

TEST REPORT

Reference No..... : WTH21X06053104W
FCC ID : 2A24X-LLB-63XB
Applicant : AEB Technologies Inc, dba Lunasea Lighting
Address..... : 9619 W. Yulee Drive, Homosassa, FL 34448
Product Name : LunaSafe
Test Model. : LLB-63xB Series
Standards : FCC Part 15.231
Date of Receipt sample : Jun. 01, 2021
Date of Test..... : Jun. 01, 2021 to Oct. 18, 2021
Date of Issue : Oct. 18, 2021
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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Report version

Version No.	Date of issue	Description
Rev.00	Oct. 18, 2021	Original
/	/	/

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: AEB Technologies Inc, dba Lunasea Lighting
Address of applicant: 9619 W. Yulee Drive, Homosassa, FL 34448

Manufacturer: AEB Technologies Inc, dba Lunasea Lighting
Address of manufacturer: 9619 W. Yulee Drive, Homosassa, FL 34448

General Description of EUT	
Product Name:	LunaSafe
Trade Name:	Lunasea Lighting
Model No.:	LLB-63xB Series
Adding Model(s):	/
Rated Voltage:	Battery DC 3.7V
Power Adaptor :	/
Note: The test data is gathered from a production sample provided by the manufacturer.	

Technical Characteristics of EUT	
Frequency Range:	433.92 MHz
Max. Field Strength:	433.92MHz: 76.24dBuV/m(3m)
Modulation:	FSK
Antenna Type:	PCB Antenna
Antenna Gain:	1.9dBi

1.2 Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.231: Periodic operation in the band 40.66-40.70MHz and above 70MHz.

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission/immunity, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

1.4 Test Facility

Address of the test laboratory

Laboratory: Waltek Testing Group (Shenzhen) Co., Ltd.

Address: 1/F., Room 101, Building 1, Hongwei Industrial Park, Liuxian 2nd Road, Block 70 Bao'an District, Shenzhen, Guangdong, China

FCC – Registration No.: 125990

Waltek Testing Group (Shenzhen) 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. The Designation Number is CN5010, and Test Firm Registration Number is 125990.

Industry Canada (IC) Registration No.: 11464A

The 3m Semi-anechoic chamber of Waltek Testing Group (Shenzhen) Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

1.5 EUT Setup and Test Mode

The EUT was operated at continuous transmitting mode that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	Transmitting	433.92MHz

Test Conditions	
Temperature:	22~25 °C
Relative Humidity:	50~55 %.
ATM Pressure:	1019 mbar

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
Occupied Bandwidth	Conducted	± 1.5%
Conducted Spurious Emission	Conducted	± 2.17dB
Transmission Time	Conducted	± 5%
Conducted Emissions	Conducted	9-150kHz ± 3.74dB
		0.15-30MHz ± 3.34dB
Transmitter Spurious Emissions	Radiated	30-200MHz ± 4.52dB
		0.2-1GHz ± 5.56dB
		1-6GHz ± 3.84dB
		6-18GHz ± 3.92dB

1.7 Test Equipment List and Details

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due. Date
SEMT-1075	Communication Tester	Rohde & Schwarz	CMW500	148650	2021-03-27	2022-03-26
SEMT-1063	GSM Tester	Rohde & Schwarz	CMU200	114403	2021-03-27	2022-03-26
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2021-03-27	2022-03-26
SEMT-1079	Spectrum Analyzer	Agilent	N9020A	US47140102	2021-03-27	2022-03-26
SEMT-1080	Signal Generator	Agilent	83752A	3610A01453	2021-03-27	2022-03-26
SEMT-1081	Vector Signal Generator	Agilent	N5182A	MY47070202	2021-03-27	2022-03-26
SEMT-1028	Power Divider	Weinschel	1506A	PM204	2021-03-27	2022-03-26
SEMT-1082	Power Divider	RF-Lambda	RFLT4W5M18G	14110400027	2021-03-27	2022-03-26
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2021-03-27	2022-03-26
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2021-03-27	2022-03-26
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2021-04-12	2022-04-11
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2021-04-12	2022-04-11
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2021-03-19	2023-03-18
SEMT-1068	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2021-03-19	2023-03-18
SEMT-1042	Horn Antenna	ETS	3117	00086197	2021-03-19	2023-03-18
SEMT-1121	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170582	2021-04-27	2023-04-26
SEMT-1169	Pre-amplifier	Direction Systems Inc.	PAP-2640	14145-14153	2021-04-27	2022-04-26
SEMT-1163	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2021-03-27	2022-03-26
SEMT-1166	Power Limiter	Agilent	N9356B	MY45450376	2021-03-27	2022-03-26
SEMT-1076	RF Switcher	Top Precision	RCS03-A2	/	2021-03-19	2023-03-18
SEMT-C001	Cable	Zheng DI	LL142-07-07-10M(A)	/	/	/
SEMT-C002	Cable	Zheng DI	ZT40-2.92J-2.92J-6M	/	/	/
SEMT-C003	Cable	Zheng DI	ZT40-2.92J-2.92J-2.5M	/	/	/
SEMT-C004	Cable	Zheng DI	2M0RFC	/	/	/
SEMT-C005	Cable	Zheng DI	1M0RFC	/	/	/
SEMT-C006	Cable	Zheng DI	1M0RFC	/	/	/

