Test Report

Verified code: 155542

Report No.: E202409271682-4EN

Customer:	Kostal (shanghai) Management Co.Ltd
Address:	No.189 Xingting Road, Jiading District, Shanghai, P.R.China
Sample Name:	Keyfob
Sample Model:	SCW-433MHz
Receive Sample Date:	Feb.18,2025
Test Date:	Mar.11,2025 ~ Mar.25,2025
Reference Document:	47 CFR Part 15 Subpart C Intentional Radiators ANSI C63.10:2020
Test Result:	Pass

Prepared by: Huang Lifang

Huang Lifang

Reviewed by: Wu Haoting

Wu Haoting

Approved by: Xiao Liang

Xiao Liang

GRG METROLOGY & TEST GROUP CO., LTD.

Issued Date: 2025-04-14

Statement

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2. The sample information is provided by the client and responsible for its authenticity; The content of the report is only valid for the samples sent this time.

3. When there are reports in both Chinese and English, the Chinese version will prevail when the language problems are inconsistent.

4. If there is any objection concerning the report, please inform us within 15 days from the date of receiving the report.

5. This testing report is only for scientific research, teaching, internal quality control, etc.

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TABLE OF CONTENTS

REPORT ISSUED HISTORY

Report Version	Report No.	Description	Compile Date
1.0	E202409271682-4EN	Original Issue	2025-03-27

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1. TEST RESULT SUMMARY

Standard	Item	Limit / Severity	Result
47 CFR Part 15 Subpart C (15.231)	Conducted Emissions	§15.207	N/A[1)]
	Antenna Requirement	§15.203	PASS
	Transmission Time	§15.231(a) (2)	PASS
	20DB Bandwidth	§15.231 (c)	PASS
	Radiated Spurious Emission	§15.231(b)	PASS

Note:
[1)]: The EUT is power by battery, the AC conduction emission is not applicant.
[2)]: The EUT antenna is PCB antenna. Max antenna gain is -2.16dBi .which accordance 15.203.is considered sufficient to comply with the provisions of this section.

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2. GENERAL DESCRIPTION OF EUT

2.1 APPLICANT

Name:	Kostal (shanghai) Management Co.Ltd
Address:	No.189 Xingting Road, Jiading District, Shanghai, P.R.China

2.2 MANUFACTURER

Name:	Kostal (shanghai) Management Co.Ltd
Address:	No.189 Xingting Road, Jiading District, Shanghai, P.R.China

2.3 FACTORY

Name:	Kostal (shanghai) Management Co.Ltd
Address:	No.189 Xingting Road, Jiading District, Shanghai, P.R.China

2.4 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment:	Keyfob
Model No.:	SCW-433MHz
Adding Model	/
Model Differences:	/
Trade Name:	KOSTAL
FCC ID:	2AYAR2024HZZW
Power Supply:	DC 3V
Battery Specification:	Model: CR2032 Nominal Voltage: 3Vdc
Frequency Range:	433.92MHz
Max Antenna gain:	PCB antenna, -2.16dBi(Max)
Type of Modulation:	FSK
Temperature Range:	-40℃~+85℃
Sample submitting way:	■Provided by customer □Sampling
Sample No:	E202409271682-0002, E202409271682-0006, E202409271682-0008

1. The EUT information is provided by the applicant. This report is made solely on the basis of such data and/or information. We accept no responsibility for the authenticity and completeness of the above data and information and the validity of the results and/or conclusions.
2. There has four different vehicle logo to show on the Keyfob, the difference between of them only the Silk screen logo, the same technical construction including circuit diagram, PCB LAYOUT, hardware version and software version identical.

Note:

Product name	Model	Brand	Vehicle logo	KOSTAL part number
Keyfob	SCW-433MHz	KOSTAL	CITROEN	9873097580
			OPEL	9873097080
			VAUXHALL	9873097480
			FIAT	9873097180

After evaluation, the difference do not affect test results, so the Vehicle logo CITROEN was tested in this report.

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2.5 TEST MODE

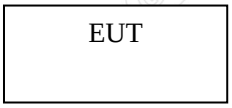
Mode No.	Description of the modes
Mode 1	FSK 433.92MHz Transmitting

2.6 LOCAL SUPPORTIVE

Name of Equipment	Manufacturer	Model	Serial Number	Note
/	/	/	/	/

No.	Cable Type	Qty.	Shielded Type	Ferrite Core(Qty.)	Length
/	/	/	/	/	/

2.7 CONFIGURATION OF SYSTEM UNDER TEST



2.8 TEST SOFTWARE:

Software version	Test level
/	/

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3. LABORATORY AND ACCREDITATIONS

3.1 LABORATORY

The tests & measurements refer to this report were performed by Shenzhen EMC Laboratory of GRG METROLOGY & TEST GROUP CO., LTD.

Add.:	No.1301 Guanguang Road Xinlan Community, Guanlan Street, Longhua District Shenzhen, 518110, People's Republic of China.
P.C.:	518110
Tel :	0755-61180008
Fax:	0755-61180008

3.2 ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to GB/T 27025(ISO/IEC 17025:2017)

USA	A2LA(Certificate #2861.01)

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada	ISED (Company Number: 24897，CAB identifier:CN0069)
USA	FCC (Registration Number: 759402，Designation Number:CN1198)

Copies of granted accreditation certificates are available for downloading from our web site, http://www.grgtest.com

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4. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement		Frequency	Uncertainty
Radiated Emission	X	9kHz～30MHz	4.4dB[1)]
	Y	9kHz～30MHz	4.4dB[1)]
	Z	9kHz～30MHz	4.4dB[1)]
	Horizontal	30MHz～200MHz	4.6dB[1)]
		200MHz～1000MHz	4.8dB[1)]
		1GHz～6GHz	5.0dB[1)]
	Vertical	30MHz～200MHz	4.7dB[1)]
		200MHz～1000MHz	4.7dB[1)]
		1GHz～6GHz	5.1dB[1)]

Measurement	Uncertainty
RF frequency	6.0×10^{-6}
RF power conducted	0.78 dB
Occupied channel bandwidth	0.40 dB
Unwanted emission, conducted	0.68 dB
Humidity	6.0 %
Temperature	2.0℃

Note:
[1)] This uncertainty represents an expanded uncertainty expressed at approximately the 95%.
This uncertainty represents an expanded uncertainty factor of *k*=2.

