



TEST REPORT

Applicant Name : FUZHOU ESUN ELECTRONIC CO., LTD
Address : ZONE 3, FLOOR 2, BUILDING 3, GULOU INDUSTRIAL PARK,
JUYUANZHOU, JIANXIN TOWN, CANGSHAN DISTRICT, FUZHOU CITY,
FUJIAN PROVINCE, CHINA
Report Number : XMTN1220221-05158E-RF
FCC ID: 2APN2-EN8822
Test Standard (s)
FCC PART 15.231

Sample Description

Product Type: OUTDOOR THERMOMETER HUMIDITY TRANSMITTER
Model No.: T21
Trade Mark: N/A
Date Received: 2022-02-21
Date of Test: 2022-03-03 to 2022-03-24
Report Date: 2022-03-25

Test Result:	Pass*
--------------	-------

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Ting Lü
EMC Engineer

Approved By:

Candy Li
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★".

Shenzhen Accurate Technology Co., Ltd. is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.

This report cannot be reproduced except in full, without prior written approval of the Company. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested. This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

Shenzhen Accurate Technology Co., Ltd.

1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China
Tel: +86 755-26503290 Fax: +86 755-26503396 Web: www.atc-lab.com

TABLE OF CONTENTS

GENERAL INFORMATION	3
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....	3
OBJECTIVE	3
TEST METHODOLOGY	3
MEASUREMENT UNCERTAINTY.....	4
SYSTEM TEST CONFIGURATION	5
JUSTIFICATION	5
EUT EXERCISE SOFTWARE	5
SPECIAL ACCESSORIES.....	5
EQUIPMENT MODIFICATIONS	5
SUPPORT EQUIPMENT LIST AND DETAILS	5
EXTERNAL I/O CABLE.....	5
BLOCK DIAGRAM OF TEST SETUP	6
SUMMARY OF TEST RESULTS	7
TEST EQUIPMENT LIST AND DETAILS	8
FCC §15.203 - ANTENNA REQUIREMENT	9
APPLICABLE STANDARD	9
ANTENNA CONNECTOR CONSTRUCTION	9
FCC §15.205, §15.209, §15.231 (E) - RADIATED EMISSIONS	10
APPLICABLE STANDARD	10
EUT SETUP	10
EMI TEST RECEIVER SETUP.....	11
TEST PROCEDURE	11
CORRECTED AMPLITUDE & MARGIN CALCULATION	12
TEST RESULTS SUMMARY	12
TEST DATA	12
FCC §15.231(E) - DEACTIVATION TESTING	19
APPLICABLE STANDARD	19
TEST PROCEDURE	19
TEST DATA	19
FCC §15.231(C) – 20 DB EMISSION BANDWIDTH TESTING	22
APPLICABLE STANDARD	22
TEST PROCEDURE	22
TEST DATA	22

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	OUTDOOR THERMOMETER HUMIDITY TRANSMITTER
Tested Model	T21
Frequency Range	433.93MHz
Modulation Technique	ASK
Antenna Specification*	0dBi(It is provided by the applicant)
Voltage Range	DC 3V from battery
Sample serial number	XMTN1220221-05158E-RF
Sample/EUT Status	Good condition

Objective

All the test measurements were performed according to the measurement procedure described in ANSI C63.10 - 2013.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.209, 15.35(c) and 15.231 rules.

Test Methodology

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

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters. Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
Unwanted Emission, conducted		1.6dB
Emissions, Radiated	30MHz - 1GHz	4.28dB
	1GHz- 18GHz	4.98dB
Temperature		1°C
Humidity		6%
Supply voltages		0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358, the FCC Designation No.: CN1189. Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

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

SYSTEM TEST CONFIGURATION

Justification

The system was configured for testing by manufacturer.

Operating frequency: 433.93MHz

Note: The product has 3 channels, RF transmitting power is the same, and the maximum duty cycle is tested and recorded.

EUT Exercise Software

No software was used during testing and the power level was default*.

Special Accessories

No special accessories was used

Equipment Modifications

No modification was made to the EUT.

Support Equipment List and Details

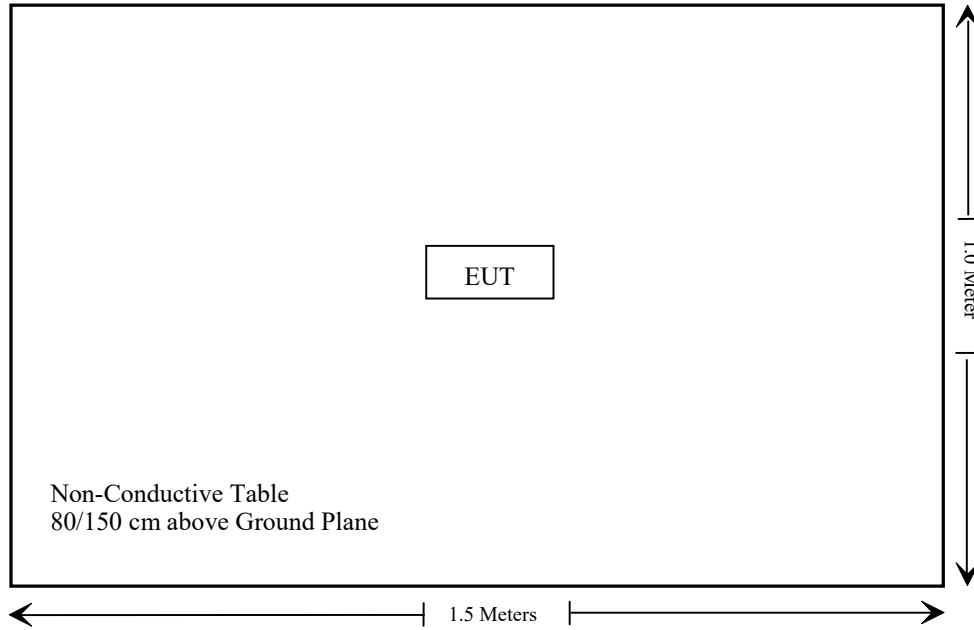
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

