

Product Name: AC ceiling fan controller	Report No: FCC022022-05747RF0
Product Model: XL002	Security Classification: Open
Version: V1.0	Total Page: 36

TIRT Testing Report

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FCC Radio Test Report

FCC ID: 2A8EX01

This report concerns: ☒Original Grant

Project No. : 2022-05747
Equipment : AC ceiling fan controller
Brand Name : N/A
Test Model : XL002
Series Model : N/A
Applicant : TAISHAN CITY LIHUA ELECTRIC FACTORY LTD.
Address : North Gate 8th, Industrial District, Fu Cheng Town, Taishan City, Guangdong, P.R.C.
Manufacturer : TAISHAN CITY LIHUA ELECTRIC FACTORY LTD.
Address : North Gate 8th, Industrial District, Fu Cheng Town, Taishan City, Guangdong, P.R.C.
Factory : TAISHAN CITY LIHUA ELECTRIC FACTORY LTD.
Address : North Gate 8th, Industrial District, Fu Cheng Town, Taishan City, Guangdong, P.R.C.
Date of Receipt : Nov. 03, 2022
Date of Test : Nov. 11, 2022 ~ Dec. 30, 2022
Issued Date : Jan. 10, 2023
Report Version : V1.0
Test Sample : Engineering Sample No.: 20221103019327
Standard(s) : FCC CFR Title 47, Part 15, Subpart C
ANSI C63.10-2013

- The test result referred exclusively to the presented test model /sample.
- Without written approval of TIRT Inc. the test report shall not reproduced except in full.

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REPORT ISSUED HISTORY

Report No.	Version	Description	Issued Date	Note
FCC022022-05747RF0	V1.0	Original	2023.01.10	Valid

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standard(s):

FCC CFR Title 47, Part 15, Subpart C				
Standard(s) Section	Test Item	Test Result	Judgment	Remark
15.207	AC Power Line Conducted Emissions	Appendix A	N/A	-----
15.231(b) 15.205(a) 15.209(a)	Radiated Emissions	Appendix B Appendix C Appendix D	PASS	-----
15.231(c)	Bandwidth	Appendix E	PASS	-----
15.231(a)	Timing Testing	Appendix F	PASS	-----
15.203	Antenna Requiremen	-----	PASS	Note (2)

Note:

- (1) "N/A" denotes test is not applicable in this test report
- (2). The device what use a permanently attached antenna were considered sufficient to comply with the provisions of 15.203.

1.1 TEST FACILITY

Company:	Beijing TIRT Technology Service Co.,Ltd Shenzhen
Address:	101, 3 # Factory Building, Gongjin Electronics Shatin Community, Kengzi Street, Pingshan District, Shenzhen, China
CNAS Registration Number:	CNAS L14158
A2LA Registration Number:	6049.01
FCC Accredited Lab. Designation Number:	CN1309
FCC Test Firm Registration Number:	825524
Telephone:	+86-0755-27087573

1.2 MEASUREMENT UNCERTAINTY

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2))
The TIRT measurement uncertainty as below table:

Uncertainty	
Parameter	Uncertainty
Occupied Channel Bandwidth	±142.12 kHz
RF power conducted	±0.74 dB
RF power radiated	±3.25dB
Spurious emissions, conducted	±1.78dB
Spurious emissions, radiated (30MHz~1GHz)	±4.6dB
Spurious emissions, radiated (1GHz~18G)	±4.9dB
Conduction Emissions(150kHz~30MHz)	±3.1 dB
Humidity	±4.6%
Temprature	±0.7°C
Time	±1.25%

Note: Unless specifically mentioned, the uncertainty of measurement has not been taken into account to declare the compliance or non-compliance to the specification.

1.3 TEST ENVIRONMENT CONDITIONS

Test Item	Temperature	Humidity	Test Voltage	Tested By
Radiated Emissions-9kHz to 30MHz	24°C	54%	DC 12V	Stone Tang
Radiated Emissions-30MHz to 1GHz	24°C	54%	DC 12V	Stone Tang
Radiated Emissions-Above 1GHz	24°C	54%	DC 12V	Stone Tang
Bandwidth	22°C	59%	DC 12V	Stone Tang
Timing Testing	22°C	59%	DC 12V	Stone Tang

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	AC ceiling fan controller
Brand Name	N/A
Test Model	XL002
Series Model	N/A
Model Difference(s)	N/A
Power Source	Spplied from Battery.
Power Rating	DC 12V 23A
Product Type	Momentarily Operated Devices
Operation Frequency	433.92 MHz
Modulation Type	ASK
Number Of Channel	1CH, 433.92 MHz
Antenna Designation	PCB Antenna
Max. Field Strength	50.13 dBuV/m(Peak) 44.19 dBuV/m(AVG)
Max. Output Power	-5.26 dBm (0.00030W) (Peak) -6.19 dBm (0.00024W) (AVG)

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

2.2 DUTY CYCLE

DWELL TIME OF PERIODIC OPERATION MEASUREMENT

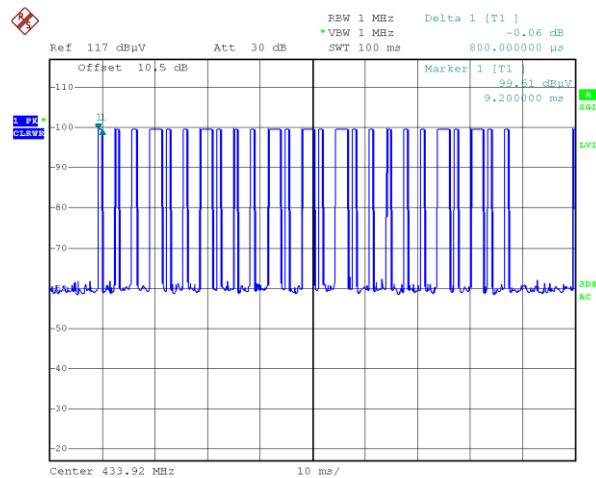
Duty Cycle = $(N_1 \cdot L_1 + N_2 \cdot L_2 + \dots + N_{n-1} \cdot L_{n-1} + N_n \cdot L_n) / 100$ or T

Duty Cycle = $31.2 / 100 = 0.312$

Average Reading = Peak Reading (dBuV/m) + $20 \log$ (Duty cycle)