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5. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Radiated Spurious Emission				
Loop Antenna	Schwarzbeck	FMZB 1513-60	1513-60-56	2025-05-07
Test Receiver	R&S	ESR26	101758	2025-09-10
Bi-log Antenna	schwarzbeck	VULB 9160	VULB9160-3402	2025-09-11
Preamplifier	SHIRONG ELECTRONIC	DLNA-9k1G-G40	20200928003	2025-10-30
Horn Antenna	Schwarzbeck	BBHA 9120D	02143	2025-09-07
Amplifier	Tonscend	TAP01018048	AP20E8060075	2026-02-06
RF Cable	TIMES	LMR240UF-NM NM-9000	/	2025-09-11
RF Cable	WCS	C220706518	/	2025-09-11
RF Cable	ROSENBERGER	L72-CM071-400	/	2025-09-11
RF Cable	TIMES	SFT205PUR-NM SWSM	/	2025-09-07
RF Cable	TIMES	SFT205-SMSM	/	2025-09-07
RF Cable	TIMES	SFT205-SMNM	/	2025-09-07
RF Cable	ROSENBERGER	L72-C2057-1000	/	2025-09-07
Test S/W	Tonscend	JS32-RE		
Transmission Time & 20DB Bandwidth & Duty cycle				
Spectrum Analyzer	Agilent	N9020A	MY50510140	2025-08-22

Note: The calibration interval of the above test instruments is 12 months.

6. RADIATED SPURIOUS EMISSIONS

6.1 LIMITS

§15.231(b) In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	[1]1,250 to 3,750	[1]125 to 375
174-260	3,750	375
260-470	[1]3,750 to 12,500	[1]375 to 1,250
Above 470	12,500	1,250

1. ** linear interpolations

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, uV/m at 3 meters = 56.81818*F - 6136.3636; for the band 260-470 MHz, uV/m at 3 meters = 41.6667*F - 7083.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

§15.231(b)(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

Frequency (MHz)	Quasi-peak(μV/m)	Measurement distance(m)	Quasi-peak(dBμV/m)@distance 3m
0.009-0.490	2400/F(kHz)	300	128.5~93.8
0.490-1.705	24000/F(kHz)	30	73.8~63
1.705-30.0	30	30	69.5
30 ~ 88	100	3	40
88~216	150	3	43.5
216 ~ 960	200	3	46
Above 960	500	3	54

NOTE: (1) The lower limit shall apply at the transition frequencies.

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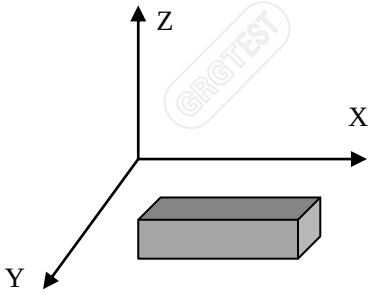
6.2 TEST PROCEDURES

1) The EUT was placed on the top of a rotating table 0.8 meters (for below 1GHz) / 1.5 meters (for above 1GHz) above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3) Height of receiving antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
5) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6) If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported.
   Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
7) The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.