Software List			
Description	Manufacturer	Model	Version
EMI Test Software (Radiated Emission)*	Farad	EZ-EMC	RA-03A1
EMI Test Software (Conducted Emission)*	Farad	EZ-EMC	RA-03A1

*Remark: indicates software version used in the compliance certification testing.

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 15.203	Antenna Requirement	Compliant
§15.205	Restricted Band of Operation	Compliant
§ 15.209	Radiated Spurious Emissions	Compliant
§15.231(a)	Deactivation Testing	Compliant
§15.231(b)	Radiated Emissions	Compliant
§15.231(c)	20dB Bandwidth Testing	Compliant
§ 15.207(a)	Conducted Emission	N/A

N/A: not applicable.

3. Antenna Requirement

3.1 Standard Applicable

According to FCC Part 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.

3.2 Test Result

This product has a PCB antenna, fulfill the requirement of this section.

4. Radiated Emissions

4.1 Standard Applicable

According to §15.231(b), 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	2,250	225
70 - 130	1,250	125
130 - 174	1,250 to 3,750 **	125 to 375 **
174 - 260	3,750	375
260 - 470	3,750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

** linear interpolations

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.

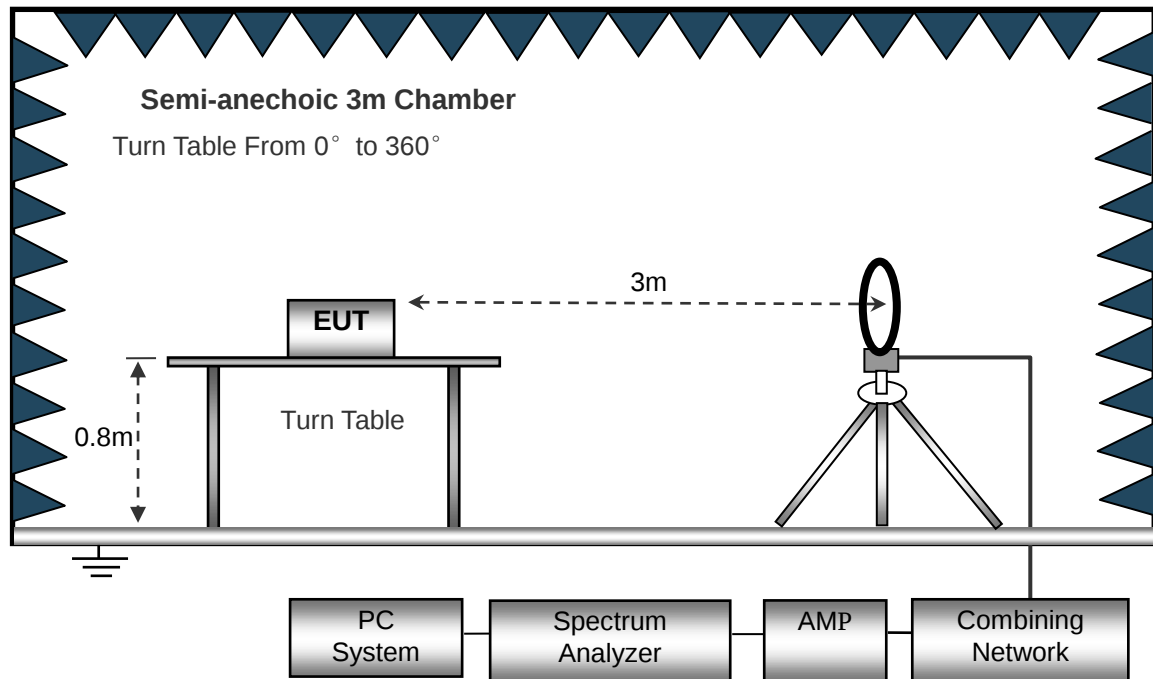
The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

Compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

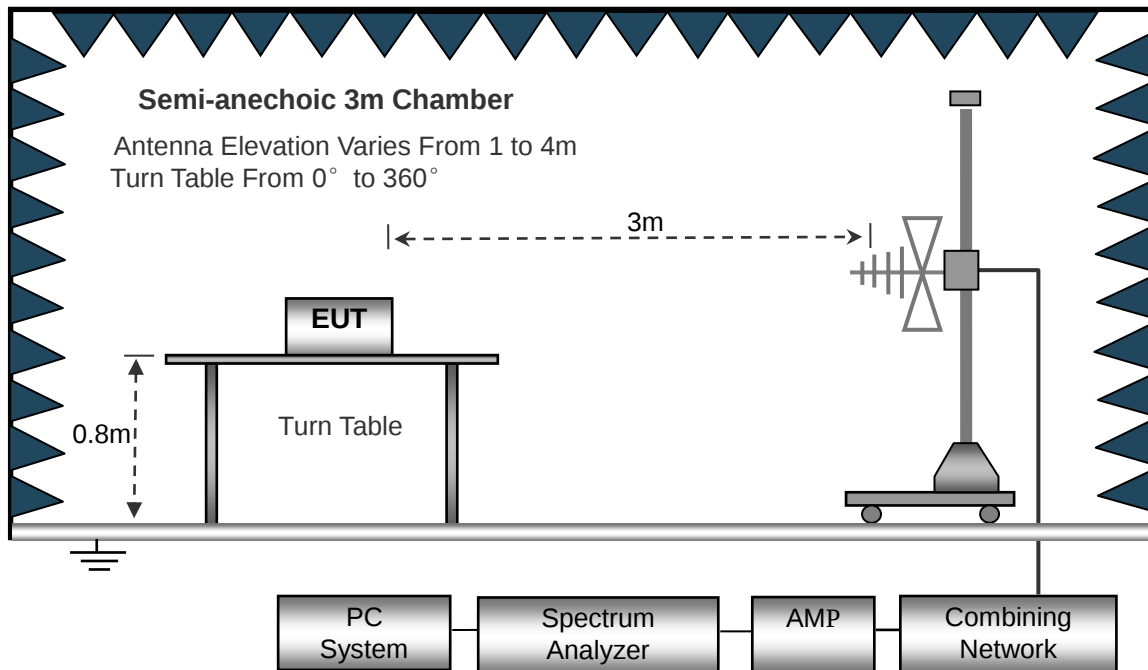
4.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.231(b) and FCC Part 15.209 Limit.

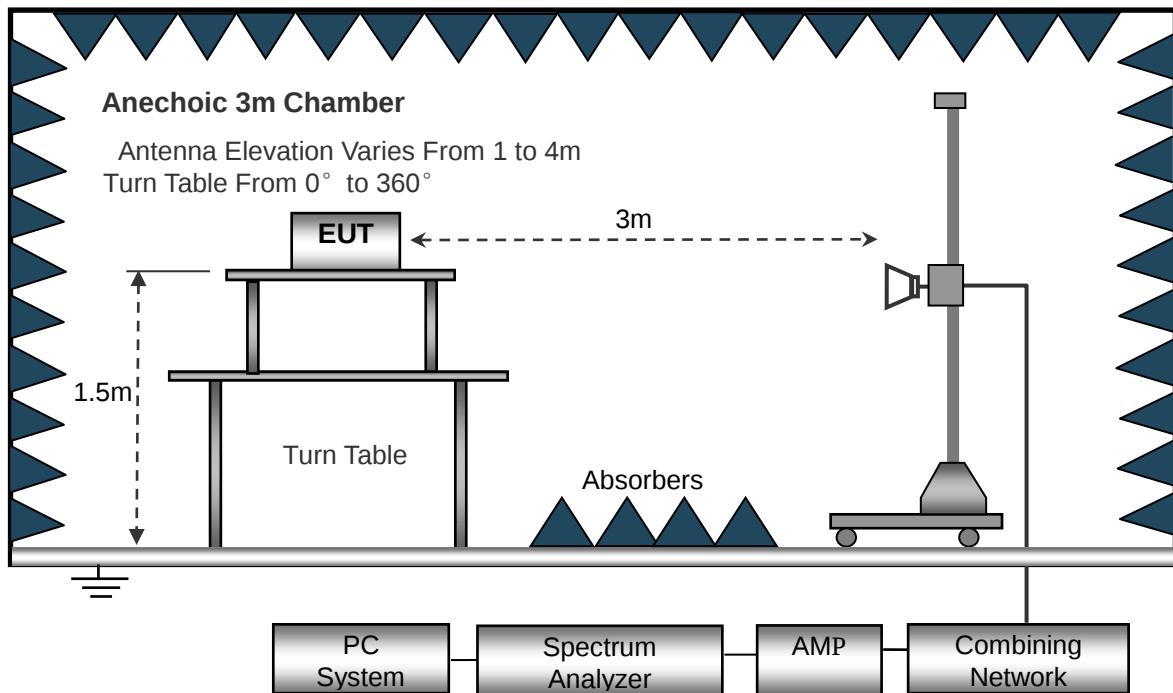
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1GHz.