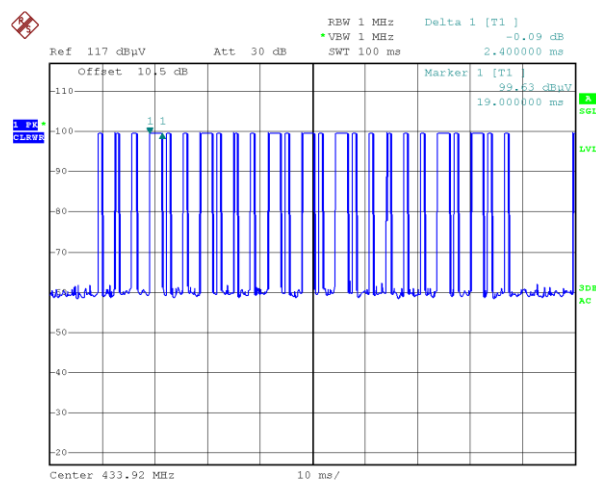
Average Reading = Peak + $20 \cdot \log$ (Duty Cycle) = Peak - 10.12

Duty Cycle 1



Date: 25.DEC.2022 15:19:56

Duty Cycle 2



Date: 25.DEC.2022 15:20:50

2.3 DESCRIPTION OF TEST MODES

The test system was pre-tested based on the consideration of all possible combinations of EUT operation mode.

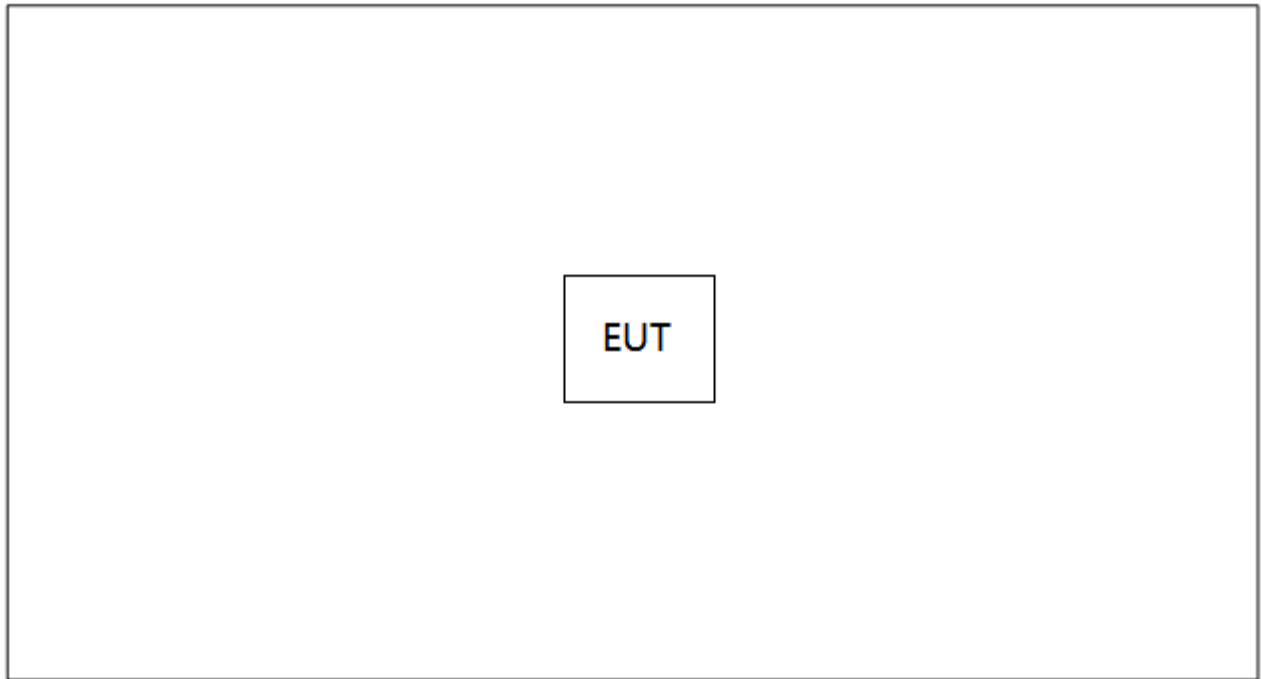
Pretest Mode	Description
Mode 1	TX Mode

Following mode(s) was (were) found to be the worst case(s) and selected for the final test.

Radiated emissions test	
Final Test Mode	Description
Mode 1	TX Mode

Conducted test	
Final Test Mode	Description
Mode 1	TX Mode

2.4 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



2.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.
-	-	-	-	-

Item	Cable Type	Shielded Type	Ferrite Core	Length
-	-	-	-	-

3. AC POWER LINE CONDUCTED EMISSIONS TEST

3.1 LIMIT

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56*	56 to 46*
0.5 - 5.0	56	46
5.0 - 30.0	60	50

Note:

- (1) The tighter limit applies at the band edges.
- (2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

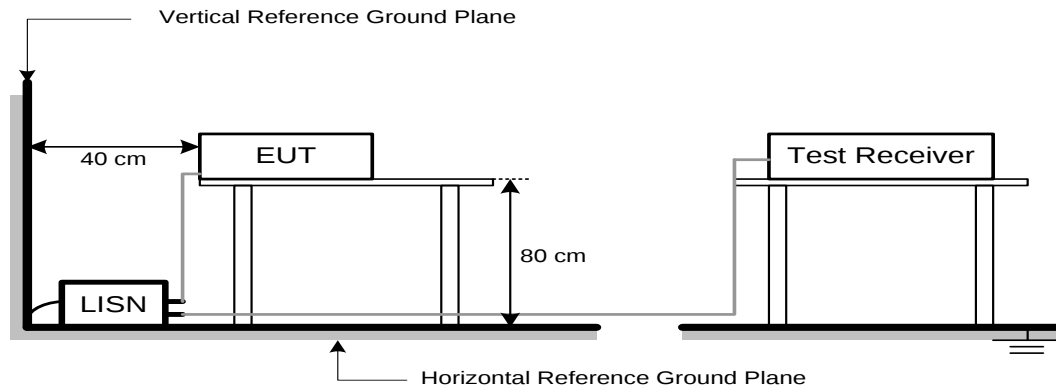
3.2 TEST PROCEDURE

- a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- d. LISN at least 80 cm from nearest part of EUT chassis.
- e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.3 DEVIATION FROM TEST STANDARD

No deviation

3.4 TEST SETUP



3.5 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical function (as a customer would normally use it), EUT was programmed to be in continuously transmitting data or hopping on mode.

3.6 TEST RESULTS

Please refer to the Appendix A.

Remark:

- (1) All readings are QP Mode value unless otherwise stated AVG in column of 『Note』 . If the QP Mode Measured value compliance with the QP Limits and lower than AVG Limits, the EUT shall be deemed to meet both QP & AVG Limits and then only QP Mode was measured, but AVG Mode didn't perform in this case, a "*" marked in AVG Mode column of Interference Voltage Measured.
- (2) Measuring frequency range from 150 kHz to 30 MHz.