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6.3 TEST SETUP

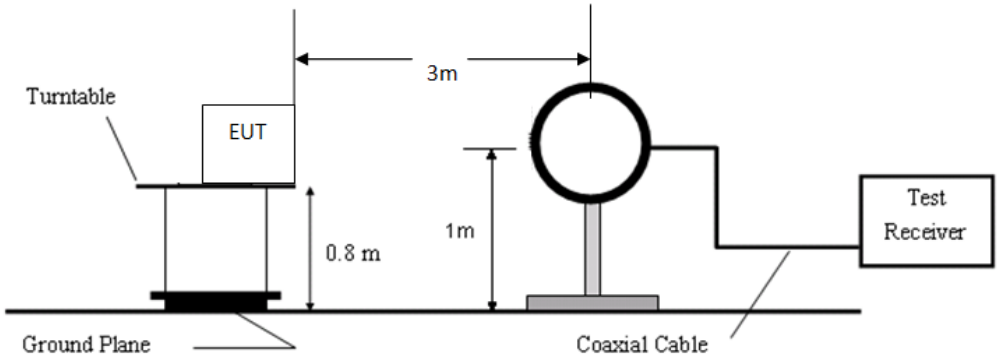

Figure 1. 9kHz to 30MHz radiated emissions test configuration

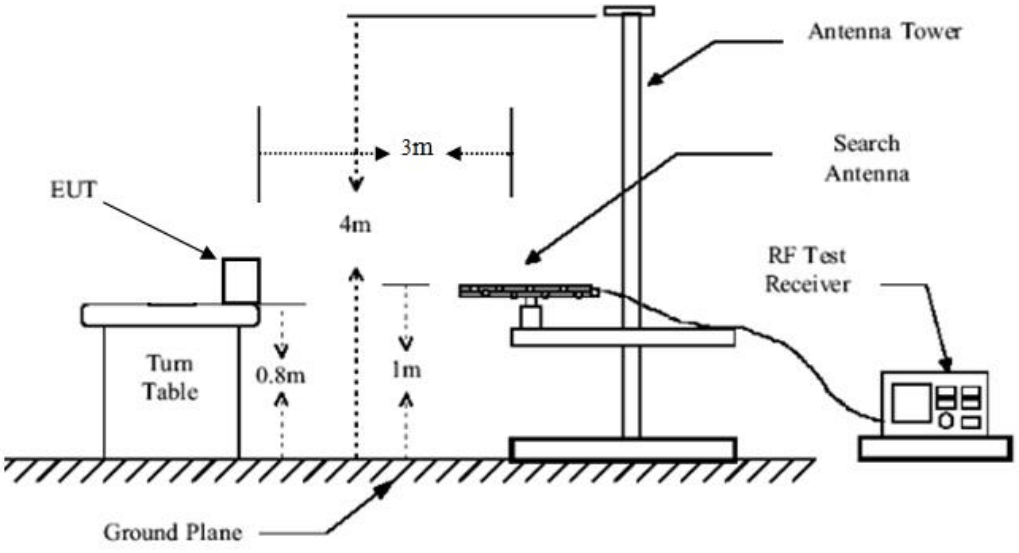

Figure 2. 30MHz to 1GHz radiated emissions test configuration

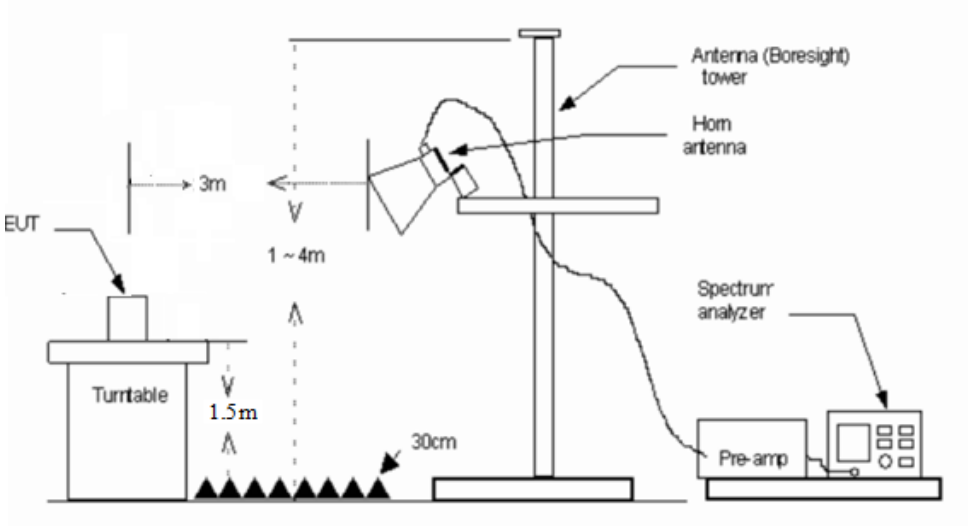

Figure 3. Above 1GHz radiated emissions test configuration

6.4 DATA SAMPLE

30MHz to 1GHz

Suspected Data List										
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Trace	Height [cm]	Angle [°]	Polarity
xxxx	xxxx	66.85	31.09	-35.76	40.00	8.91	PK	200	351	Horizontal

Final Data List									
NO.	Freq. [MHz]	Factor [dB]	QP Reading [dBμV/m]	Level [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
xxxx	xxxx	-31.57	71.28	39.71	46.00	6.29	100	196	Horizontal

Frequency (MHz) = Emission frequency in MHz

Reading (dBuV/m) = Uncorrected Analyzer / Receiver reading

Factor (dB) = Antenna factor + Cable loss – Amplifier gain

Level (dBuV/m) = Reading (dBuV/m) + Factor (dB)

Limit (dBuV/m) = Limit stated in standard

Margin (dB) = Limit (dBuV/m) – Level (dBuV/m)

Polarity = Antenna polarization

Peak = Peak Reading

QP = Quasi-peak Reading

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1GHz to 6GHz

No.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Remark
xxx	xxxx	78.01	55.30	-22.71	74.00	18.70	100	50	Horizontal	Peak
xxx	xxxx	66.37	43.66	-22.71	54.00	10.34	100	50	Horizontal	AVG

Frequency (MHz) = Emission frequency in MHz
Reading (dBuV/m) = Uncorrected Analyzer / Receiver reading
Factor (dB) = Antenna factor + Cable loss – Amplifier gain
Level for 1m (dBuV/m) = Reading (dBuV/m) + Factor (dB)
Level for 3m (dBuV/m) = Level for 1m (dBuV/m) + 20*log(1/3)
Limit (dBuV/m) = Limit stated in standard
Margin (dB) = Limit (dBuV/m) – Level (dBuV/m)
Polarity = Antenna polarization
Peak = Peak Reading
AVG = Average Reading