4.3 Corrected Amplitude & Margin Calculation

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

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Ant. Loss} + \text{Cab. Loss} - \text{Ampl. Gain}$$

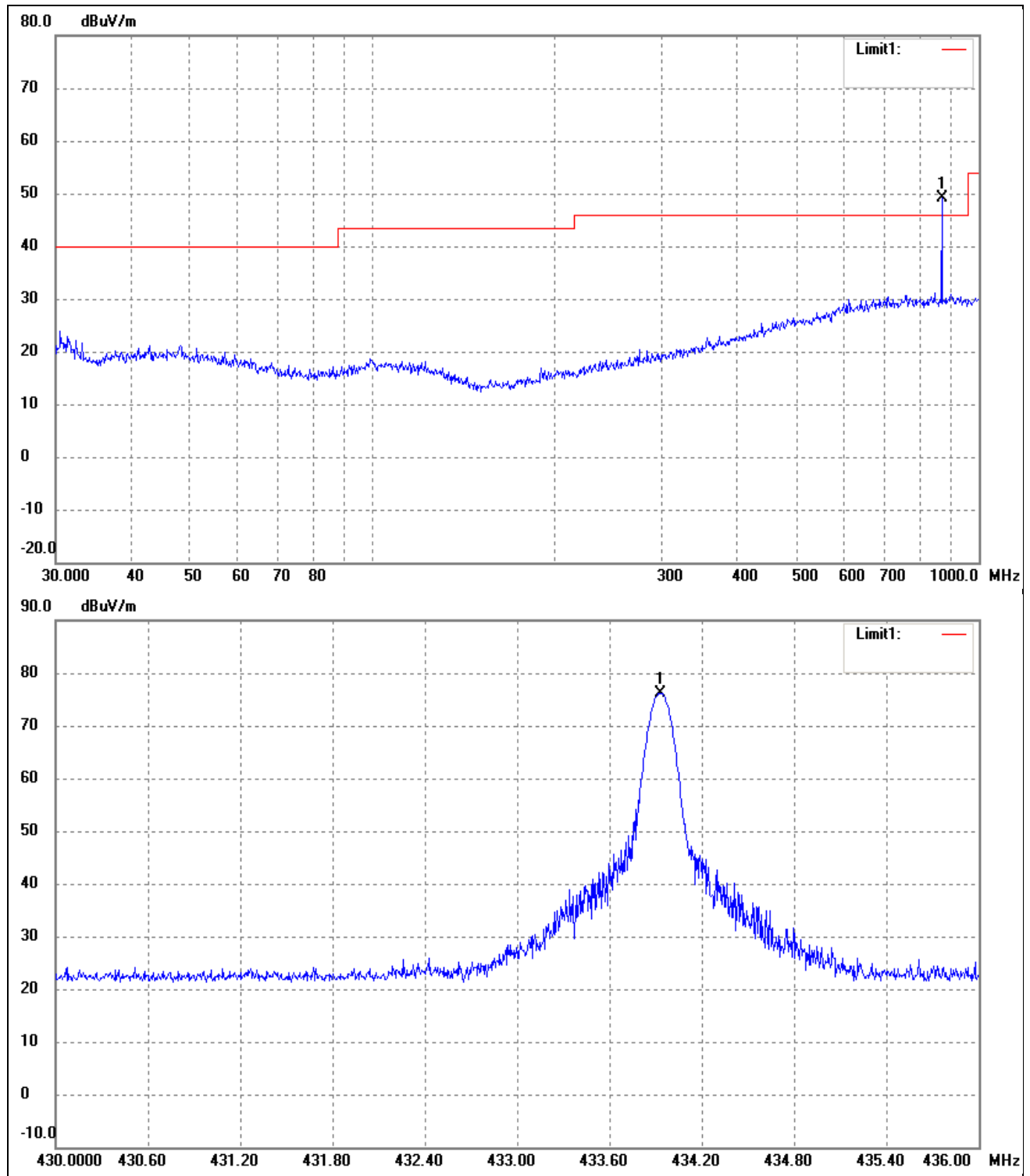
The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15C Limit}$$