4. RADIATED EMISSION TEST

4.1 LIMIT

Frequency Band (MHz)	Fundamental Emissions Limit($\mu\text{V/m}$) at 3m
70-130	500
130-174	500-1500(Note1)
174-260	1500
260-470	1500-5000(Note1)
Above 470	5000

Frequency Band (MHz)	Spurious Emissions Limit($\mu\text{V/m}$) at 3m (Note2)
70-130	50
130-174	50-150(Note1)
174-260	150
260-470	150-500(Note1)
Above 470	500

Note:

- Linear interpolations, the formulas for calculating the maximum permitted fundamental field strengths are as follows:

(1) For the band 130 - 174 MHz, $\mu\text{V/m}$ at 3 meters = $22.73 \times (\text{operating frequency, MHz}) - 2454.55$;

(2) For the band 260 - 470 MHz, $\mu\text{V/m}$ at 3 meters = $16.67 \times (\text{operating frequency, MHz}) - 2833.33$.

So the field strength of emission limits has been calculated in below table.

Carrier Frequency (MHz)	Fundamental Emissions Limit(dBuV/m) at 3m
433.92 MHz	72.87 (Average)
433.92 MHz	92.87 (Peak)

- Unwanted emissions shall be 10 times below the fundamental emissions field strength limits in table or comply with the general field strength limits specified in RSS-Gen(please refer to below table), whichever is less stringent.

LIMITS OF RADIATED EMISSION MEASUREMENT (9 kHz-30 MHz)

Frequency (MHz)	Magnetic field strength (H-Field) ($\mu\text{A/m}$)	Measurement Distance (meters)
0.009-0.490	$6.37/F$ (F in kHz)	300
0.490-1.705	$63.7/F$ (F in kHz)	30
1.705-30.0	0.08	30

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 30 MHz)

Frequency (MHz)	Field Strength ($\mu\text{V/m}$ at 3m)
30-88	100
88-216	150
216-960	200
Above 960	500

4.2 SETTING

Receiver Parameter	Setting
Attenuation	Auto
Center Frequency	Fundamental Frequency
RBW	120 kHz
Detector	Peak / Average

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1MHz / 1MHz for Peak, AV Mode with Dwell time

Spectrum Parameters	Setting
Start ~ Stop Frequency	9 kHz~90 kHz for PK/AVG detector
Start ~ Stop Frequency	90 kHz~110 kHz for QP detector
Start ~ Stop Frequency	110 kHz~490 kHz for PK/AVG detector
Start ~ Stop Frequency	490 kHz~30 MHz for QP detector
Start ~ Stop Frequency	30 MHz~1000 MHz for QP detector
Start ~ Stop Frequency	1 GHz~26.5 GHz for PK/AVG detector

4.3 TEST PROCEDURE

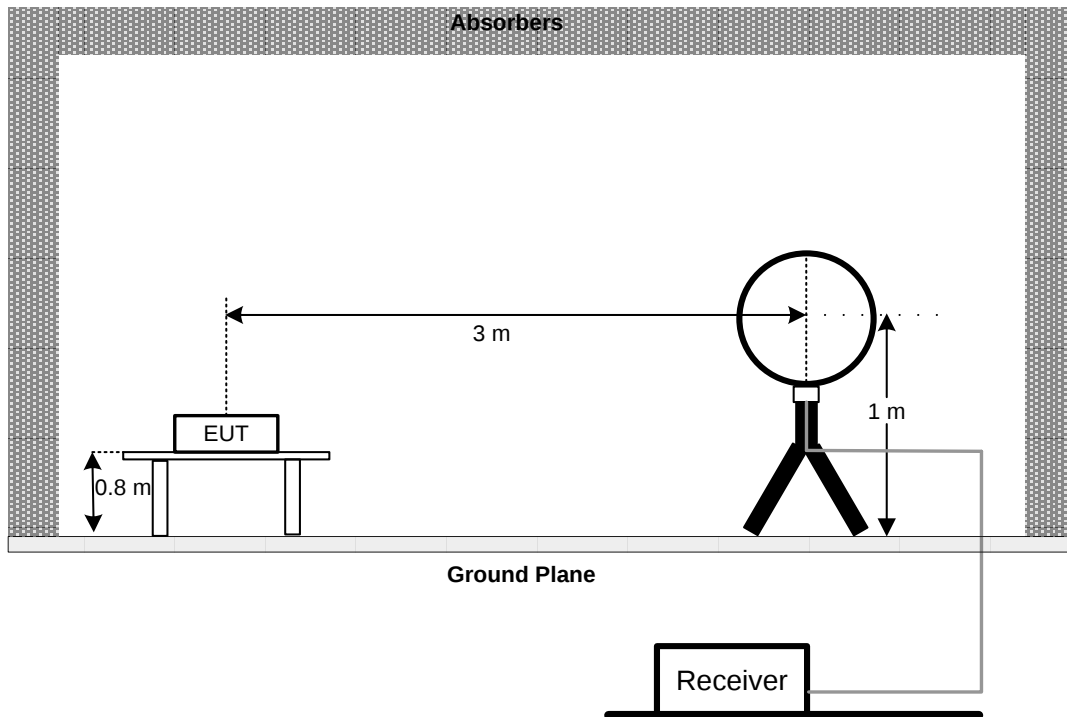
- The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(below 1GHz)
- The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 1.5 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(above 1GHz)
- The height of the equipment or of the substitution antenna shall be 0.8 m or 1.5 m, the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights find the maximum reading (used Bore sight function).
- The receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1GHz.
- The initial step in collecting radiated emission data is a receiver peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- All readings are Peak unless otherwise stated QP in column of Note. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform. (below 1GHz)
- All readings are Peak Mode value unless otherwise stated AVG in column of Note. If the Peak Mode Measured value compliance with the Peak Limits and lower than AVG Limits, the EUT shall be deemed to meet both Peak & AVG Limits and then only Peak Mode was measured, but AVG Mode didn't perform. (above 1GHz)
- For the actual test configuration, please refer to the related Item – EUT Test Photos.

