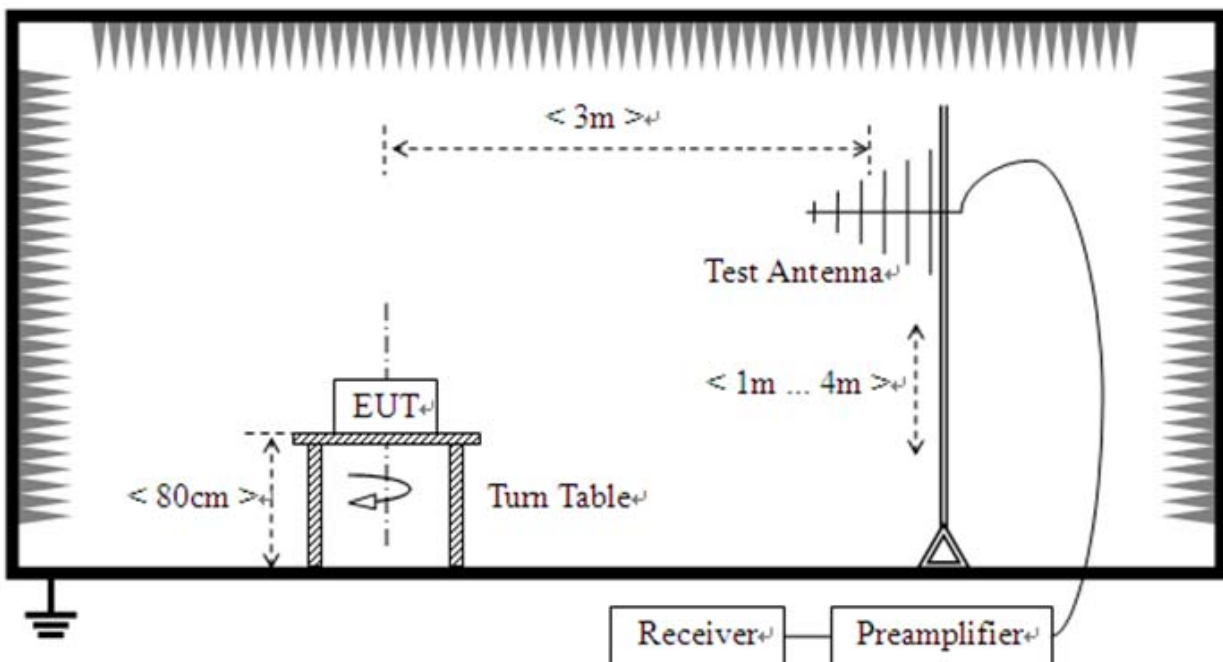
## 2.5.2. Test Description

### Test Setup:

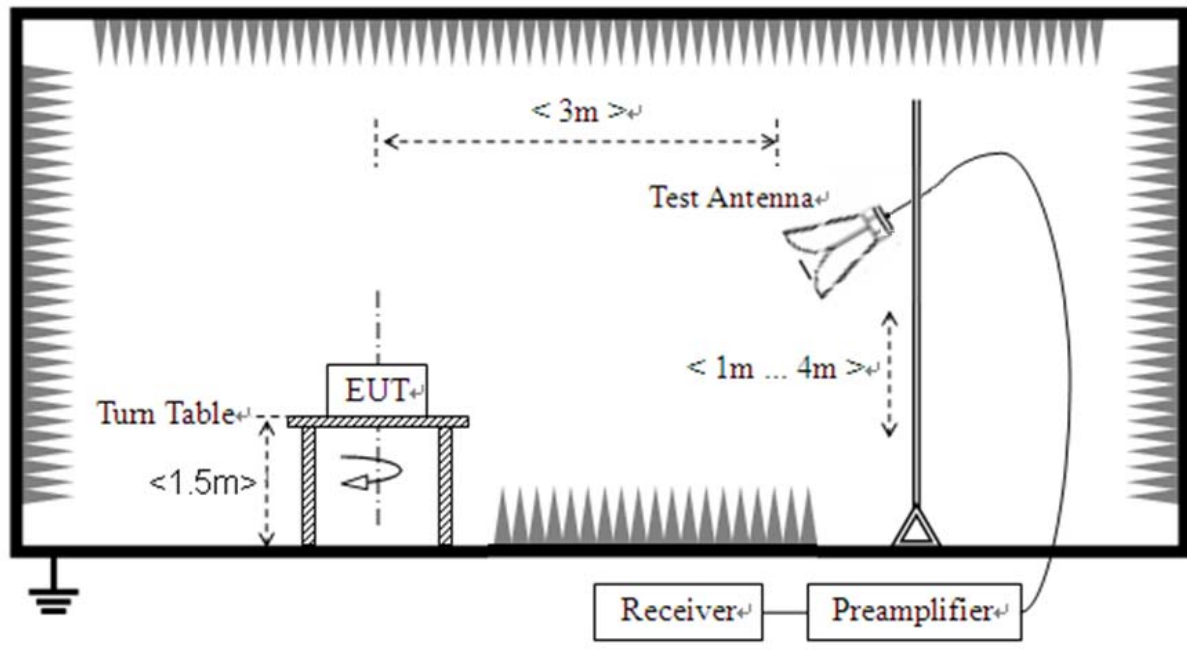
- 1) For radiated emissions from 9kHz to 30MHz



