

TEST REPORT

Reference No...... : WTD22D04076600W V1
FCC ID..... : 2A24X-LLB-64XB
Applicant : AEB Technologies Inc., dba Lunasea Lighting
Address : 9619 W. Yulee Drive, Homosassa, Florida United States 34448
Manufacturer : AEB Technologies Inc., dba Lunasea Lighting
Address : 9619 W. Yulee Drive, Homosassa, Florida United States 34448
Product : LunaSafe
Model(s) : LLB-64xB
Standards : FCC 47CFR Part 15 Subpart C Section 15.231
Date of Receipt sample : 2022-04-22
Date of Test : 2022-04-22 to 2022-05-11
Date of Issue : 2022-05-16
Test Result : **Pass**

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

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3 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTD22D04076600W	2022-04-22	2022-04-22 to 2022-05-11	2022-05-13	Original	-	Replaced
WTD22D04076600W V1	2022-04-22	2022-04-22 to 2022-05-11	2022-05-16	Version 1	Updated	Valid

4 General Information

4.1 General Description of E.U.T.

Product Name: LunaSafe
Model No.: LLB-64xB
Model Difference: N/A
Hardware Version: Rev 1.4
Software Version: PCM-6403-01-BO

4.2 Details of E.U.T.

Frequency Range: 433.92±0.5MHz
Type of Modulation: FSK
The Lowest Oscillator: XTAL: 13.56MHz
Antenna installation: PCB Printed Antenna
Antenna Gain: 1.9dBi
Battery: DC 3V CR2032 Lithium battery

4.3 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode	Channel
Transmitting	433.92MHz

4.4 Test Facility

The test facility has a test site registered with the following organizations:

ISED CAB identifier: CN0013. Test Firm Registration No.: 7760A.

Waltek Testing Group Co., Ltd. Has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files.

Registration number 7760A, October 15, 2016.

FCC Designation No.: CN1201. Test Firm Registration No.: 523476.

Waltek Testing Group Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration number 523476, September 10, 2019.

4.5 Subcontracted

Whether parts of tests for the product have been subcontracted to other labs:

☐ Yes ☒ No

If Yes, list the related test items and lab information:

Test Lab: /

Lab address: /

Test items: /

4.6 Abnormalities from Standard Conditions

None.

5 Equipment Used during Test

5.1 Equipments List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
3m Semi-anechoic Chamber for Radiation Emissions						
1	Test Receiver	R&S	ESCI	101296	2021-04-26 2022-04-22	2022-04-25 2023-04-21
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2021-10-30	2022-10-29
3	Amplifier	ANRITSU	MH648A	M43381	2021-04-26 2022-04-22	2022-04-25 2023-04-21
4	Cable	HUBER+SUHNER	CBL2	525178	2021-04-26 2022-04-22	2022-04-25 2023-04-21
5	Spectrum Analyzer	R&S	FSP30	100091	2021-04-26 2022-04-22	2022-04-25 2023-04-21
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	2022-04-30 2022-04-25	2023-04-29 2023-04-24
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2021-07-26	2022-07-25
RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	Spectrum Analyzer	Agilent	N9020A	MY49100060	2021-07-26	2022-07-25
2	Spectrum Analyzer	R&S	FSP30	100091	2021-04-26 2022-04-22	2022-04-25 2023-04-21
3	Humidity Chamber	GF	GTH-225-40-1P	IAA061213	2021-07-26	2022-07-25
4	EXA Signal Analyzer	Keysight	N9010A	MY50520207	2021-04-26 2022-04-22	2022-04-25 2023-04-21

5.2 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-6}$
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Radiated Spurious Emissions test	± 5.03 dB (30M~1000MHz)
	± 5.47 dB (1000M~25000MHz)
Confidence interval:95%. Confidence factor: k=2	

5.3 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R. China.

6 Test Summary

Test Items	Test Requirement	Result
Conduct Emission	15.207	N/A*
Radiated Spurious Emissions	15.205(a) 15.209 15.231(a)	Pass
Periodic Operation	15.231(a)	Pass
Emission Bandwidth	15.231(c)	Pass
Antenna Requirement	15.203	Pass
Note: Pass=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable *: The EUT is only powered by battery, no need to evaluate AC Power Conducted Emission.		