4.4 DEVIATION FROM TEST STANDARD

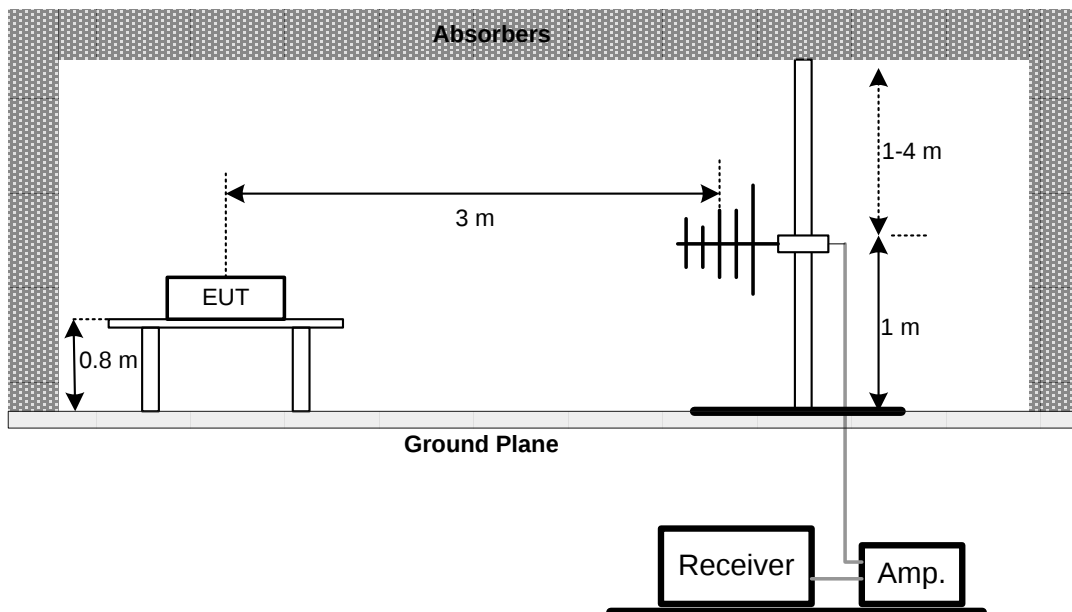
No deviation

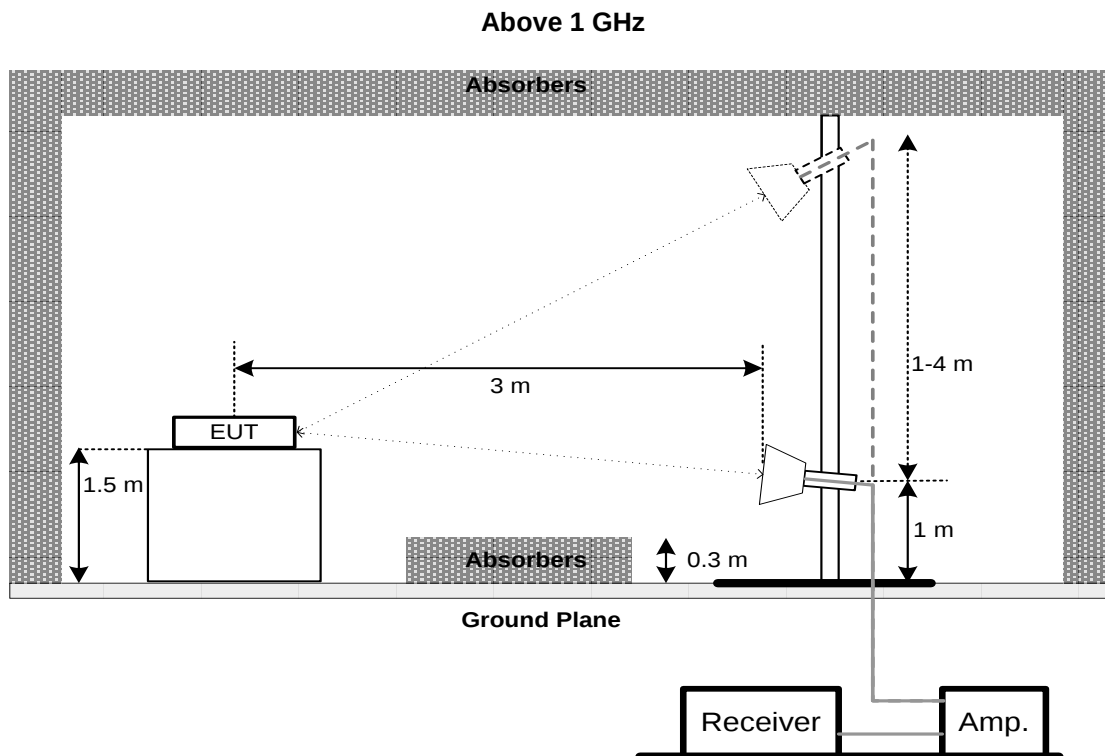
4.5 TEST SETUP

9 kHz to 30 MHz



30 MHz to 1 GHz





4.6 TEST DEVIATION

There is no deviation with the original standard.

4.7 EUT OPERATION DURING TEST

The EUT was programmed to be in continuously transmitting mode.

4.8 TEST RESULT - 9 kHz TO 30 MHz

Please refer to the Appendix B.

Remark:

- (1) Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB).
- (2) Limit line = specific limits (dBuV) + distance extrapolation factor.

4.9 TEST RESULT - 30 MHz TO 1000 MHz

Please refer to the Appendix C.

4.10 TEST RESULTS - ABOVE 1000 MHz

Please refer to the Appendix D.

Remark:

- (1) No limit: This is fundamental signal, the judgment is not applicable.
For fundamental signal judgment was referred to Peak output test.

5. BANDWIDTH TEST

5.1 LIMIT

The bandwidth of the emissions shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. So the emission bandwidth limits have been calculated in below table.

Fundamental Frequency	Limits (MHz)
433.92 MHz	1.0848

5.2 SETTING

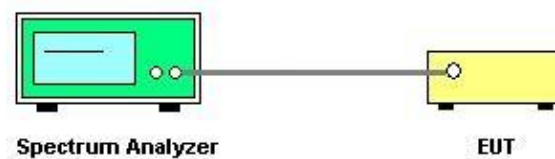
The following table is the setting of the Spectrum Analyzer.

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> 20dB Bandwidth
RB	10 kHz
VB	10 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.3 TEST PROCEDURES

1. The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.
2. The resolution bandwidth of 10 kHz and the video bandwidth of 10 kHz were used.
3. Measured the spectrum width with power higher than 20dB below carrier.

5.4 TEST SETUP LAYOUT



5.5 TEST DEVIATION

There is no deviation with the original standard.

5.6 EUT OPERATION DURING TEST

The EUT was programmed to be in continuously transmitting mode.

5.7 TEST RESULTS

Please refer to the Appendix E.

6. TIMING TESTING

6.1 LIMIT

In addition, 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.