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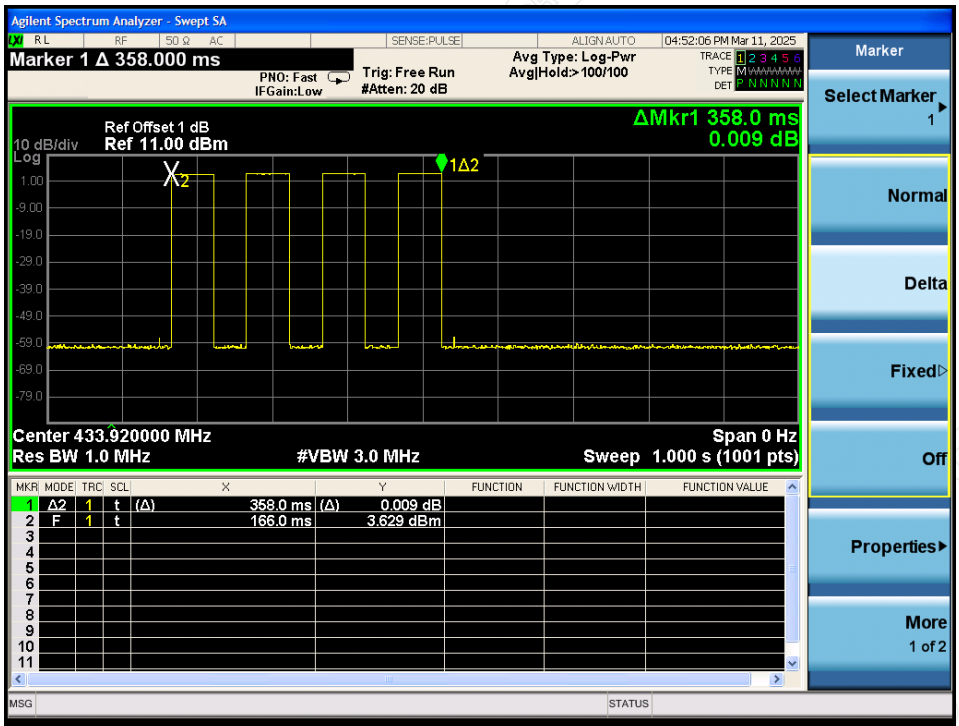
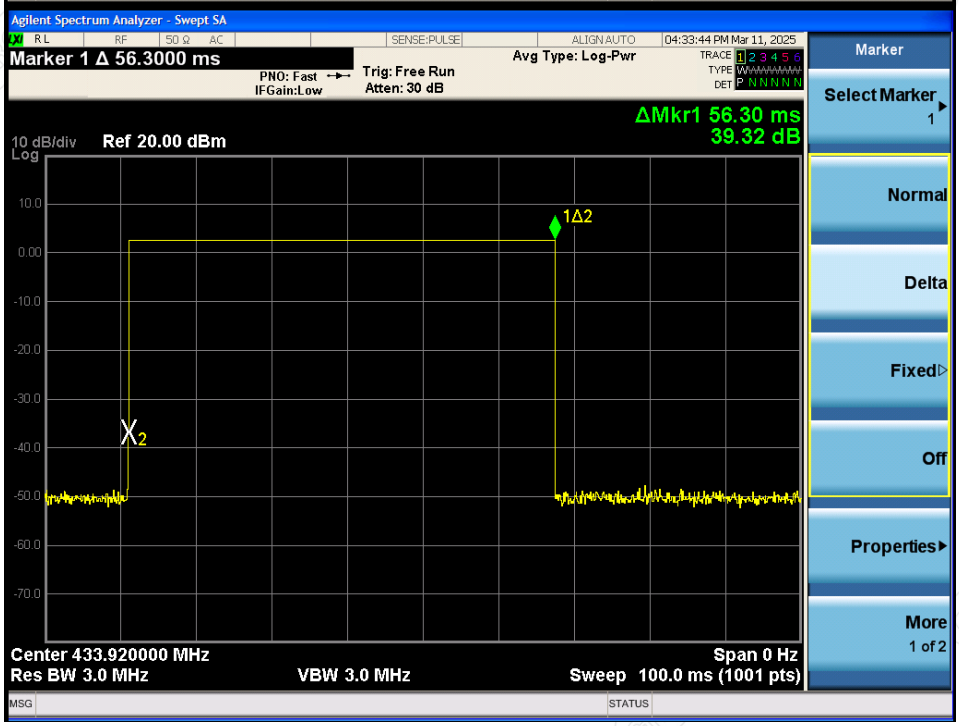
6.5 TEST RESULTS

Duty Cycle: 433.92MHz

Environment:	24.6℃/52%RH/101kPa
Power Source:	DC 3V
Test Date:	2025-03-11
Test By :	Qin Tingting





The field strength of fundamental:

Environment:	23.1℃/47%RH/101kPa
Power Source:	DC 3V
Test Date:	2025-03-25
Test By :	Qin Tingting

TX / 433.92MHz

Frequency (MHz)	Reading (dBuV/m)	Result (dBuV/m)	Correct Factor(dB)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg)	Antenna Pole (V/H)	Remark
433.92	104.75	81.80	-22.95	100.83	19.03	100	85	H	peak
433.92	90.11	67.16	-22.95	100.83	33.67	200	350	V	peak

Frequency (MHz)	PK Result (dBuV/m)	Duty Cycle Correction Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Pole(V/H)	Remark
433.92	81.80	-4.99	76.81	80.83	4.02	H	AVG
433.92	67.16	-4.99	62.17	80.83	18.66	V	AVG

Remark:

1) dBuV/m=20Log(uV/m).
2) AVG=Peak+20Log(Duty Cycle).
3) According to C63.10 caluse7.5 g), On time=56.3ms/100ms =0.563.
4) Duty Cycle Correction Factor: 20Log (0.563)= -4.99.