Cable Description	Length (m)	From / Port	To
/	/	/	/

Block Diagram of Test Setup

For Radiated Emission: Below and Above 1GHz



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliant
§15.207 (a)	Conducted Emissions	Note Applicable
§ 15.205, §15.209, §15.231(e)	Radiated Emissions	Compliant
§15.231 (c)	20dB Emission Bandwidth	Compliant
§ 15.231 (e)	Deactivation	Compliant

Note:

Not Applicable: The EUT is powered by battery.

TEST EQUIPMENT LIST AND DETAILS

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emissions Test					
Rohde & Schwarz	Test Receiver	ESR	102725	2021/12/13	2022/12/12
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2021/12/13	2022/12/12
A.H. Systems, inc.	Preamplifier	PAM-0118P	531	2021/11/09	2022/11/08
SONOMA INSTRUMENT	Amplifier	310 N	186131	2021/11/09	2022/11/08
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Unknown	RF Coaxial Cable	No.10	N050	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.11	N1000	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.12	N040	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.13	N300	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.14	N800	2021/12/14	2022/12/13
Radiated Emission Test Software: e3 19821b(V9)					
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSV40	101495	2021/12/13	2022/12/12
WEINSCHHEL	10dB Attenuator	5324	AU 3842	Each time	

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

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

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.

Antenna Connector Construction

The EUT has one Spring antenna arrangement which was permanently attached. And the antenna gain is 0dBi; fulfill the requirement of this section. Please refer to EUT photos.

Result: Compliant.

FCC §15.205, §15.209, §15.231 (e) - RADIATED EMISSIONS

Applicable Standard

FCC §15.205, §15.209, §15.231 (e)

According to FCC §15.231(e), the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

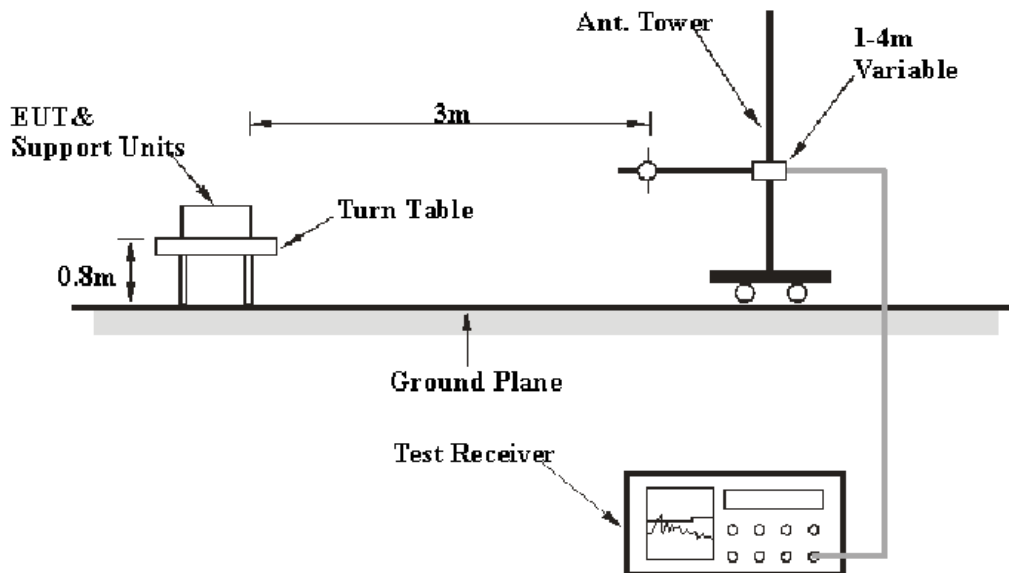
Fundamental frequency (MHz)	Field Strength of Fundamental (Microvolts /meter)	Field Strength of spurious emissions ((Microvolts /meter)
40.66-40.70	1000	100
70-130	500	50
130-174	500 to 1500*	50 to 150*
174-260	1500	150
260-470	1500 to 5000*	150 to 500*
Above 470	5000	500