4.4 Summary of Test Results/Plots

Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

Test Mode	TM1	Polarity:	Horizontal
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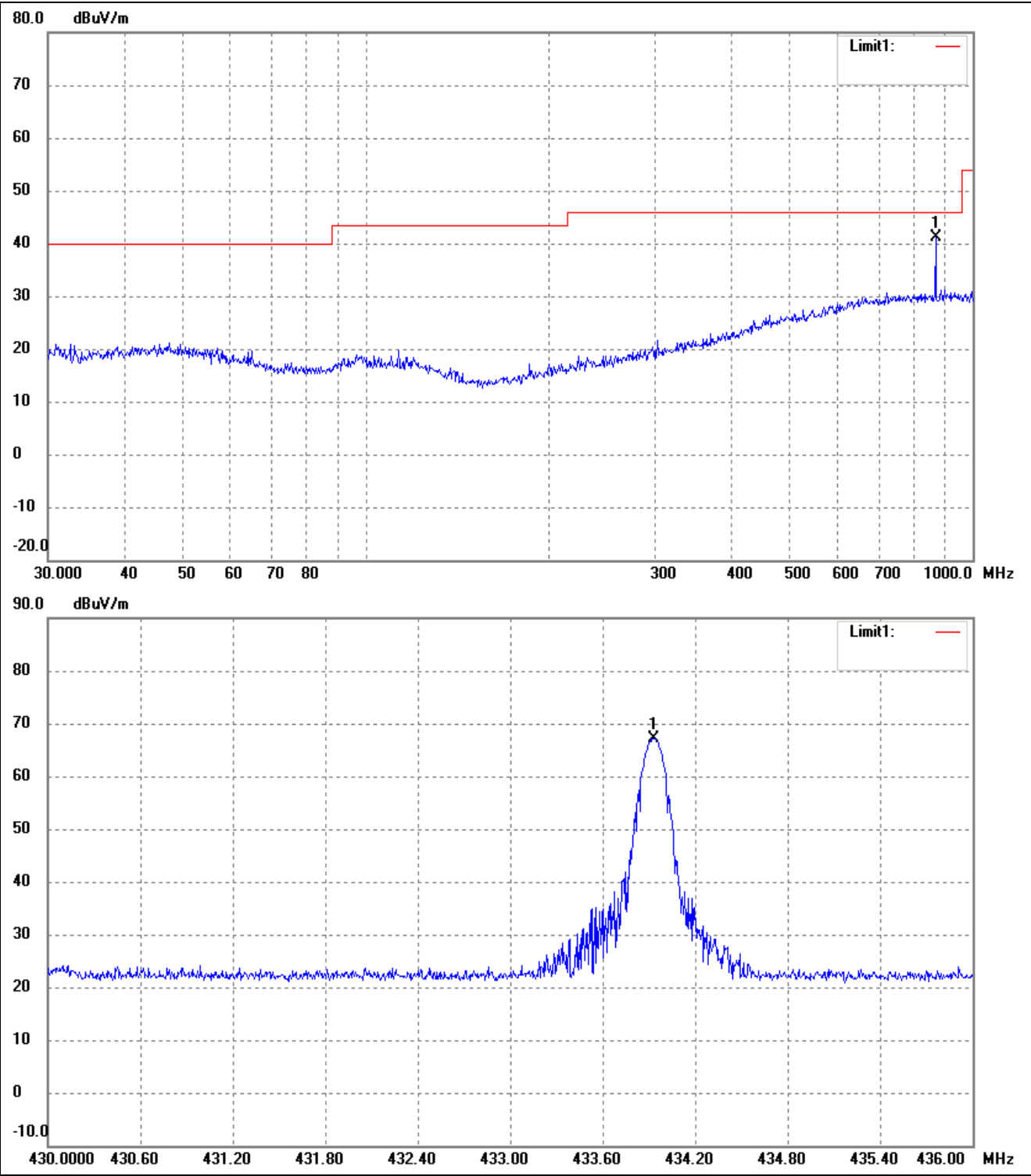


No.	Frequency	Reading	Corr.	Dutycycle	Result	Limit	Margin	Deg.	Height	Remark
	MHz	dBuV/m	Factor(dB)	Factor(dB)	dBuV/m	dBuV/m	(dB)	(°)	(cm)	
1	433.9300	80.74	-4.5	N/A	76.24	100.83	-24.59	140	100	peak
	433.9300	/	/	-3.54	72.7	80.83	-8.13	217	100	Ave
2	869.1302	46.60	2.52	N/A	49.12	81.00	-31.88	16	100	peak
	869.1302	/	/	-3.54	45.58	61.00	-15.42	309	100	Ave