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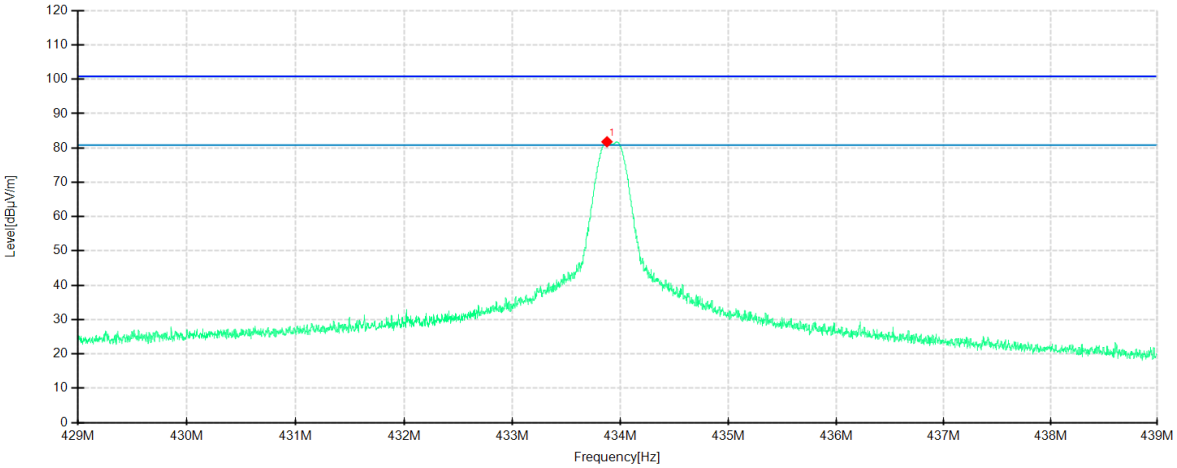
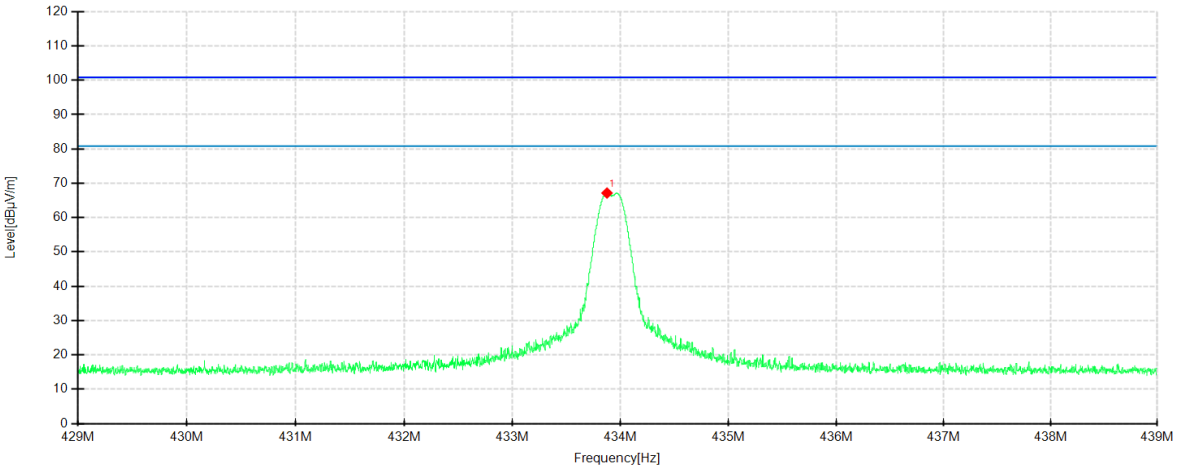
433.92MHz



Suspected Data List									
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	433.8738	104.75	81.80	-22.95	100.83	19.03	100	85	Horizontal



Suspected Data List									
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	433.8738	90.11	67.16	-22.95	100.83	33.67	200	350	Vertical

Radiated Spurious Emission

For 9kHz to 30MHz

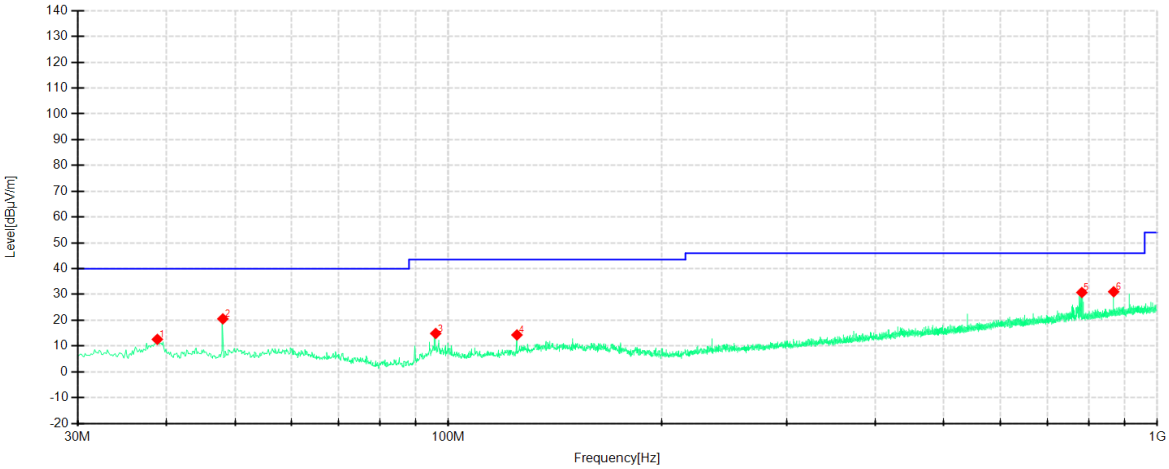
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

For 30MHz – 1GHz

Environment:	23.3℃/50%RH/101kPa
Test Mode:	Mode 1
Power Source:	DC 3V
Test Date:	2025-03-16
Test By :	Qin Tingting