7 Radiated Spurious Emissions

Test Requirement: FCC Part15 §15.231(a), (b)

Test Method: ANSI C63.10:2013

Test Result: PASS

Measurement Distance: 3m

Limit:

Fundamental Frequency (MHz)	Field Strength of Fundamental (uV/m)	Field Strength of Fundamental (dBuV/m)	Field Strength of Spurious Emission (uV/m)	Field Strength of Spurious Emission (dBuV/m)
44.66-40.70	2250	67	225	47
70-130	1250	62	125	42
130-174	1250 to 3750	62 to 71.48	125 to 375	42 to 51.48
174-260	3750	71.48	375	51.48
260-470	3750 to 12500	71.48 to 81.94	375 to 1250	51.48 to 61.94
Above 470	12500	81.94	1250	61.94
aa** linear interpolations				

7.1 EUT Operation

Operating Environment:

Temperature: 21.5 °C

Humidity: 53.4 % RH

Atmospheric Pressure: 101.3kPa

Test Voltage: DC 3V by Battery

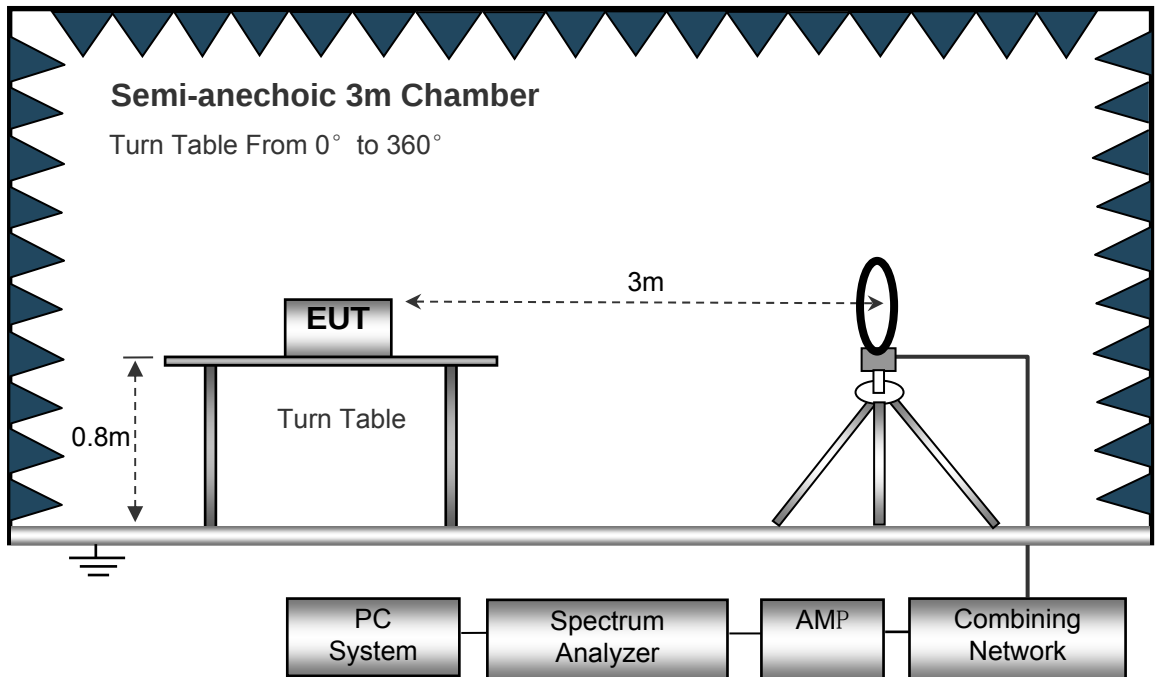
EUT Operation:

The test was performed in transmitting mode, the test data were shown in the report.