6.2 SETTING

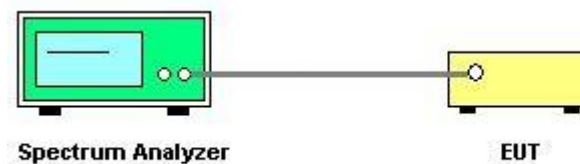
The following table is the setting of the Spectrum Analyzer.

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	Zero Span
RB	1MHz
VB	1MHz
Detector	Peak
Trace	Max Hold
Sweep Time	50 seconds

6.3 TEST PROCEDURES

1. The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.
2. The resolution bandwidth of 1MHz and the video bandwidth of 1MHz were used.

6.4 TEST SETUP LAYOUT



6.5 TEST DEVIATION

There is no deviation with the original standard.

6.6 EUT OPERATION DURING TEST

The EUT was programmed to be in normal mode.

6.7 TEST RESULTS

Please refer to the Appendix F.

7. MEASUREMENT INSTRUMENTS LIST

No.	Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	EMI Receiver	Rohde&Schwarz	ESCI	1166.5950.03	2023/10/14
2	AMN	Rohde&Schwarz	ENV216	3560.6550.05	2023/10/14
3	AMN	Schwarzbeck	NSLK8127	#829	2023/10/14
4	ECSI RF IN RF Cable	Rohde&Schwarz	RP-X1	\	2023/10/14
5	ECSI RF IN RF Cable	Rohde&Schwarz	Sapre sm	\	2023/10/14
6	EMI Receiver	Rohde&Schwarz	ESR7	102013	2023/10/14
7	Spectrum analyzer	Rohde&Schwarz	FSV30	103741	2023/10/17
8	EMI receiver	Rohde&Schwarz	ESU	100184	2023/07/20
9	Spectrum analyzer	KEYSIGHT	N9010A-44	MY51440158	2023/10/17
10	Loop Antenna*	Schwarzbeck	FMZB1519B	00029	2025/07/03
11	Integral Antenna	Schwarzbeck	VULB 9163	VULB 9163-361	2023/10/20
12	Integral Antenna	Schwarzbeck	BBHA 9120D	BBHA 9120D 1201	2023/10/15
13	Integral Antenna	Schwarzbeck	BBHA 9170	9170#685	2023/10/15
14	Preamplifier	CD Systems Inc	PAP-03036-30	85060000	2023/10/15
15	Preamplifier	Schwarzbeck	BBV9721	9721-019	2023/10/15
16	Preamplifier	emci	EMC012645 SE	980417	2023/10/16
17	ECSI RF IN RF Cable	Rohde&Schwarz	AP-X1	\	2023/10/16
18	Spectrum Analyzer	Agilent	N9010A	MY52221119	2023/10/17
19	Power Collection Unit	Tonscend	JS0806-2	188060134	2023/10/16
20	Tonscend Test System	Tonscend	2.6.77.0518	NA	NA
21	10dB Attenuator	Tonscend	10dB	NA	NA
22	Temp&Humidity Recorder	Anymetre	JR900	NA	2023/10/16
23	Temp&Humidity Chamber	ETOMA	NTH1100-30 A	16080628	2023/10/16
24	Filter	STI	STI15-9845	N/A	N/A
25	Filter	STI	5.1G	N/A	N/A
26	Filter	STI	STI15-9845	N/A	N/A
27	Testing Software	EZ-EMC	TW-03A2	N/A	N/A

Remark: "N/A" denotes no model name, serial no. or calibration specified.

"**" calibration period of equipment list is three year.

Except * item, all calibration period of equipment list is one year.

APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS

Test Mode: N/A

Note: "N/A" denotes test is not applicable to this device.

APPENDIX B - RADIATED EMISSION - 9 KHZ TO 30 MHZ

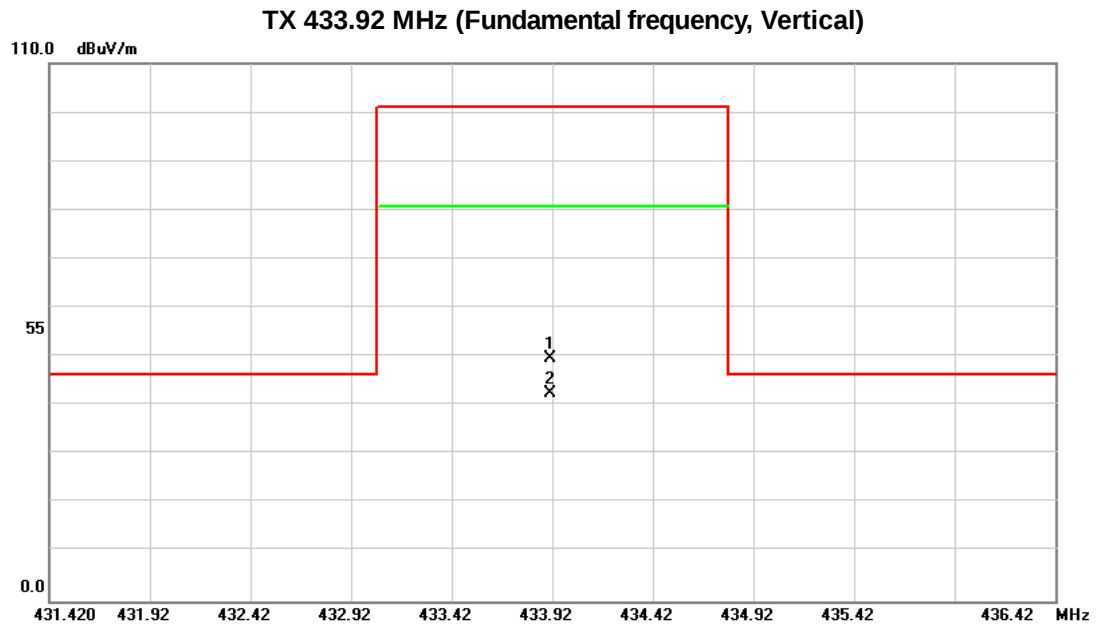
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