- 2) For radiated emissions from 30MHz to 1GHz



### 3) For radiated emissions above 1GHz



The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 30MHz, the emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9kHz-90 kHz, 110kHz-490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector.

For measurements below 1GHz the resolution bandwidth is set to 100kHz for peak detection measurements or 120kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1GHz the resolution bandwidth is set to 1MHz, the video band width is set to 3MHz for peak measurements and as applicable for average measurements.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.



### 2.5.3. Test Result

According to ANSI C63.10, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak (or average) limit, it is unnecessary to perform an quasi-peak measurement (or average).

The measurement results are obtained as below:

$$E [\text{dB}\mu\text{V/m}] = U_R + A_T + A_{\text{Factor}} [\text{dB}]; A_T = L_{\text{Cable loss}} [\text{dB}] - G_{\text{preamp}} [\text{dB}]$$

$A_T$ : Total correction Factor except Antenna

$U_R$ : Receiver Reading

$G_{\text{preamp}}$ : Preamplifier Gain

$A_{\text{Factor}}$ : Antenna Factor at 3m

During the test, the total correction Factor  $A_T$  and  $A_{\text{Factor}}$  were built in test software.

**Note1:** All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

**Note2:** For the frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

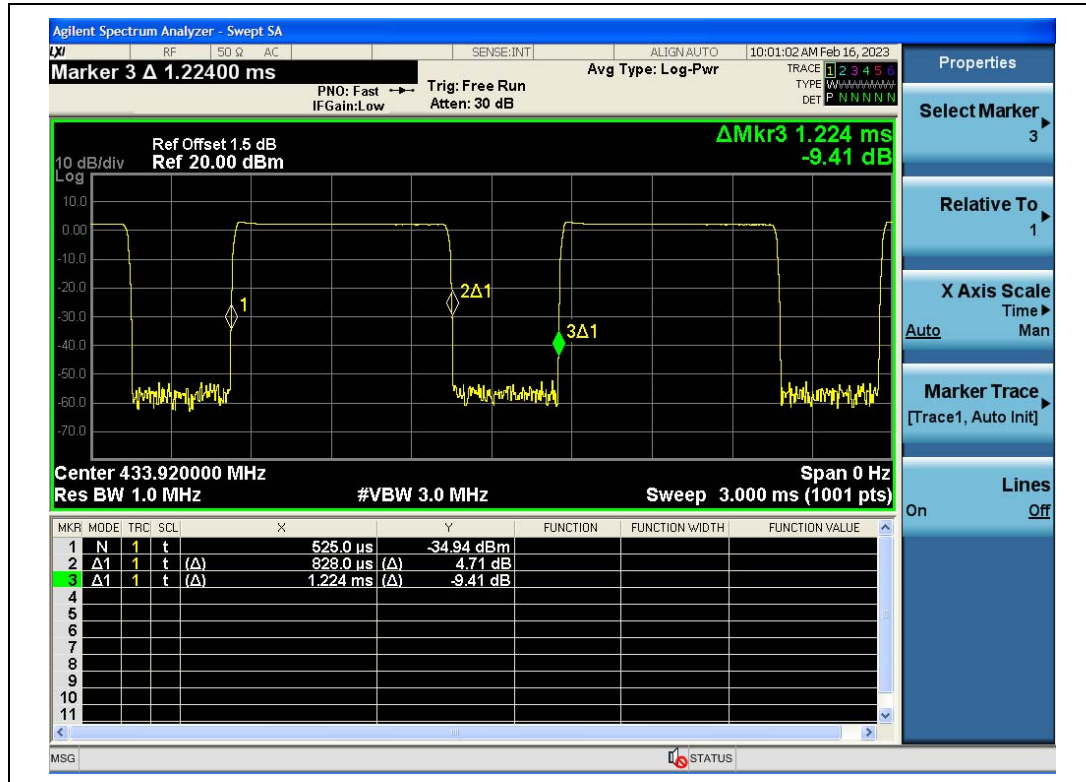




The duty cycle is simply the on-time divided by the period:

The duration of one cycle:	0.828ms
Effective period of the cycle:	1.224ms
Duty cycle (%):	67.65

Therefore, the average factor is found by  $20\log(\text{Duty cycle}) = -3.395$



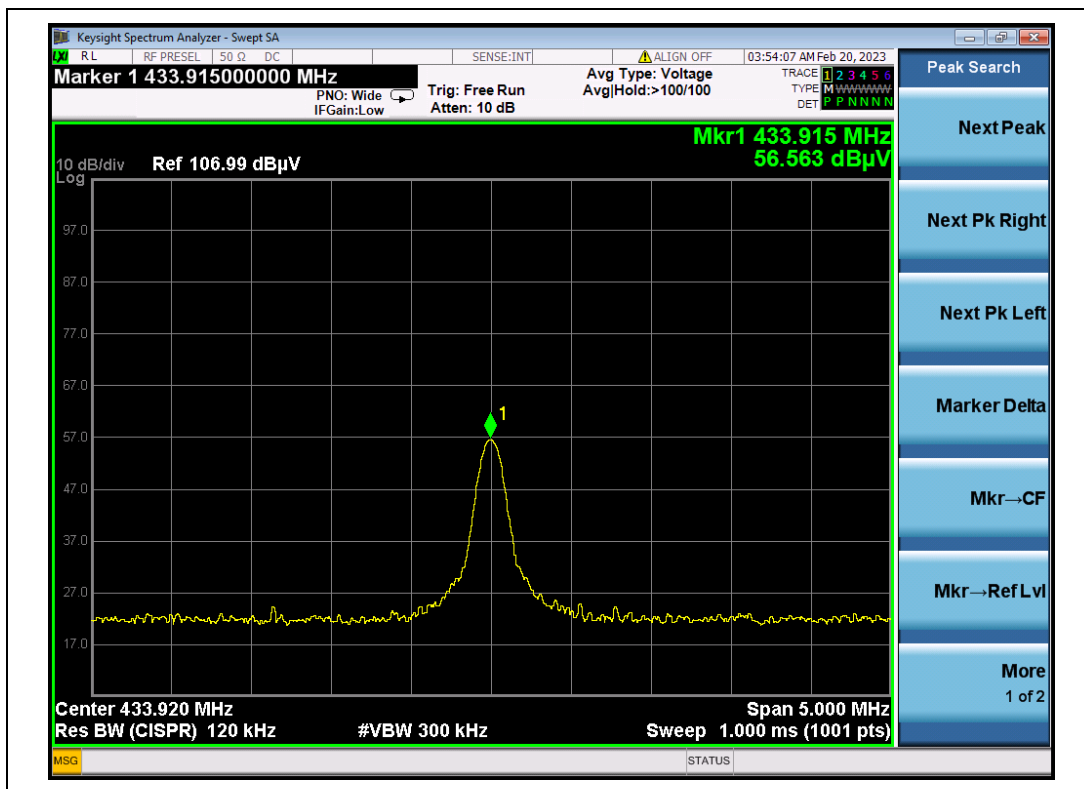
(Release Time)