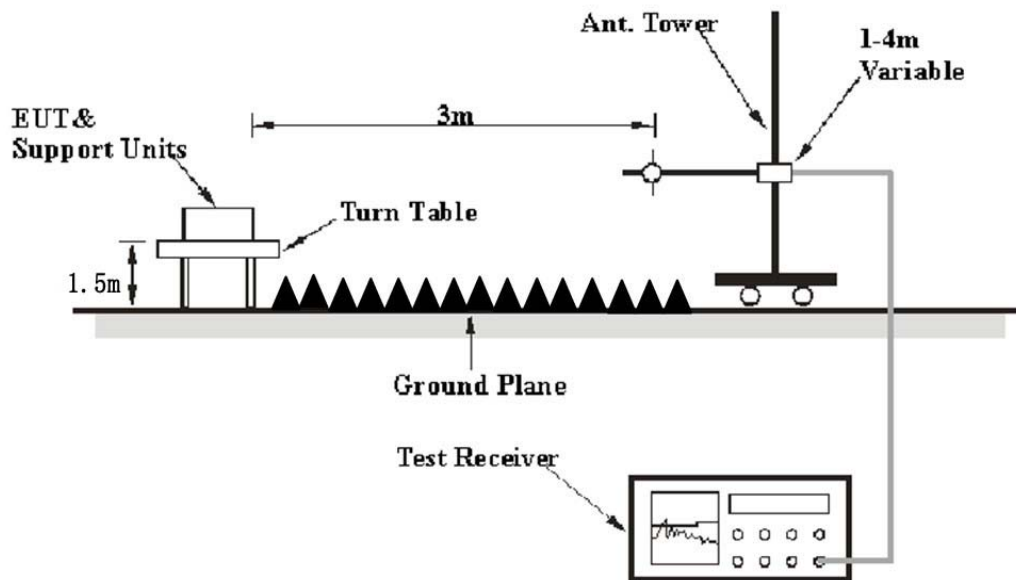
*Linear interpolations.

The above field strength limits are specified at a distance of 3-meters the tighter limits apply at the band edges.

EUT Setup

Below 1 GHz:



Above 1 GHz:

The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10 - 2013. The specification used was the FCC 15 § 15.209, 15.205 and 15.231.

EMI Test Receiver Setup

The system was investigated from 30 MHz to 5 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	PK
Above 1 GHz	1 MHz	3 MHz	/	PK

Test Procedure

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

All final data was recorded in the Quasi-peak detection mode from 30MHz to 1GHz, Peak and average detection mode above 1 GHz.

If the maximized peak measured value complies with the limit, then it is unnecessary to perform QP/Average measurement.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain. The basic equation is as follows:

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

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

$$\begin{aligned} \text{Margin / Over Limit} &= \text{Result / Absolute Level} - \text{Limit} \\ \text{Result / Absolute Level} &= \text{Reading} + \text{Factor} \end{aligned}$$

Test Results Summary

According to the data in the following table, the EUT complied with the FCC §15.205, §15.209, §15.231 (e).

Test Data

Environmental Conditions

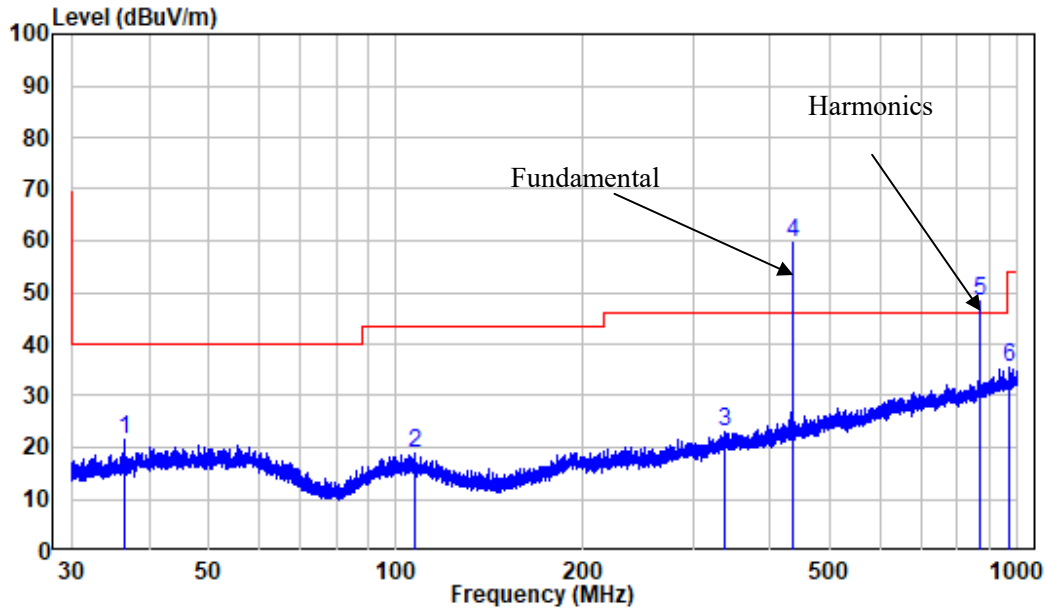
Temperature:	20°C
Relative Humidity:	58%
ATM Pressure:	101.0 kPa

The testing was performed by Chao Mo on 2020-03-03 to 2022-03-24.