APPENDIX C - RADIATED EMISSION - 30MHZ TO 1000MHZ

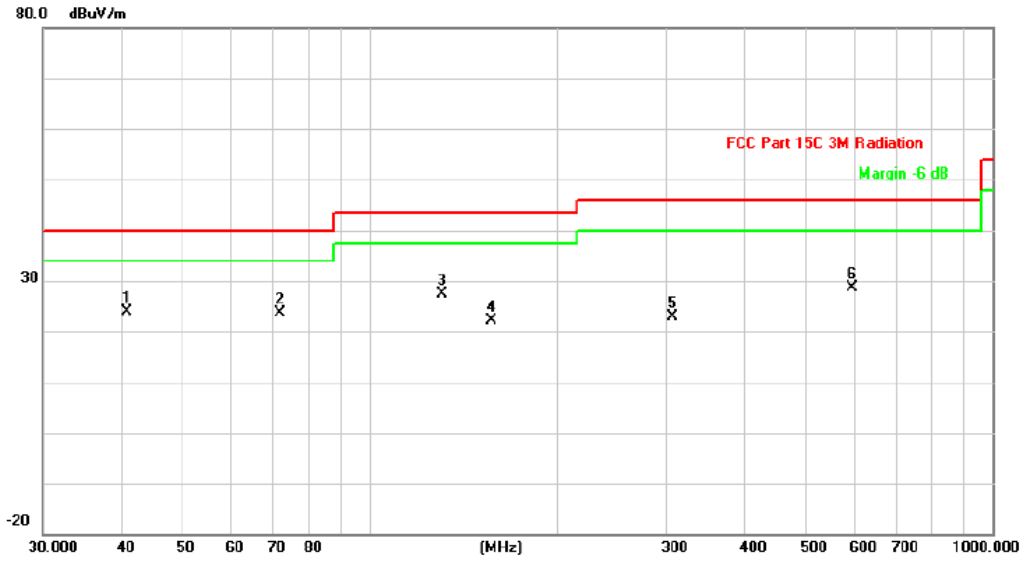
Test Mode: TX Mode

About the duty cycle correction factor calculated, please refer to the page 9



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		433.9100	55.03	-5.38	49.65	100.83	-51.18	peak
2 *		433.9100	47.83	-5.38	42.45	80.83	-38.38	AVG

Radiated Emission

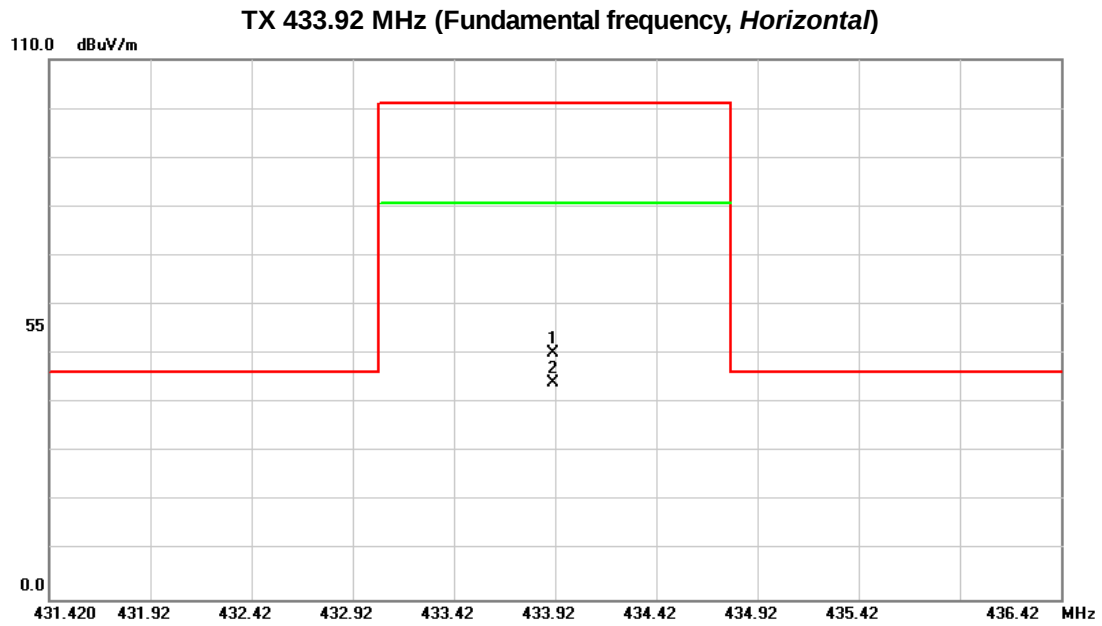


Remark:

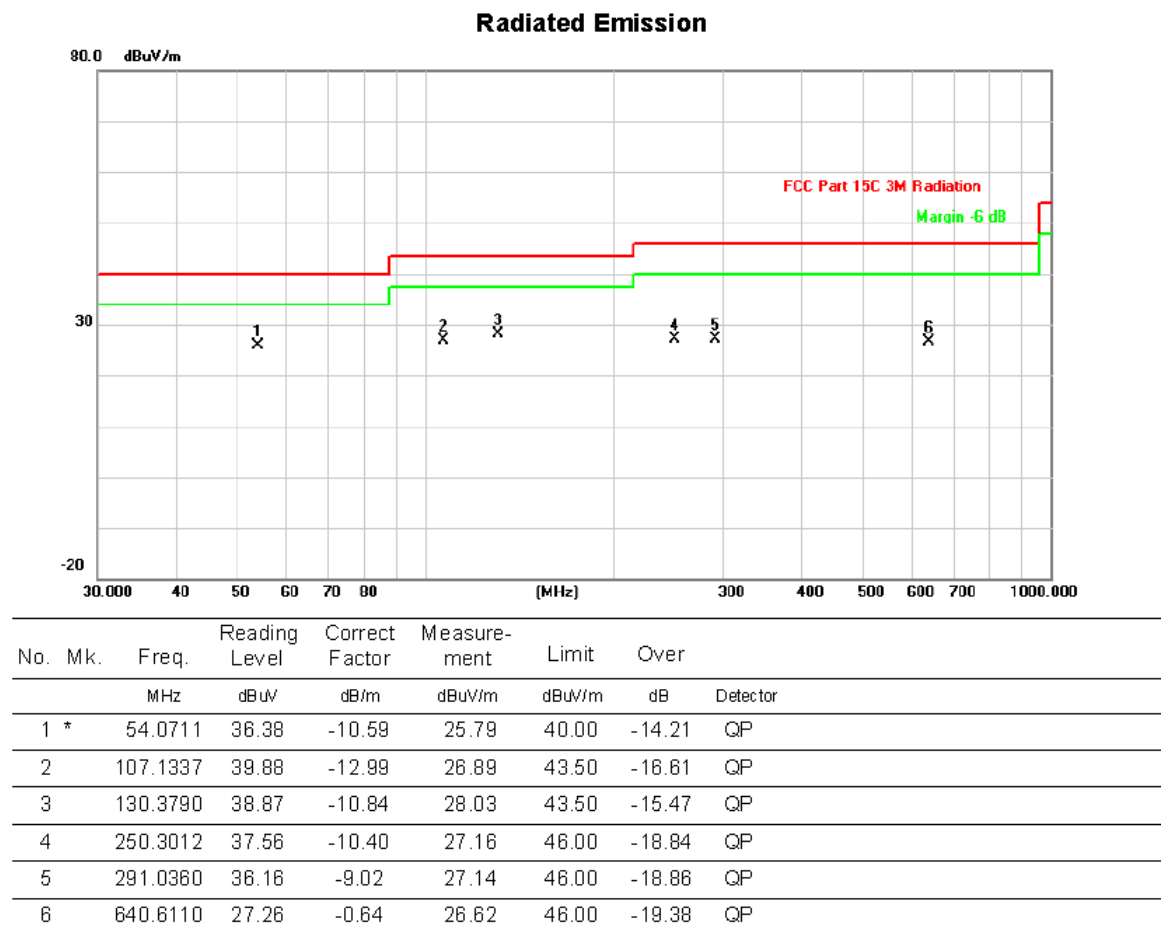
- (1) The average value of fundamental frequency is:
Average = Peak value + 20log(Duty cycle), Final AV=PK – 10.12