Above 1GHz

No.	Frequency	Reading	Corr.	Dutycycle	Result	Limit	Margin	Deg.	Height	Remark
	MHz	dBuV/m	Factor(dB)	Factor(dB)	dBuV/m	dBuV/m	dB	(°)	(cm)	
1	2168.51	61.37	-9.95	N/A	51.42	81	-29.58	105	150	Peak
	2168.51	/	/	-3.54	47.88	61	-13.12	141	150	Ave
2	2603.351	60.61	-9.15	N/A	51.46	81	-29.54	218	150	Peak
	2603.351	/	/	-3.54	47.92	61	-13.08	41	150	Ave
3	3037.063	68.85	-8.53	N/A	60.32	81	-20.68	150	150	Peak
	3037.063	/	/	-3.54	56.78	61	-4.22	164	150	Ave

Test Mode	TM1	Polarity:	Vertical
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No.	Frequency	Reading	Corr.	Dutycycle	Result	Limit	Margin	Deg.	Height	Remark
	MHz	dBuV/m	Factor(dB)	Factor(dB)	dBuV/m	dBuV/m	(dB)	(°)	(cm)	
1	433.9300	71.67	-4.5	N/A	67.17	100.83	-33.66	136	100	peak
	433.9300	/	/	-3.54	63.63	80.83	-17.20	226	100	Ave
2	869.1302	38.50	2.52	N/A	41.02	81.00	-39.98	10	100	peak
	869.1302	/	/	-3.54	37.48	61.00	-23.52	304	100	Ave

Above 1GHz

No.	Frequency	Reading	Corr.	Dutycycle	Result	Limit	Margin	Deg.	Height	Remark
	MHz	dBuV/m	Factor(dB)	Factor(dB)	dBuV/m	dBuV/m	dB	(°)	(cm)	
1	2168.51	60.22	-9.95	N/A	50.27	81	-30.73	111	150	Peak
	2168.51	/	/	-3.54	46.73	61	-14.27	136	150	Ave
2	2603.351	64.08	-9.15	N/A	54.93	81	-26.07	222	150	Peak
	2603.351	/	/	-3.54	51.39	61	-9.61	42	150	Ave
3	3037.063	55.99	-8.53	N/A	47.46	81	-33.54	145	150	Peak
	3037.063	/	/	-3.54	43.92	61	-17.08	161	150	Ave

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

5. 20dB Bandwidth

5.1 Standard Applicable

According to FCC Part 15.231(c), the bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz. Bandwidth is determined at the points 20dB down from the modulated carrier.

5.1 Test Procedure

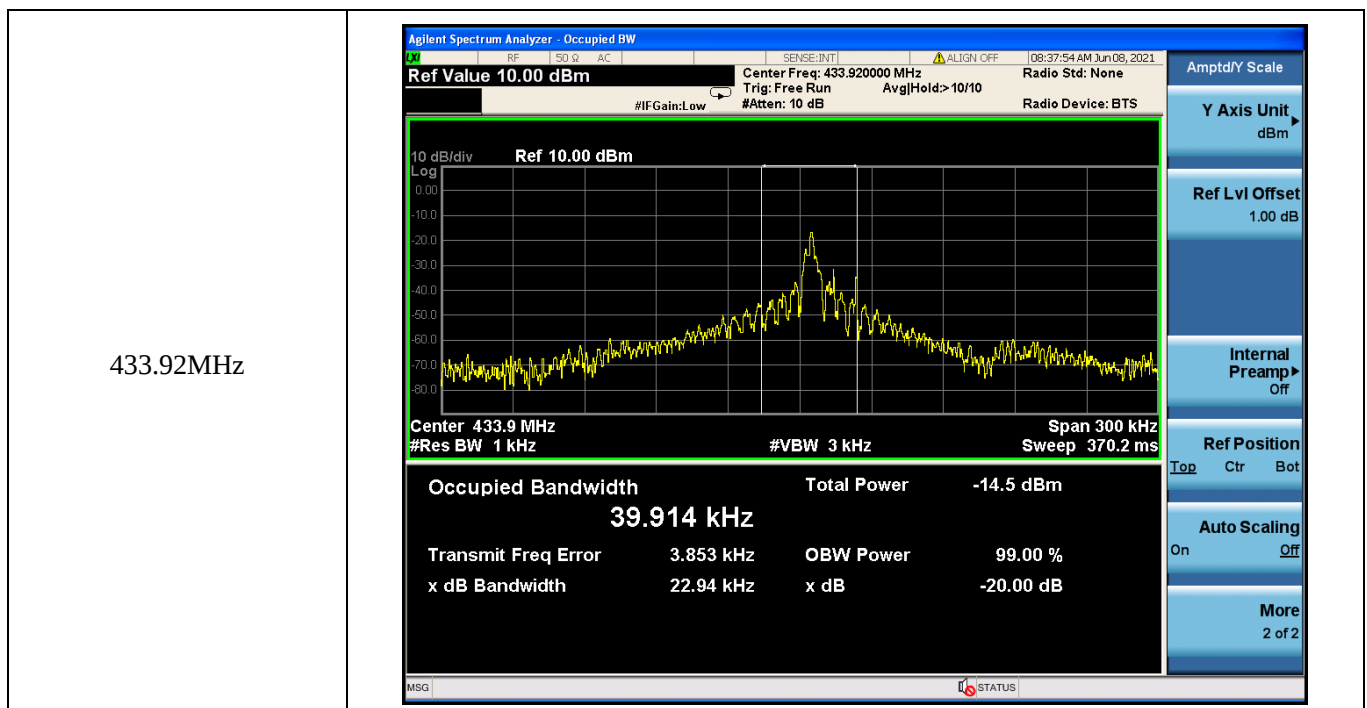
With the EUT's antenna attached, the EUT's 20dB Bandwidth power was received by the test antenna, which was connected to the spectrum analyzer with the START, and STOP frequencies set to the EUT's operation band.