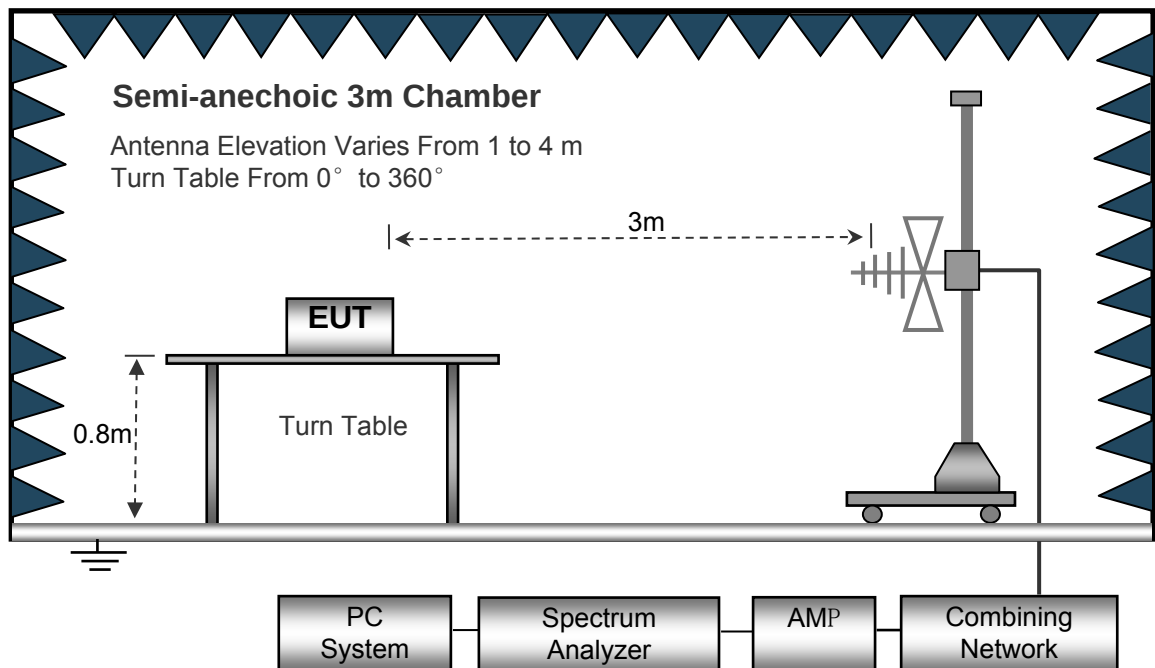
7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10.

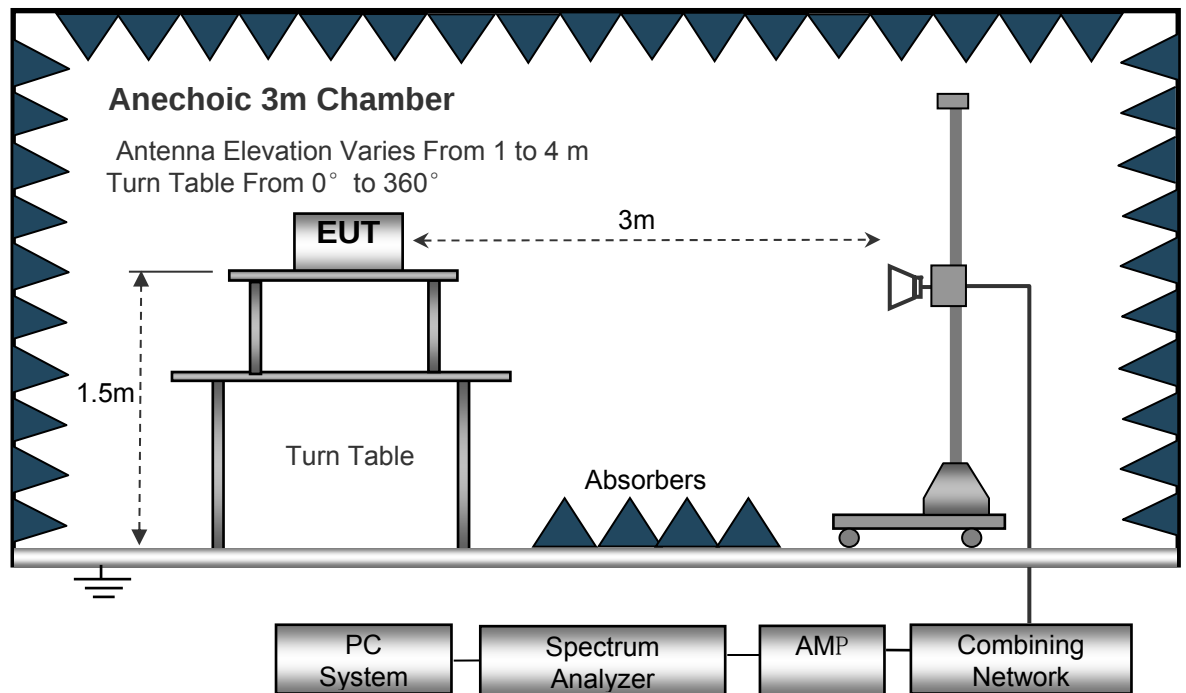
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.