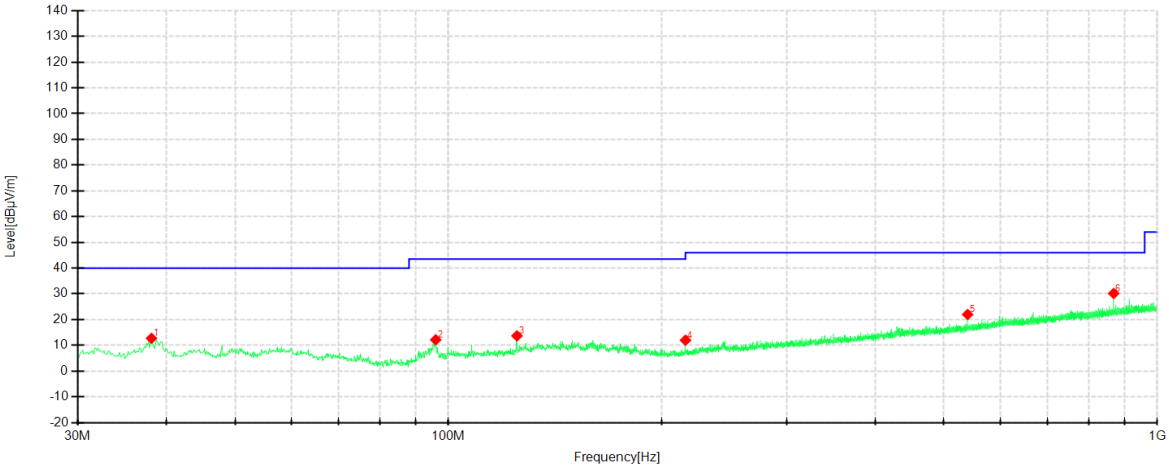
433.92MHz

Polarity: Horizontal



Suspected Data List											
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Height [cm]	Angle [°]	Polarity	Verdict
1	38.8524	41.90	12.59	-29.31	40.00	27.41	PK	100	206	Horizontal	PASS
2	48.0685	49.45	20.53	-28.92	40.00	19.47	PK	100	90	Horizontal	PASS
3	95.9682	47.62	14.87	-32.75	43.50	28.63	PK	100	76	Horizontal	PASS
4	124.9506	44.17	14.29	-29.88	43.50	29.21	PK	100	260	Horizontal	PASS
5	782.6928	47.80	30.74	-17.06	46.00	15.26	PK	100	234	Horizontal	PASS
6	867.9422	46.78	31.03	-15.75	46.00	14.97	PK	200	179	Horizontal	PASS

Polarity: Vertical



Suspected Data List											
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Height [cm]	Angle [°]	Polarity	Verdict
1	38.1248	42.03	12.72	-29.31	40.00	27.28	PK	100	192	Vertical	PASS
2	95.9682	44.90	12.15	-32.75	43.50	31.35	PK	100	231	Vertical	PASS
3	124.9506	43.55	13.67	-29.88	43.50	29.83	PK	100	112	Vertical	PASS
4	216.0208	43.00	11.98	-31.02	46.00	34.02	PK	100	323	Vertical	PASS
5	540.0413	42.57	21.97	-20.60	46.00	24.03	PK	100	179	Vertical	PASS
6	867.8210	45.88	30.13	-15.75	46.00	15.87	PK	200	222	Vertical	PASS

Remark:

1 No emission found between lowest internal used/generated frequency to 30MHz.

2 Radiated emissions measured in frequency range from 30MHz to 1GHz were made with an instrument using Peak detector mode. If the margin of the pre test results is greater than 6db, it meets the requirements of quasipeak or average values, and final testing is no longer required.

3 The IF bandwidth of Receiver between 30MHz to 1GHz was 120kHz.

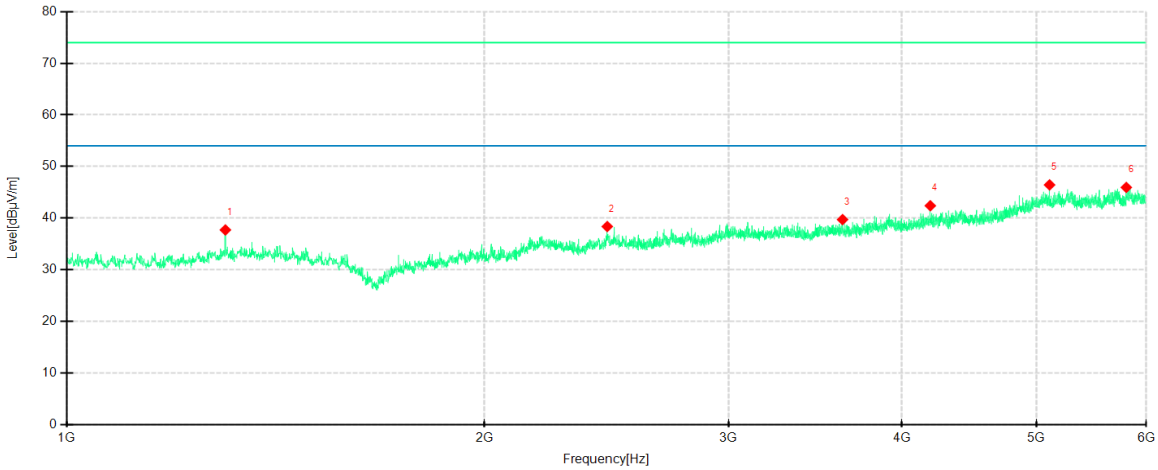
4 Below 1GHz: factor = Antenna Factor + Cable Loss.