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

30MHz – 1 GHz:

Horizontal:

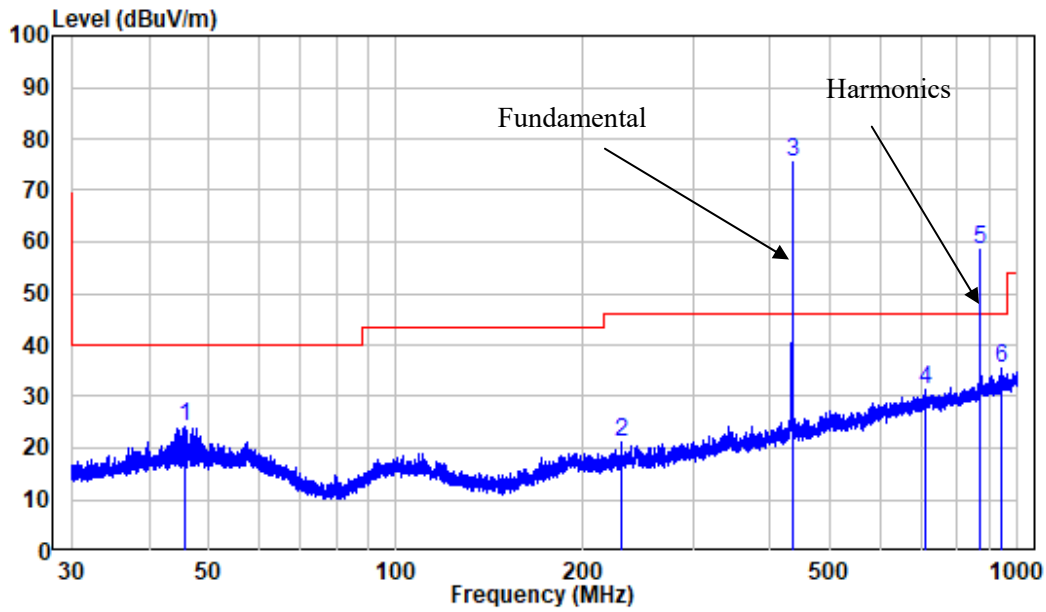


Site : chamber
 Condition: 3m HORIZONTAL
 Job No. : XMTN1220221-05158E-RF
 Test Mode: Transmitting

	Freq	Factor	Read Level	Limit Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	36.541	-11.10	32.54	21.44	40.00	-18.56	Peak
2	107.087	-11.96	30.98	19.02	43.50	-24.48	Peak
3	337.068	-7.54	30.71	23.17	46.00	-22.83	Peak
4	433.930	-5.72	65.24	59.52	92.87	-33.35	Peak
5	867.860	0.85	47.56	48.41	72.87	-24.46	Peak
6	972.764	2.41	33.17	35.58	54.00	-18.42	Peak

Note: The results which over 6dB below to the limit were not recorded Quasi-peak.

Vertical:



Site : chamber
 Condition: 3m VERTICAL
 Job No. : XMTN1220221-05158E-RF
 Test Mode: Transmitting

	Freq	Factor	Read Level	Limit Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	45.555	-9.97	34.31	24.34	40.00	-15.66	Peak
2	230.603	-11.09	32.39	21.30	46.00	-24.70	Peak
3	433.930	-5.72	81.35	75.63	92.87	-17.24	Peak
4	709.804	-1.49	32.94	31.45	46.00	-14.55	Peak
5	867.860	0.85	57.54	58.39	72.87	-14.48	Peak
6	938.833	1.74	33.69	35.43	46.00	-10.57	Peak

Note: The results which over 6dB below to the limit were not recorded Quasi-peak.

Horizontal

Frequency (MHz)	Reading (dB μ V)	Factor Corr.	Average Factor	Result (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)	
	Peak	(dB/m)	(dB)	AV	Peak	AV	Peak	AV	Peak
433.9300	65.24	-5.72	-13.98	45.54	59.52	72.87	92.87	-27.33	-33.35
867.8600	47.56	0.85	-13.98	34.43	48.41	52.87	72.87	-18.44	-24.46
1301.7900	61.1	-10.2	-13.98	36.92	50.9	54	74	-17.08	-23.1
1735.7200	48.87	-8.85	-13.98	26.04	40.02	52.87	72.87	-26.83	-32.85
2169.6500	62.96	-7.22	-13.98	41.76	55.74	52.87	72.87	-11.11	-17.13
2603.5800	62.55	-6.85	-13.98	41.72	55.7	52.87	72.87	-11.15	-17.17
3037.5100	59.99	-5.84	-13.98	40.17	54.15	52.87	72.87	-12.7	-18.72
3471.4400	55.17	-6	-13.98	35.19	49.17	52.87	72.87	-17.68	-23.7
3905.3700	58.84	-5.54	-13.98	39.32	53.3	52.87	72.87	-13.55	-19.57