7.3 Spectrum Analyzer Setup

Below 30MHz

Sweep SpeedAuto
IF Bandwidth.....10kHz
Video Bandwidth.....10kHz
Resolution Bandwidth.....10kHz

30MHz ~ 1GHz

Sweep SpeedAuto
DetectorPK
Resolution Bandwidth.....100kHz
Video Bandwidth.....300kHz

Above 1GHz

Sweep SpeedAuto
DetectorPK
Resolution Bandwidth.....1MHz
Video Bandwidth.....3MHz

7.4 Test Procedure

1. The EUT is placed on a turntable. For below 1GHz, the EUT is 0.8m above ground plane; For above 1GHz, the EUT is 1.5m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
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.

7.5 Summary of Test Results

Test Frequency: 9 kHz~30 MHz

Note: Lowest frequency generated in the device is above 30MHz, frequency range of measurement should be above 30MHz.

Test Frequency: 30MHz ~ 5GHz

Frequency	Receiver Reading	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.231/15.209/205	
	(PK)		Height	Polar		(PK)	Limit	Margin
(MHz)	(dBμV)	Degree	(m)	(H/V)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)
433.92	69.37	303	2.1	H	-11.87	57.5	100.8	-43.30
433.92	59.47	74	2	V	-11.87	47.6	100.8	-53.20
867.84	55.27	59	2.1	H	-3.47	51.8	80.8	-29.00
867.84	44.81	317	1.1	V	-3.47	41.34	80.8	-39.46
1735.68	59.32	284	1	H	-10.19	49.13	80.8	-31.67
1735.68	55.88	80	2.2	V	-12.15	43.73	80.8	-37.07
2169.60	61.99	225	1	H	-11.75	50.24	80.8	-30.56
2169.60	62.06	34	2.3	V	-11.75	50.31	80.8	-30.49

Note: the measurements were more than 20 dB below the limit and not reported.

AV = Peak +20Log₁₀(duty cycle) =PK+(-7.64) (refer to section 8 for more detail)

Frequency	PK	RX Antenna Polar	Duty cycle Factor	Result	FCC Part 15.231/209/205	
					Limit	Margin
(MHz)	(dBμV/m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
433.92	57.5	H	-7.64	49.86	80.8	-30.94
433.92	47.6	V	-7.64	39.96	80.8	-40.84
867.84	51.8	H	-7.64	44.16	60.8	-16.64
867.84	41.34	V	-7.64	33.7	60.8	-27.10
1735.68	49.13	H	-7.64	41.49	60.8	-19.31
1735.68	43.73	V	-7.64	36.09	60.8	-24.71
2169.60	50.24	H	-7.64	42.6	60.8	-18.20
2169.60	50.31	V	-7.64	42.67	60.8	-18.13

8 Periodic Operation

The duty cycle was determined by the following equation:

To calculate the actual field intensity, the duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

Duty Cycle(%)=Total On interval in a complete pulse train/ Length of a complete pulse train * %

Duty Cycle Correction Factor(dB)=20 * Log₁₀(Duty Cycle (%))

Total transmission time(ms)	1.49*1+0.19*22+0.38*47+0.2*18=27.13
Length of a complete transmission period(ms)	65.38
Duty Cycle (%)	41.50
Duty Cycle Correction Factor(dB)	-7.64

Refer to the duty cycle plot (as below), this device meets the FCC requirement.