5 Remark: The fundamental frequency's limit is controlled to the standard of Radio frequency.

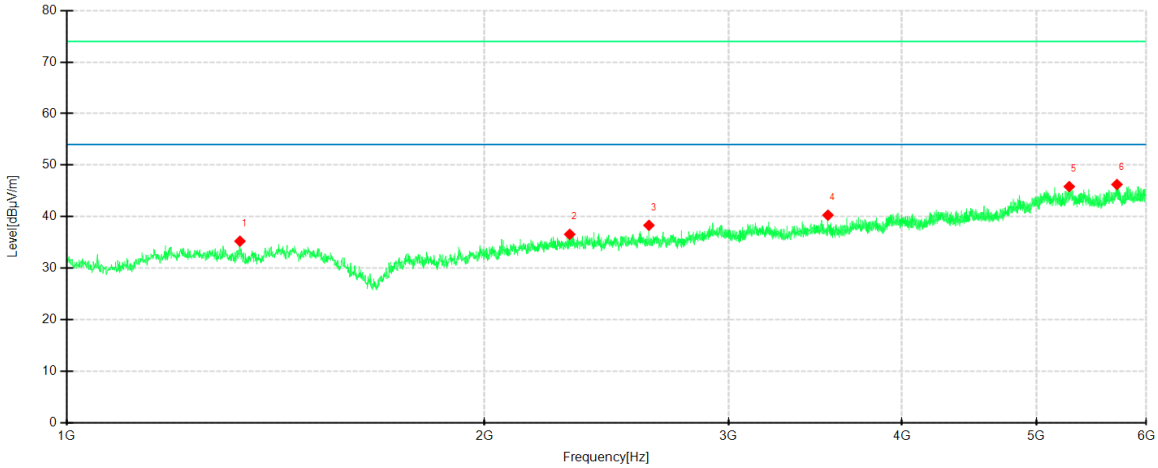
For Emission above 1GHz:
According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Environment:	23.3℃/50%RH/101kPa
Test Mode:	Mode 1
Power Source:	DC 3V
Test Date:	2025-03-16
Test By :	Qin Tingting

433.92MHz



Suspected Data List									
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1301.2500	57.81	37.70	-20.11	74.00	36.30	100	266	Horizontal
2	2452.5000	53.73	38.36	-15.37	74.00	35.64	100	136	Horizontal
3	3624.3750	51.45	39.71	-11.74	74.00	34.29	200	262	Horizontal
4	4192.5000	51.50	42.39	-9.11	74.00	31.61	200	51	Horizontal
5	5110.0000	50.30	46.43	-3.87	74.00	27.57	200	339	Horizontal
6	5804.3750	49.32	45.94	-3.38	74.00	28.06	100	44	Horizontal



Suspected Data List									
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1333.1250	56.03	35.23	-20.80	74.00	38.77	100	194	Vertical
2	2304.3750	52.89	36.56	-16.33	74.00	37.44	100	312	Vertical
3	2628.1250	53.81	38.31	-15.50	74.00	35.69	200	177	Vertical
4	3537.5000	52.59	40.28	-12.31	74.00	33.72	100	117	Vertical
5	5280.0000	48.82	45.83	-2.99	74.00	28.17	200	345	Vertical
6	5715.0000	49.06	46.24	-2.82	74.00	27.76	200	20	Vertical

Note:

1 Radiated emissions measured in frequency range from 1GHz – 6GHz were made with an instrument using Peak/AV detector mode.

2 According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it's unnecessary to perform an average measurement.

3 The IF bandwidth of Receiver between above was 1MHz

4 Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain.

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7. 20DB BANDWIDTH

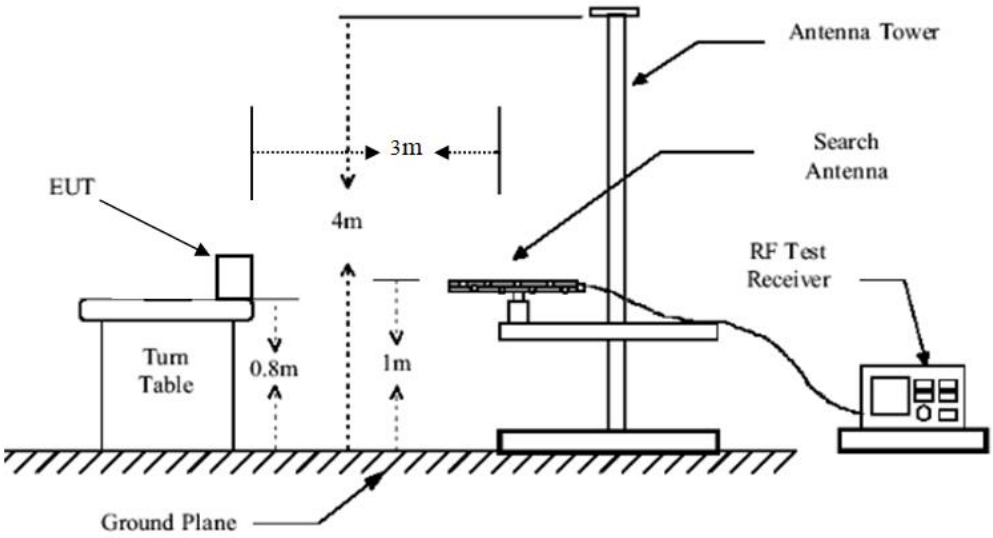
7.1 LIMITS

§15.231(c) 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.

7.2 TEST PROCEDURES

1) Set resolution bandwidth (RBW) =3kHz.Set the video bandwidth (VBW) ≥ 3 x RBW. Detector = Peak. Trace mode = max hold. Sweep = auto couple. Allow the trace to stabilize, record 20dB bandwidth value.
2) Repeat above procedures until all frequencies measured were complete.