Test Mode: TX Mode

About the duty cycle correction factor calculated, please refer to the page 9



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB Detector
1		433.9100	55.51	-5.38	50.13	100.83	-50.70 peak
2 *		433.9100	49.57	-5.38	44.19	80.83	-36.64 AVG



Remark:

- (1) The average value of fundamental frequency is:
Average = Peak value + 20log(Duty cycle), Final AV=PK – 10.12

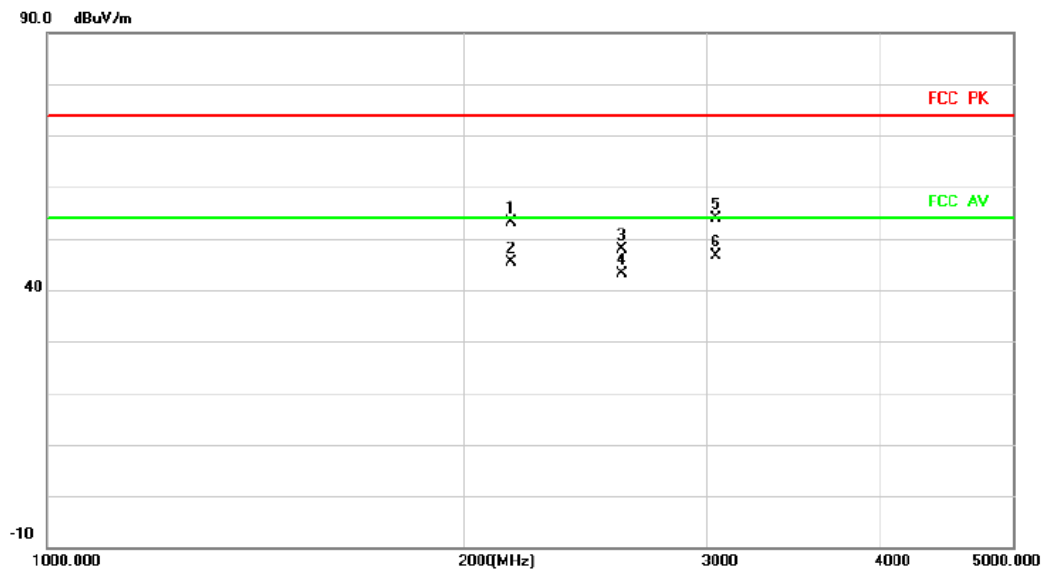
APPENDIX D - RADIATED EMISSION - ABOVE 1000MHz

Test Mode : TX Mode

About the duty cycle correction factor calculated, please refer to the page 9

Vertical

Radiated Emission

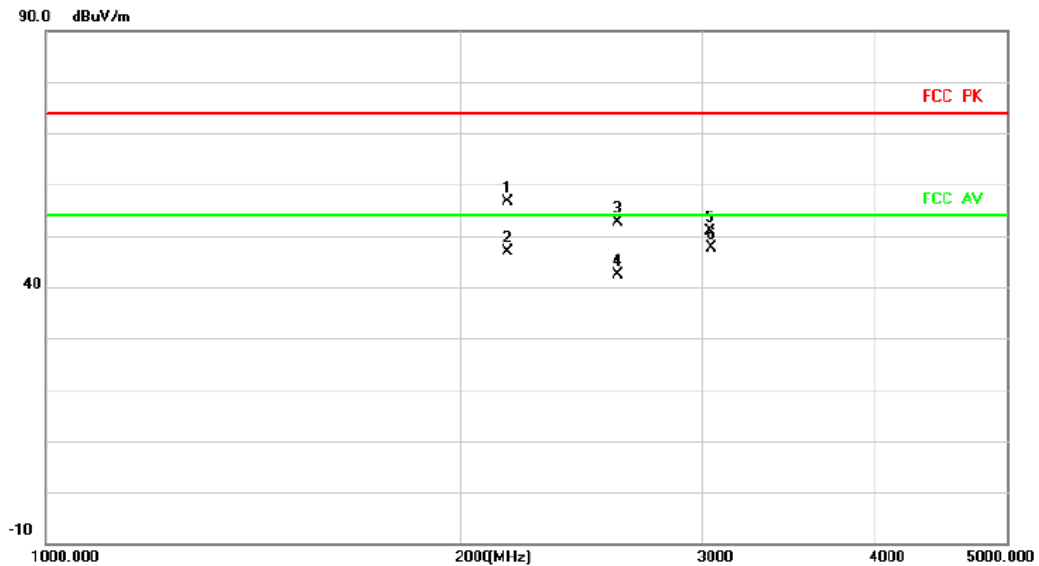


No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2168.725	65.62	-12.55	53.07	74.00	-20.93	peak
2		2168.725	57.88	-12.55	45.33	54.00	-8.67	AVG
3		2605.476	58.68	-10.74	47.94	74.00	-26.06	peak
4		2605.476	53.83	-10.74	43.09	54.00	-10.91	AVG
5		3040.803	62.96	-9.07	53.89	74.00	-20.11	peak
6 *		3040.803	55.79	-9.07	46.72	54.00	-7.28	AVG