Length of a complete pulse train:

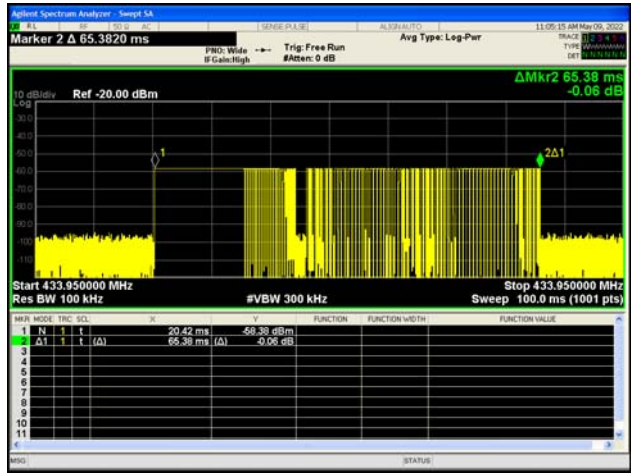
Remark:

According to FCC part15.35(c) required that a complete pulse train is more than 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

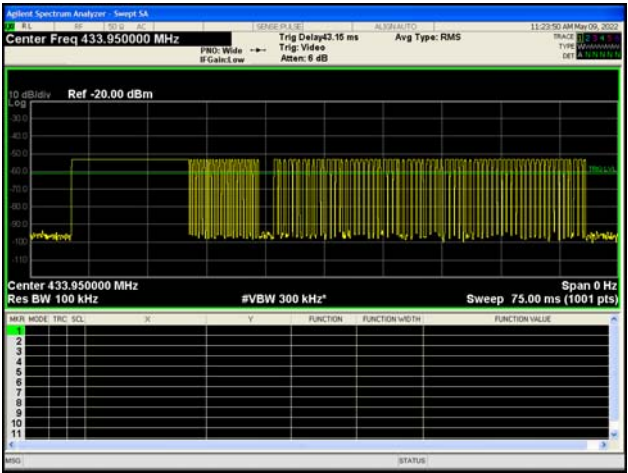
Refer to the duty cycle plot (as below)