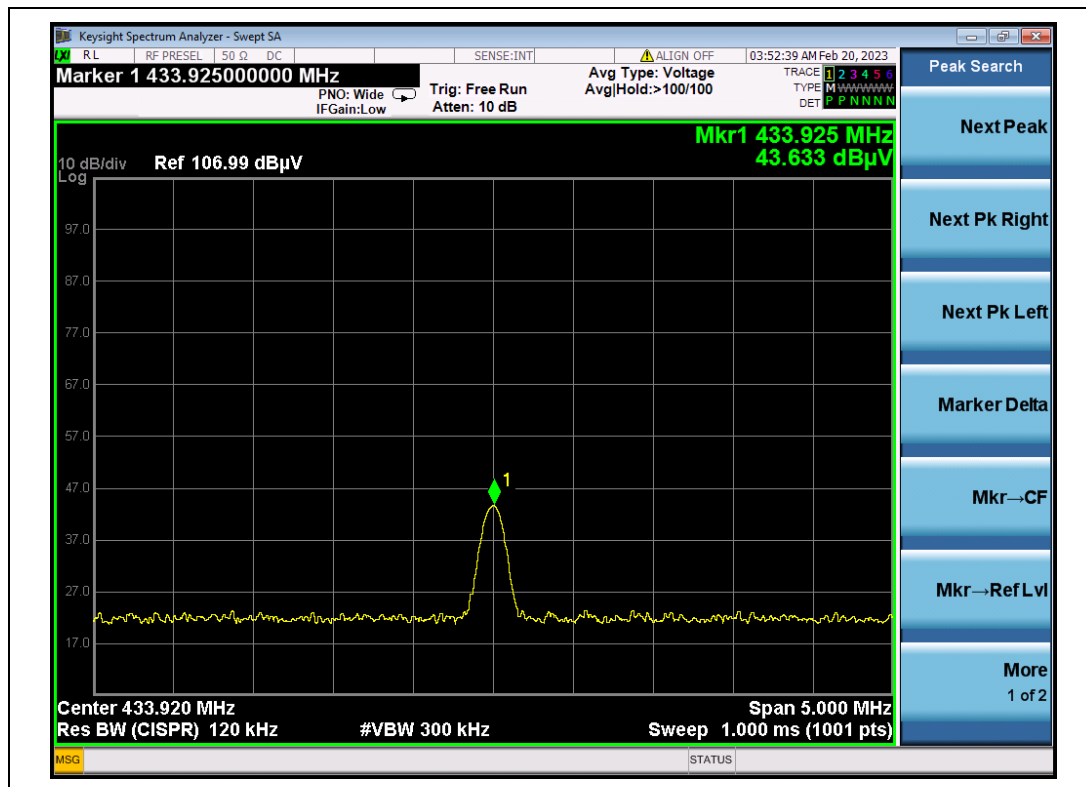
### A. Field strength of fundamental

Fre. (MHz)	AN T	Receiver Reading $U_R(PK)$ (dBuV)	$A_T$ (dB)	$A_{Factor}$ (dB@ 3m)	Final Emission _PK (dBuV/m)	Limit-PK (dBuV/m)	AV factor (dB)	Final Emission _AV (dBuV/m)	Limit-AV (dBuV/m)	Verdict
433.92	H	56.563	6.42	15.60	78.583	100.83	-3.395	75.188	80.83	PASS
433.92	V	43.633	6.42	15.60	65.653	100.83	-3.395	62.258	80.83	PASS

### Test Plot:

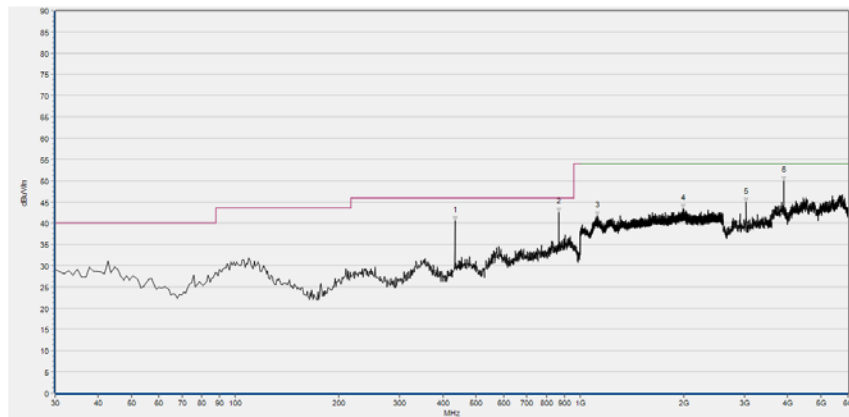


(433.92MHz, Antenna Horizontal)



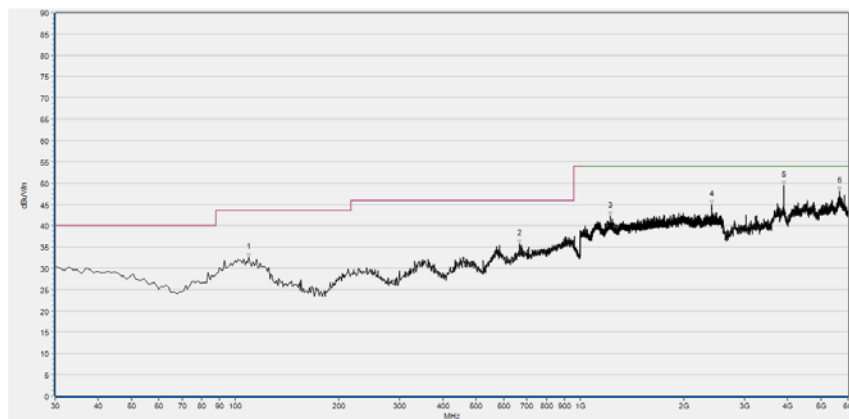
(433.92MHz, Antenna Vertical)