Vertical

Frequency (MHz)	Reading (dB μ V)	Factor Corr.	Average Factor	Result (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)	
	Peak	(dB/m)	(dB)	AV	Peak	AV	Peak	AV	Peak
433.9300	81.35	-5.72	-13.98	61.65	75.63	72.87	92.87	-11.22	-17.24
867.8600	57.54	0.85	-13.98	44.41	58.39	52.87	72.87	-8.46	-14.48
1301.7900	65.41	-10.2	-13.98	41.23	55.21	54	74	-12.77	-18.79
1735.7200	55.2	-8.85	-13.98	32.37	46.35	52.87	72.87	-20.5	-26.52
2169.6500	71.02	-7.22	-13.98	49.82	63.8	52.87	72.87	-3.05	-9.07
2603.5800	66.9	-6.85	-13.98	46.07	60.05	52.87	72.87	-6.8	-12.82
3037.5100	68.72	-5.84	-13.98	48.9	62.88	52.87	72.87	-3.97	-9.99
3471.4400	66.48	-6	-13.98	46.5	60.48	52.87	72.87	-6.37	-12.39

Note:

1. Emissions attenuated more than 20 dB below the permissible value are not reported.
2. The field strength is calculated by adding the antenna factor, high pass filter loss(if used) and cable loss, and subtracting the amplifier gain(if any)from the measured reading. The basic equation calculation is as follows:

Result = Reading + Corrected Factor

Where Corrected Factor = Antenna Factor + Cable Loss – Amplifier Gain

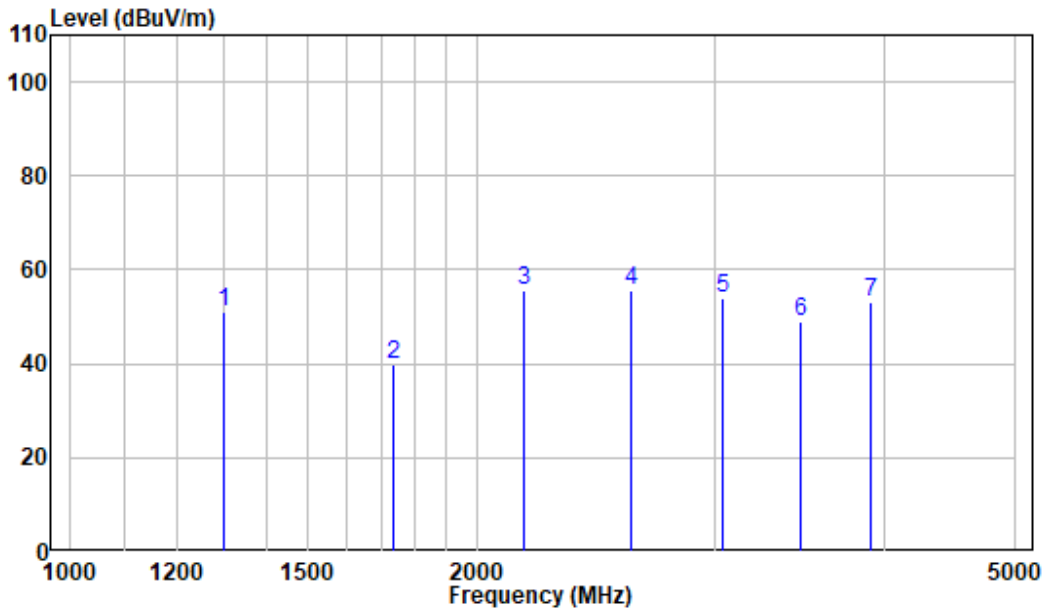
3. AV=Peak+Duty cycle factor

Duty cycle factor=20*Log(Max Duty cycle)

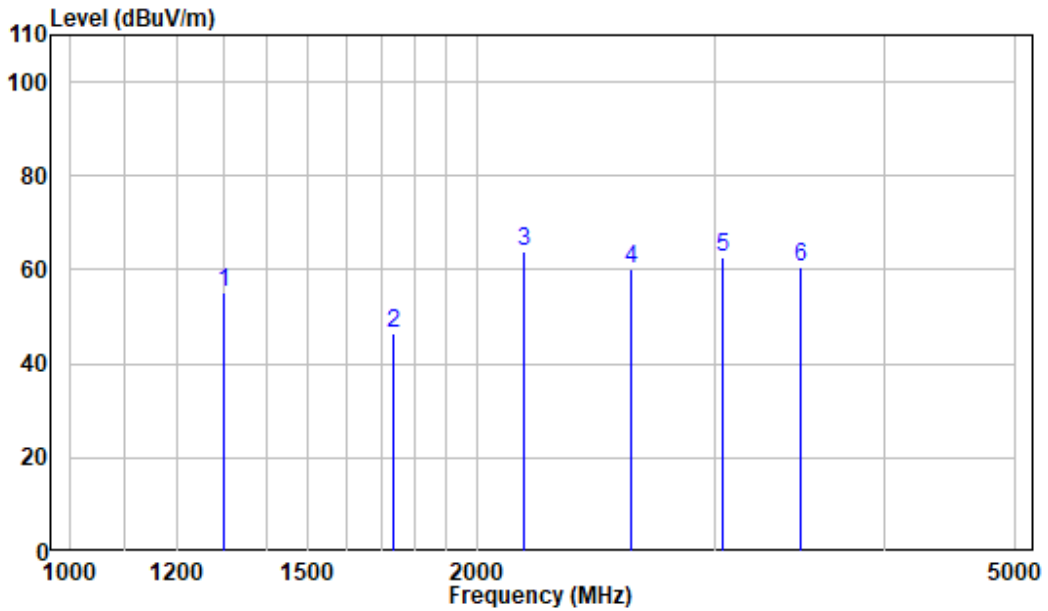
Max Duty cycle(100ms)= $T_{\max \text{ total on(in 100ms)}/100$