7.3 TEST SETUP



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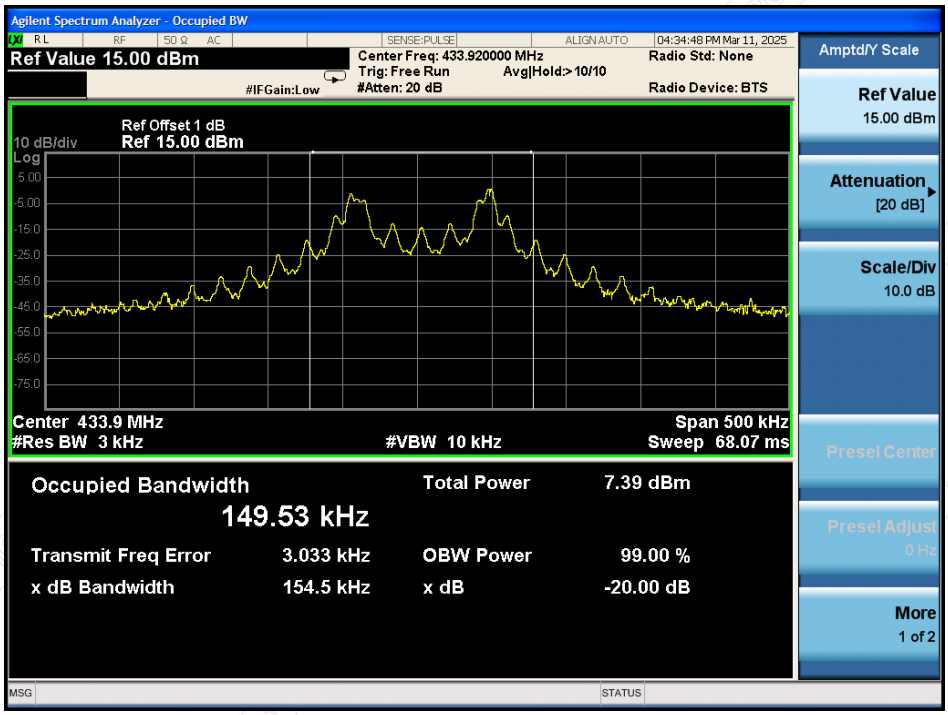
7.4 TEST RESULTS

Environment: 24.6℃/52%RH/101kPa
Power Source: DC 3V
Test Date: 2025-03-11
Test By : Qin Tingting

Test mode: 433.92MHz

Frequency(MHz)	Bandwidth(kHz)	Limit(kHz)	Test Result
433.92	154.5	1084.8	PASS

Test Plot



433.92MHz

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8. TRANSMISSION TIME

8.1 LIMITS

§15.231(a)for this periodic operation:
(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

8.2 TEST PROCEDURES

1) The spectrum analyzer resolution bandwidth that is ≤EBW. So we test the Maximum Conducted Output Power ——Integrated band power method.
2) Set the analyzer span = 0Hz. RBW = 3MHz.Set VBW =3MHz. Detector = Peak. Sweep = Adjust according to actual conditions.
3) Allow the trace to stabilize, record value.

8.3 TEST SETUP

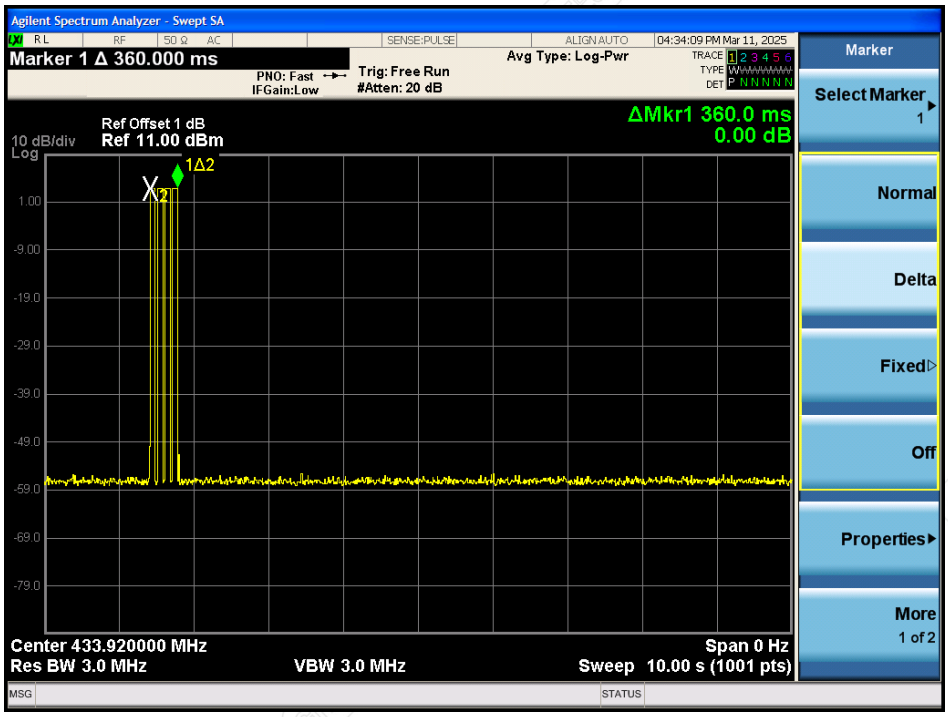
EUT → Spectrum analyzer

8.4 TEST RESULTS

Environment: 24.6℃/52%RH/101kPa
Power Source: DC 3V
Test Date: 2025-03-11
Test By : Qin Tingting

433.92MHz

Frequency (MHz)	Transmission Time (s)	Limit (s)	Result
433.92	0.36	≤5	Pass



433.92MHz

APPENDIX A. PHOTOGRAPHS OF EUT TEST SETUP

Please refer to the attached document E202409271682-Test photo.

APPENDIX B. PHOTOGRAPHS OF EUT

Please refer to the attached document E202409271682-EUT Photo.

---------- End of Report ----------