Test Mode : TX Mode

About the duty cycle correction factor calculated, please refer to the page 9

Horizontal Radiated Emission

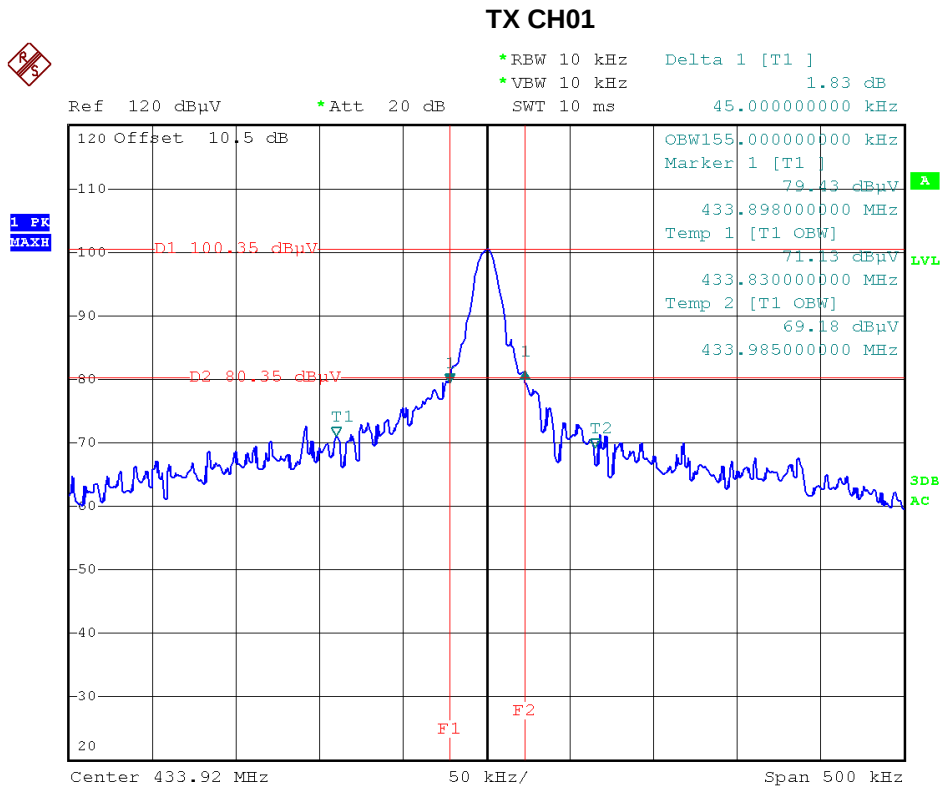


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2168.000	69.12	-12.55	56.57	74.00	-17.43	peak
2		2168.725	59.38	-12.55	46.83	54.00	-7.17	AVG
3		2605.000	63.29	-10.75	52.54	74.00	-21.46	peak
4		2605.476	53.09	-10.74	42.35	54.00	-11.65	AVG
5		3040.000	59.93	-9.08	50.85	74.00	-23.15	peak
6	*	3040.803	56.75	-9.07	47.68	54.00	-6.32	AVG

APPENDIX E - BANDWIDTH

Test Mode : TX Mode

Frequency (MHz)	20dB Bandwidth (MHz)	99% Occupied BW (MHz)	Limits (MHz)
433.92	0.045	0.155	1.0848



Date: 25.DEC.2022 15:15:48

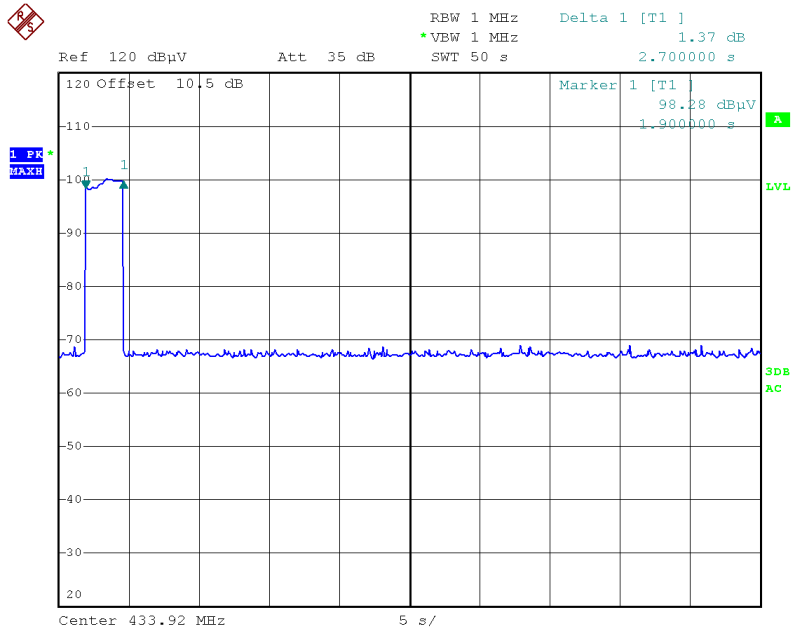
APPENDIX F - TIMING TESTING

Test Mode :	TX Mode
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Frequency (MHz)	On Time (Sec)	Limit (Sec)
433.92	2.7	<5

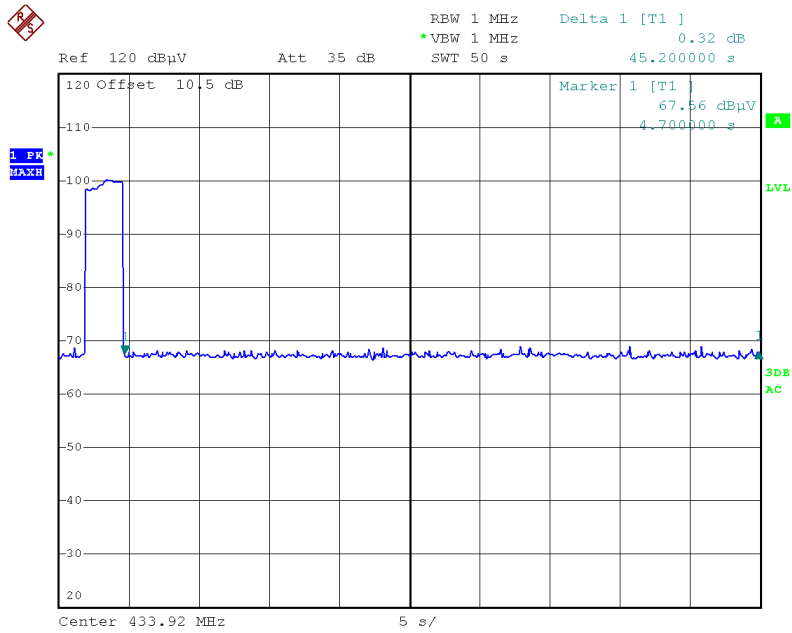
Frequency (MHz)	Off Time (Sec)	Limit (Sec)
433.92	45.2	>10

On Time



Date: 25.DEC.2022 15:24:46

Off Time



Date: 25.DEC.2022 15:25:31

End of Test Report