5.2 Summary of Test Results/Plots

Test Frequency MHz	20dB Bandwidth kHz	Limit kHz	Result
433.92	22.94	1084.8	Pass

Limit = Fundamental Frequency X 0.25% = 433.92MHz X 0.25% = 1084kHz

Please refer to the attached plots.



6. Transmission Time

6.1 Standard Applicable

According to FCC Part 15.231(a), the transmitter shall be complied the following requirements:

- 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.
- (3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

6.2 Test Procedure

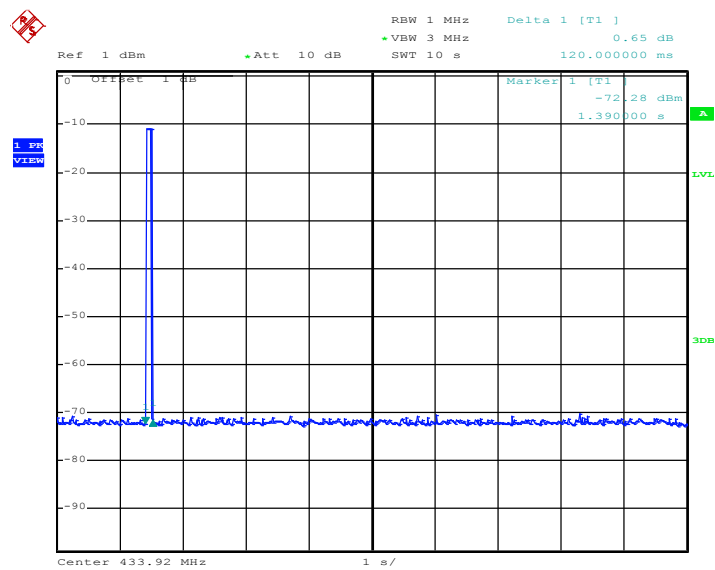
With the EUT's antenna attached, the EUT's output signal was received by the test antenna, which was connected to the spectrum analyzer. Set the center frequency to 433.92MHz, than set the spectrum analyzer to Zero Span for the release time reading. During the testing, the switch was released then the EUT automatically deactivated.

6.3 Summary of Test Results/Plots

Transmission Type	Test Frequency(MHz)	Transmission Time(s)	Limit(s)	Result
Manually	433.92	0.120	5	Pass

Please refer to the attached plots

433.92MHz



Date: 18.OCT.2021 18:39:54

7. Duty Cycle

7.1 Standard Applicable

According to FCC Part 15.231 (b)(2) and 15.35 (c), for pulse operation transmitter, the averaging pulsed emissions are calculated by peak value of measured emission plus duty cycle factor.

7.2 Test Procedure

With the EUT's antenna attached, the EUT's output signal was received by the test antenna, which was connected to the spectrum analyzer. Set the center frequency to 433.92MHz, than set the spectrum analyzer to Zero Span for the release time reading. During the testing, the switch was released then the EUT automatically deactivated.