## B. Radiated emission



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
433.520	40.60	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
868.080	42.59	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
1124.800	41.67	N/A	N/A	N/A	N/A	54.00	Horizontal	PASS
1987.733	43.33	N/A	N/A	N/A	N/A	54.00	Horizontal	PASS
3037.360	45.00	N/A	N/A	N/A	N/A	54.00	Horizontal	PASS
3905.920	49.91	N/A	N/A	N/A	N/A	54.00	Horizontal	PASS

(433.92MHz, Antenna Horizontal, 30MHz to 5GHz)



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
109.540	32.48	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
668.260	35.71	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
1226.667	42.29	N/A	N/A	N/A	N/A	54.00	Vertical	PASS
2412.267	44.94	N/A	N/A	N/A	N/A	54.00	Vertical	PASS
3905.920	49.49	N/A	N/A	N/A	N/A	54.00	Vertical	PASS
5658.440	48.09	N/A	N/A	N/A	N/A	54.00	Vertical	PASS

(433.92MHz, Antenna Vertical, 30MHz to 5GHz)



## Annex A Test Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for test performed on the EUT as specified in CISPR 16-1-2:

Test Items	Uncertainty
20 dB Bandwidth	$\pm 5\%$
Transmission Time	$\pm 5\%$
Radiated Emission	$\pm 2.95\text{dB}$

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



## Annex B Testing Laboratory Information

### 1. Identification of the Responsible Testing Laboratory

<b>Laboratory Name:</b>	Shenzhen Morlab Communications Technology Co., Ltd.
<b>Laboratory Address:</b>	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
<b>Telephone:</b>	+86 755 36698555
<b>Facsimile:</b>	+86 755 36698525

### 2. Identification of the Responsible Testing Location

<b>Name:</b>	Shenzhen Morlab Communications Technology Co., Ltd.
<b>Address:</b>	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

### 3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013 and CISPR Publication 22; the FCC designation number is CN1192, the test firm registration number is 226174.



#### 4. Test Equipments Utilized

##### 4.1 Conducted Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
EXA Signal Analyzer	MY53470836	N9010A	Agilent	2022.03.01	2023.02.28
RF Cable (30MHz-26GHz)	CB01	RF01	Morlab	N/A	N/A
Coaxial Cable	CB02	RF02	Morlab	N/A	N/A
SMA Connector	CN01	RF03	HUBER-SUHNER	N/A	N/A
USB Wideband Power Sensor	MY54180008	U2021XA	Agilent	2022.10.11	2023.10.10

##### 4.2 List of Software Used

Description	Manufacturer	Software Version
Test System	Tonscend	V2.5.77.0418
MORLAB EMCR V1.2	MORLAB	V1.0
TS+ -[JS32-CE]	Tonscend	V2.5.0.0

**4.3 Radiated Test Equipments**

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Due Date
Receiver	MY54130016	N9038A	Agilent	2022.07.06	2023.07.05
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2022.05.25	2025.05.24
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2022.02.11	2025.02.10
Test Antenna – Horn	01774	BBHA 9120D	Schwarzbeck	2022.07.13	2025.07.12
Test Antenna – Horn	BBHA9170 #773	BBHA9170	Schwarzbeck	2022.07.14	2025.07.13
Preamplifier (10MHz-6GHz)	46732	S10M100L38 02	LUCIX CORP.	2022.07.08	2023.07.07
Preamplifier (2GHz-18GHz)	61171/61172	S020180L32 03	LUCIX CORP.	2022.07.08	2023.07.07
Preamplifier (18GHz-40GHz)	DS77209	DCLNA0118-40C-S	Decentest	2022.07.23	2023.07.22
RF Coaxial Cable (DC-18GHz)	MRE001	PE330	Pasternack	2022.07.08	2023.07.07
RF Coaxial Cable (DC-18GHz)	MRE002	CLU18	Pasternack	2022.07.08	2023.07.07
RF Coaxial Cable (DC-18GHz)	MRE003	CLU18	Pasternack	2022.07.08	2023.07.07
RF Coaxial Cable (DC-40GHz)	22290045	QA360-40-K K-0.5	Qualwave	2022.07.08	2023.07.07
RF Coaxial Cable (DC-40GHz)	22290046	QA360-40-K KF-2	Qualwave	2022.07.08	2023.07.07
RF Coaxial Cable (DC-18GHz)	22120181	QA500-18-N N-5	Qualwave	2022.07.08	2023.07.07
Anechoic Chamber	N/A	9m*6m*6m	CRT	2022.05.10	2025.05.09

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