Above 1 GHz

Horizontal

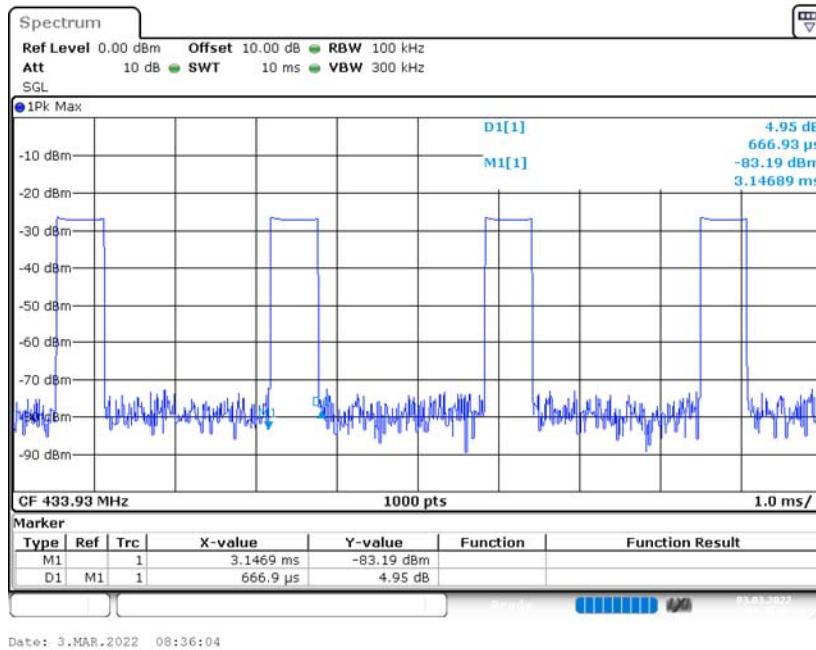


Vertical

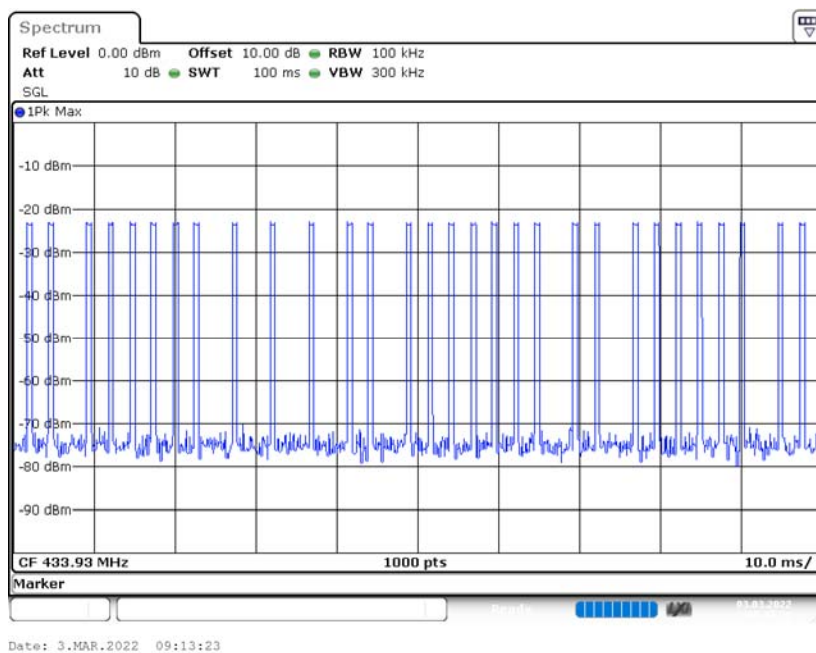


Note: All spurious emissions are compliant to the limit.