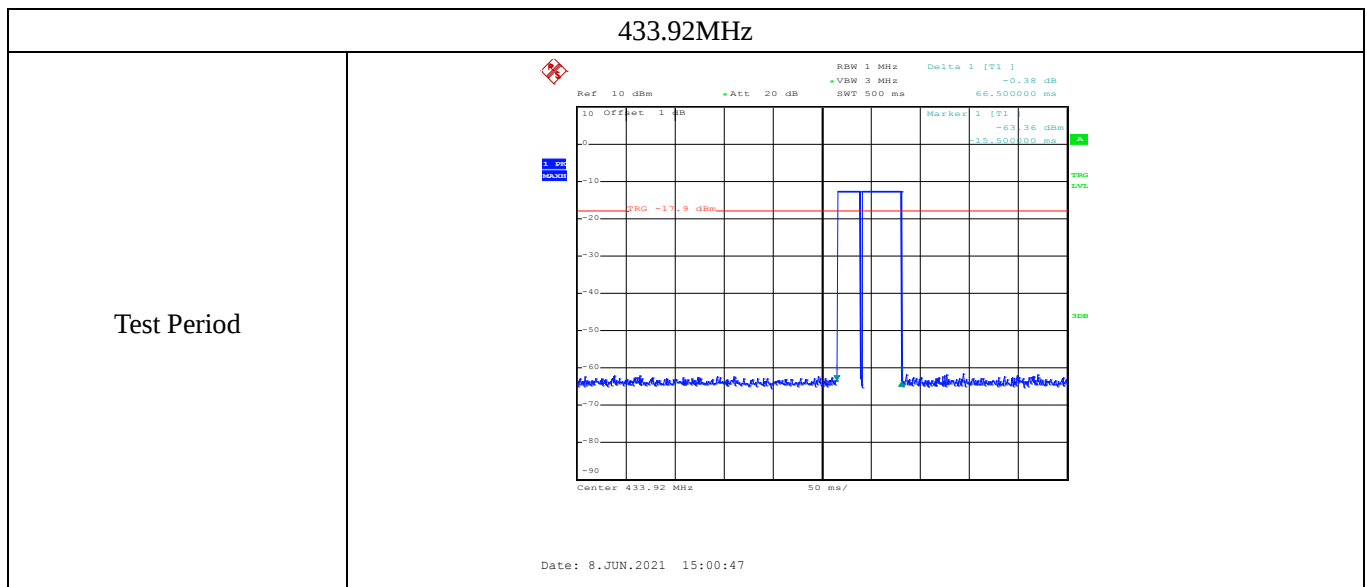
7.3 Summary of Test Results/Plots

433.93MHz:

Test Period (T _p)	Total Time (T _{on})	Duty Cycle	Duty Cycle Factor
ms	ms	%	dB
100	66.50	66.50	-3.54

Remark: Duty Cycle Factor=20*log(Duty Cycle)

Please refer to the attached test plots:

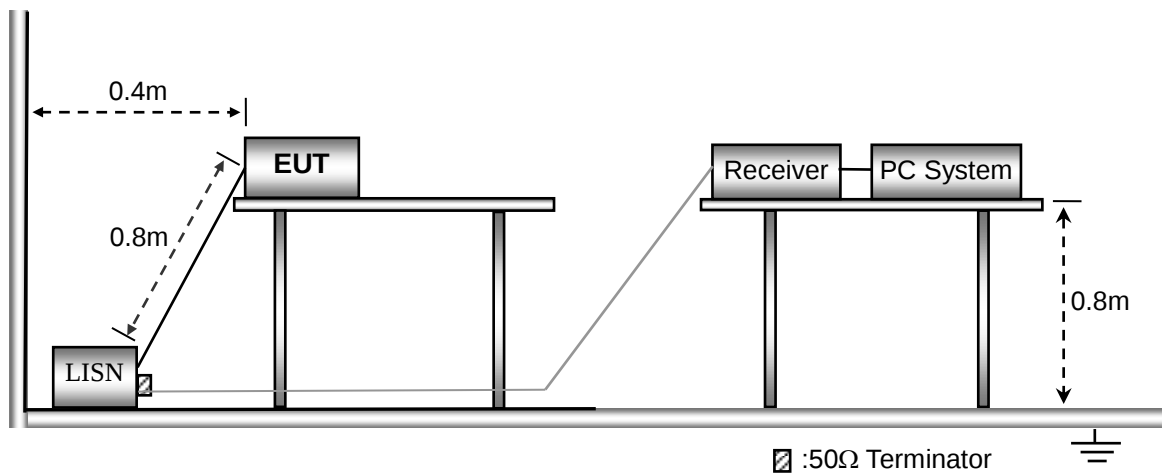


8. Conducted Emissions

8.1 Test Procedure

The setup of EUT is according with per ANSI C63.10:2013 measurement procedure. The specification used was with the FCC Part 15.207 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40cm long in the middle.
The spacing between the peripherals was 10cm.

8.2 Basic Test Setup Block Diagram



8.3 Test Receiver Setup

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

Start Frequency	150kHz
Stop Frequency	30MHz
Sweep Speed	Auto
IF Bandwidth.....	10kHz
Quasi-Peak Adapter Bandwidth	9kHz
Quasi-Peak Adapter Mode	Normal

8.4 Summary of Test Results/Plots

Not applicable

APPENDIX PHOTOGRAPHS

Please refer to “ANNEX”

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