Test Plot

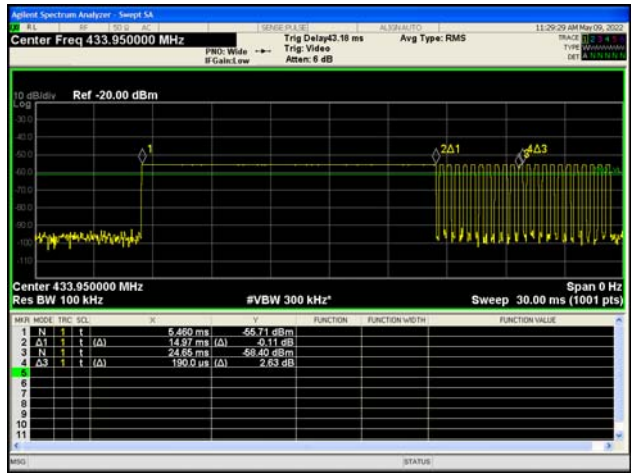
Period-100ms



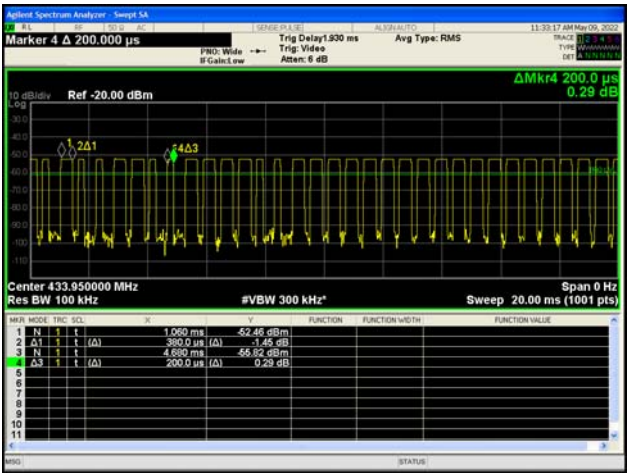
Period-75ms



Pulse T_{on-1}



Pulse T_{on-2}



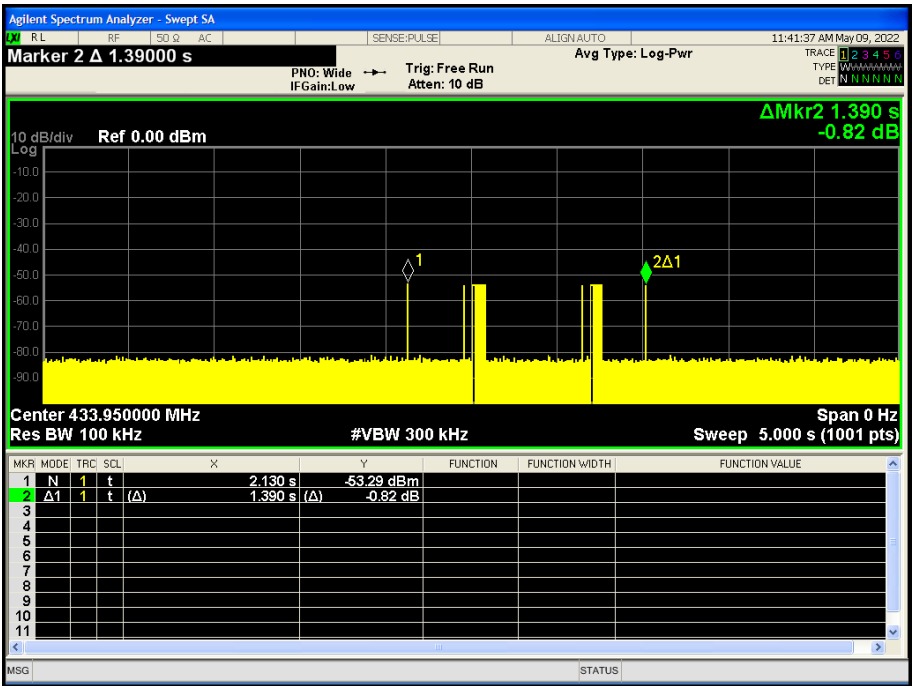
According to FCC Part15.231(a)

- (1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.
- (2)A transmitter activated automatically shall cease transmission within 5 seconds after activation.

Test result

Duration Time (ms)	Limit (s)	Result
139	<5.0	Compliance

Test Plot



9 Emission Bandwidth

Test Requirement: FCC Part15.231(c)

Test Method: FCC Part15.231(c)

Limit 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.

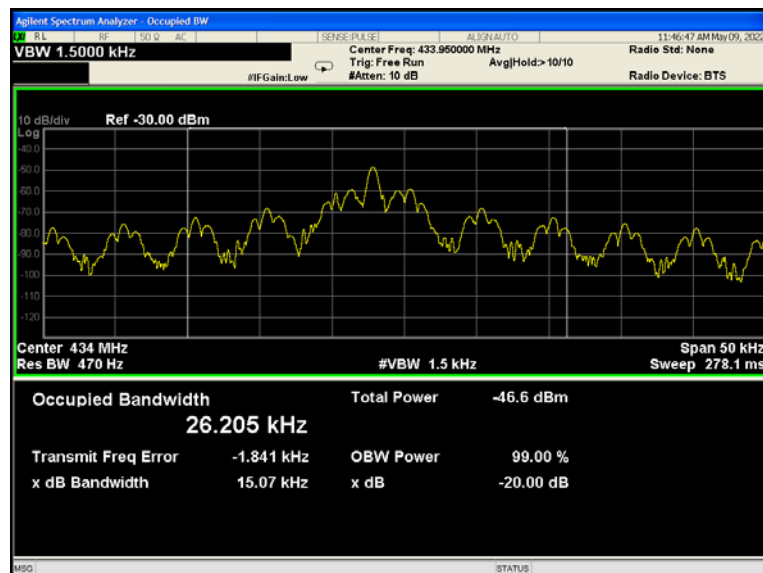
9.1 Test Procedure

1. The transmitter output (antenna port) was connected to the spectrum analyzer. EUT and its simulators are placed on a table, let EUT working in test mode, then test it.
2. The bandwidth of the fundamental frequency was measure by spectrum analyser with:
RBW=1% to 5% of OBW, VBW=3 times of RBW.
The 20 dB bandwidth and 99% bandwidth were recorded.

9.2 Test Result

Frequency (MHz)	20dB Bandwidth Emission(kHz)	99% Bandwidth Emission(kHz)	Limit (kHz)	Result
433.92	15.07	26.205	1084.5	Compliance

Test Plot



10 Antenna Requirement

According to the FCC Part 15 Paragraph 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.

This product has an integrated antenna fulfil the requirement of this section.

Note: Please refer to EUT photos for more details.

11 Photographs –Test Setup and EUT

Note: Please refer to appendix: Appendix_ LLB-64xB_Photos.

=====End of Report=====