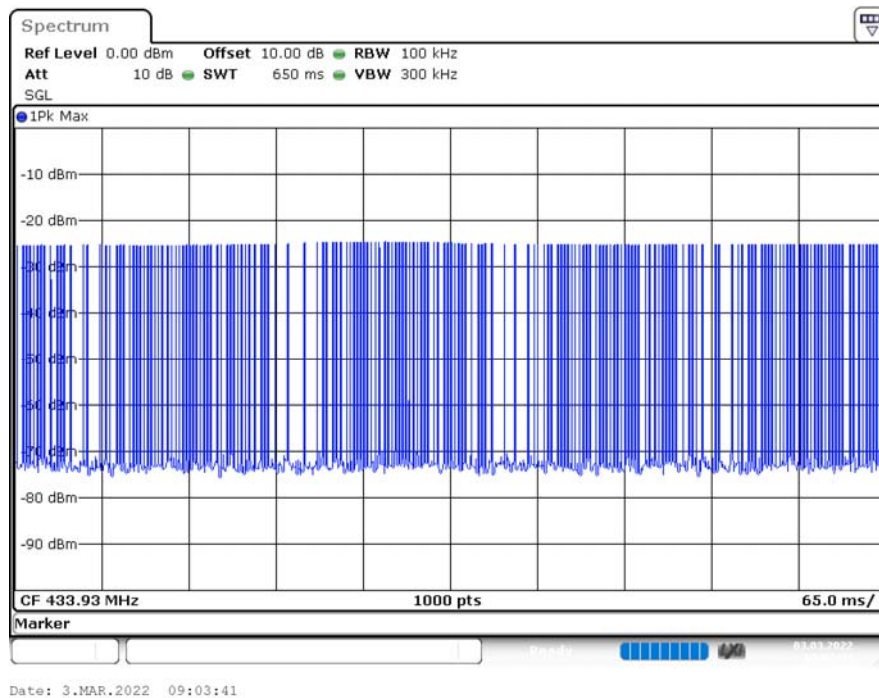
For worst case at 100ms:



The graph shows the duration of ‘on’ signal. From Marker 1 to Delta 2, duration is 0.667ms.



The graph shows the duration of ‘on’ signal. From Marker 1 to Delta 2, duration is 100ms.



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

Effective period of one cycle = (30×0.667) ms = 20.01ms

One cycle = 100ms

Duty cycle = $20.01\text{ms}/100\text{ms}=0.2$

Therefore, the average factor is found by $20 \cdot \log(0.2) = -13.98\text{dB}$

FCC §15.231(e) - DEACTIVATION TESTING

Applicable Standard

Per 15.231(e), devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

Test Procedure

1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set center frequency of spectrum analyzer=operating frequency.
3. Set the spectrum analyzer as RBW=100kHz/ VBW=300kHz/ Span=0Hz.
4. Repeat above procedures until all frequency measured was complete.

Test Data

Environmental Conditions

Temperature:	20 °C
Relative Humidity:	58 %
ATM Pressure:	101.0 kPa

The testing was performed by Paul Liu on 2022-03-24.

Test mode: Transmitting

Test Result: Compliant.

Transmission period

Transmission period (s)	Limit (s)	Result (s)
0.982241	< 1	Pass

Silent period

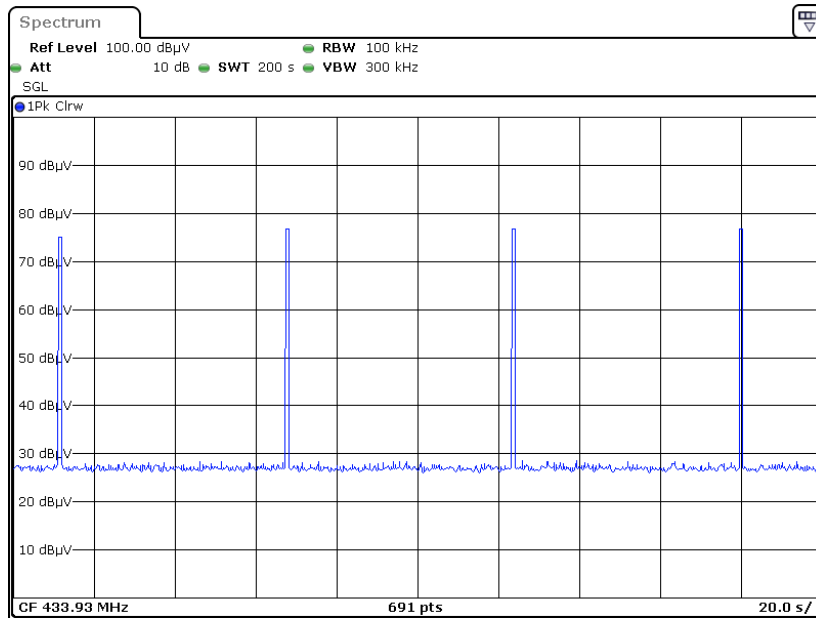
Silent period (s)	Limit (s)	Result (s)
54.841	>27.14856	Pass

Note:

The silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

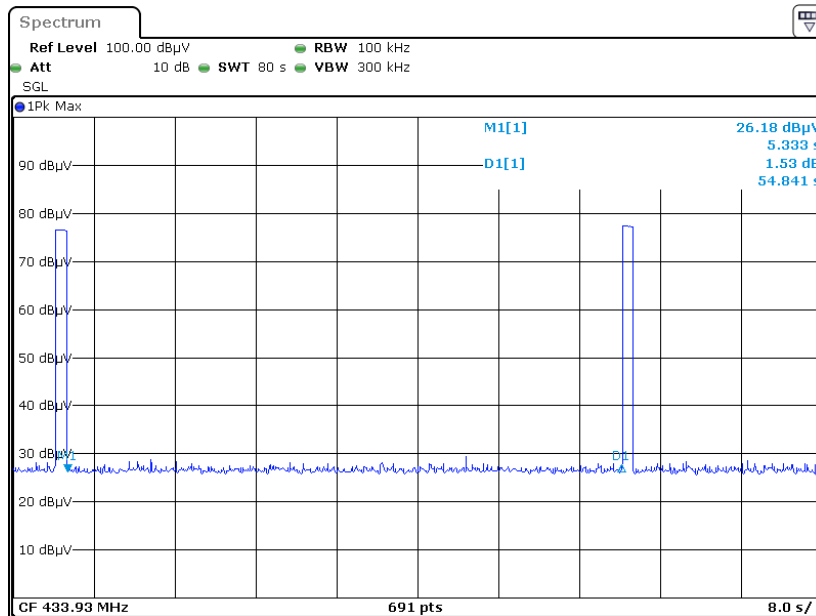
The duration time is 0.982241s, $0.982241 \times 30 = 29.46723s$.

Transmission period



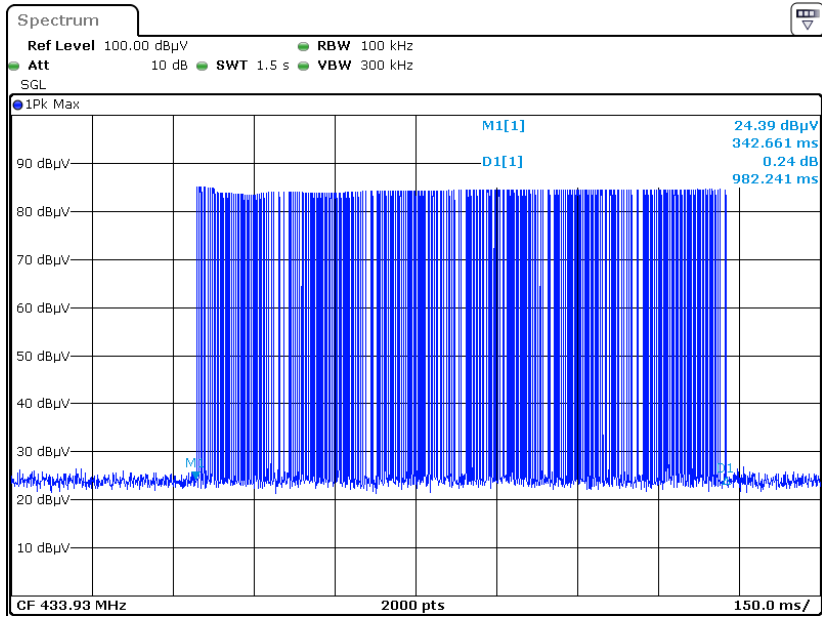
Date: 24. MAR. 2022 09:55:25

Silent period



Date: 24. MAR. 2022 10:06:42

Duration time



Date: 24.MAR.2022 10:27:53

FCC §15.231(c) – 20 dB EMISSION BANDWIDTH TESTING

Applicable Standard

Per 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. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Test Procedure

The EUT is setting to the transmit mode, the waveform was received by the test antenna which was connected to the spectrum analyzer, plot the 20 dB bandwidth.

Test Data

Environmental Conditions

Temperature:	20°C
Relative Humidity:	58 %
ATM Pressure:	101.0 kPa

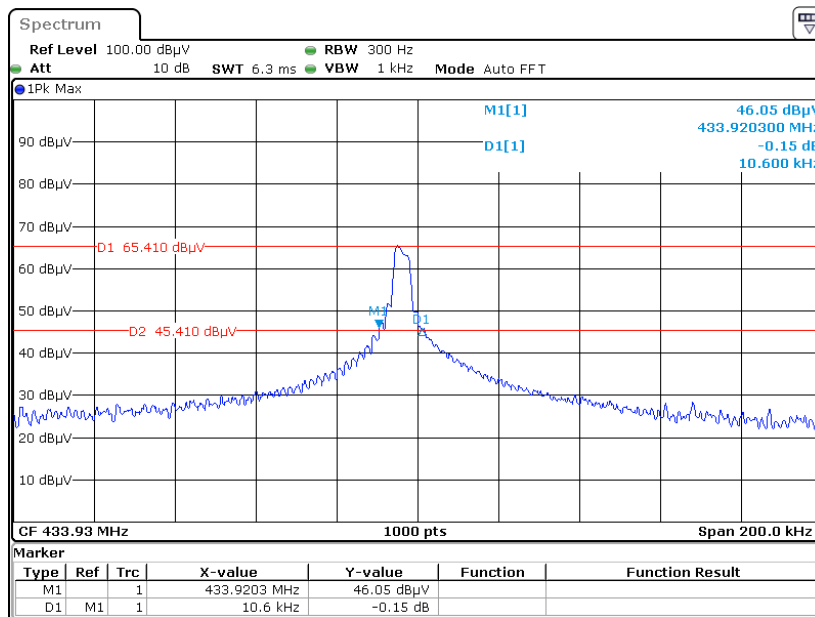
The testing was performed by Paul Liu on 2022-03-24.

Test Mode: Transmitting

Please refer to following table and plots.

Channel Frequency (MHz)	20 dB Emission Bandwidth (kHz)	Limit (kHz)	Result
433.93	10.60	<1084.8	Pass

20 dB Emission Bandwidth



Date: 24.MAR.2022 10:38:00

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