

FCC Part 15C

Measurement and Test Report

For

Ghost Controls, LLC

1572 Capital Circle NW, Tallahassee, FL

FCC ID: 2AGMZGC433WV1

FCC Rule(s):	<u>FCC Part 15.231</u>
Product Description:	<u>Ghost Control Wireless Transmitter</u>
Tested Model:	<u>AXWV</u>
Report No.:	<u>STR18118392I</u>
Sample Receipt Date:	<u>2018-11-30</u>
Tested Date:	<u>2018-12-03 to 2018-12-10</u>
Issued Date:	<u>2018-12-10</u>
Tested By:	<u>Ray Yang / Engineer</u>
Reviewed By:	<u>Silin Chen / EMC Manager</u>
Approved & Authorized By:	<u>Jandy So / PSQ Manager</u>
Prepared By:	<p>Shenzhen SEM Test Technology Co., Ltd. 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao'an District, Shenzhen, P.R.C. (518101) Tel.: +86-755-33663308 Fax.: +86-755-33663309 Website: www.semtest.com.cn</p>

Note: This test report is limited to the above client company and the product model only. It may not be duplicated without prior permission by Shenzhen SEM Test Technology Co., Ltd.

TABLE OF CONTENTS

1. GENERAL INFORMATION	3
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....	3
1.2 TEST STANDARDS.....	4
1.3 TEST METHODOLOGY.....	4
1.4 TEST FACILITY	4
1.5 EUT SETUP AND TEST MODE	5
1.6 MEASUREMENT UNCERTAINTY	5
1.7 TEST EQUIPMENT LIST AND DETAILS	6
2. SUMMARY OF TEST RESULTS	7
3. ANTENNA REQUIREMENT	8
3.1 STANDARD APPLICABLE.....	8
3.2 TEST RESULT.....	8
4. RADIATED EMISSIONS.....	9
4.1 STANDARD APPLICABLE.....	9
4.2 TEST PROCEDURE.....	10
4.3 CORRECTED AMPLITUDE & MARGIN CALCULATION.....	11
4.4 SUMMARY OF TEST RESULTS/PLOTS	11
5. 20DB BANDWIDTH	14
5.1 STANDARD APPLICABLE.....	14
5.2 TEST PROCEDURE.....	14
5.3 SUMMARY OF TEST RESULTS/PLOTS	14
6. TRANSMISSION TIME.....	15
6.1 STANDARD APPLICABLE.....	15
6.2 TEST PROCEDURE.....	15
6.3 SUMMARY OF TEST RESULTS/PLOTS	15
7. DUTY CYCLE.....	16
7.1 STANDARD APPLICABLE.....	16
7.2 TEST PROCEDURE.....	16
7.3 SUMMARY OF TEST RESULTS/PLOTS	16

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: Ghost Controls, LLC
Address of applicant: 1572 Capital Circle NW, Tallahassee, FL

Manufacturer: Ghost Controls, LLC
Address of manufacturer: 1572 Capital Circle NW, Tallahassee, FL

General Description of EUT	
Product Name:	Ghost Control Wireless Transmitter
Trade Name:	Ghost Contro
Model No.:	AXWV
Adding Model(s):	/
Rated Voltage:	DC3V
Power Adaptor :	/
<i>Note: The test data is gathered from a production sample provided by the manufacturer.</i>	

Technical Characteristics of EUT	
Frequency Range:	433.92 MHz
Max. Field Strength:	87.34dBuV/m(3m)
Modulation:	OOK
Antenna Type:	Integral Antenna
Antenna Gain:	0dBi

1.2 Test Standards

The tests were performed according to following standards:

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

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

FCC – Registration No.: 125990

Shenzhen SEM Test Technology Co., Ltd. Laboratory has been recognized to perform compliance testing on equipment subject to the Commissions Declaration Of Conformity (DOC). The Designation Number is CN5010, and Test Firm Registration Number is 125990.

Industry Canada (IC) Registration No.: 11464A

The 3m Semi-anechoic chamber of Shenzhen SEM Test Technology 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	$\pm 1.5\%$	
Conducted Spurious Emission	Conducted	$\pm 2.17\text{dB}$	
Transmission Time	Conducted	$\pm 5\%$	
Conducted Emissions	Conducted	$9\text{-}150\text{kHz} \pm 3.74\text{dB}$	
		$0.15\text{-}30\text{MHz} \pm 3.34\text{dB}$	
Transmitter Spurious Emissions	Radiated	$30\text{-}200\text{MHz} \pm 4.52\text{dB}$	
		$0.2\text{-}1\text{GHz} \pm 5.56\text{dB}$	
		$1\text{-}6\text{GHz} \pm 3.84\text{dB}$	
		$6\text{-}18\text{GHz} \pm 3.92\text{dB}$	

1.7 Test Equipment List and Details

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due Date
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2018-05-22	2019-05-21
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2018-05-22	2019-05-21
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2018-05-22	2019-05-21
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2018-05-22	2019-05-21
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2018-05-22	2019-05-21
SEMT-1011	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2017-06-08	2020-06-07
SEMT-1042	Horn Antenna	ETS	3117	00086197	2017-06-08	2020-06-07
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2017-06-08	2020-06-07
SEMT-1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2018-05-22	2019-05-21
SEMT-1003	L.I.S.N	Schwarz beck	NSLK8126	8126-224	2018-05-22	2019-05-21
SEMT-1166	Power Limiter	Agilent	N9356B	MY45450376	2018-05-22	2019-05-21
SEMT-1048	RF Limiter	ATTEN	AT-BSF-2400~2500	/	2018-05-22	2019-05-21
SEMT-1076	RF Switcher	Top Precision	RCS03-A2	/	2018-05-22	2019-05-21
SEMT-C001	Cable	Zheng DI	LL142-07-07-10M(A)	/	2018-03-19	2019-03-18
SEMT-C002	Cable	Zheng DI	ZT40-2.92J-2.92J-6M	/	2018-03-19	2019-03-18
SEMT-C003	Cable	Zheng DI	ZT40-2.92J-2.92J-2.5M	/	2018-03-19	2019-03-18
SEMT-C004	Cable	Zheng DI	2M0RFC	/	2018-03-19	2019-03-18
SEMT-C005	Cable	Zheng DI	1M0RFC	/	2018-03-19	2019-03-18
SEMT-C006	Cable	Zheng DI	1M0RFC	/	2018-03-19	2019-03-18

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 Compliant

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 an Integral 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

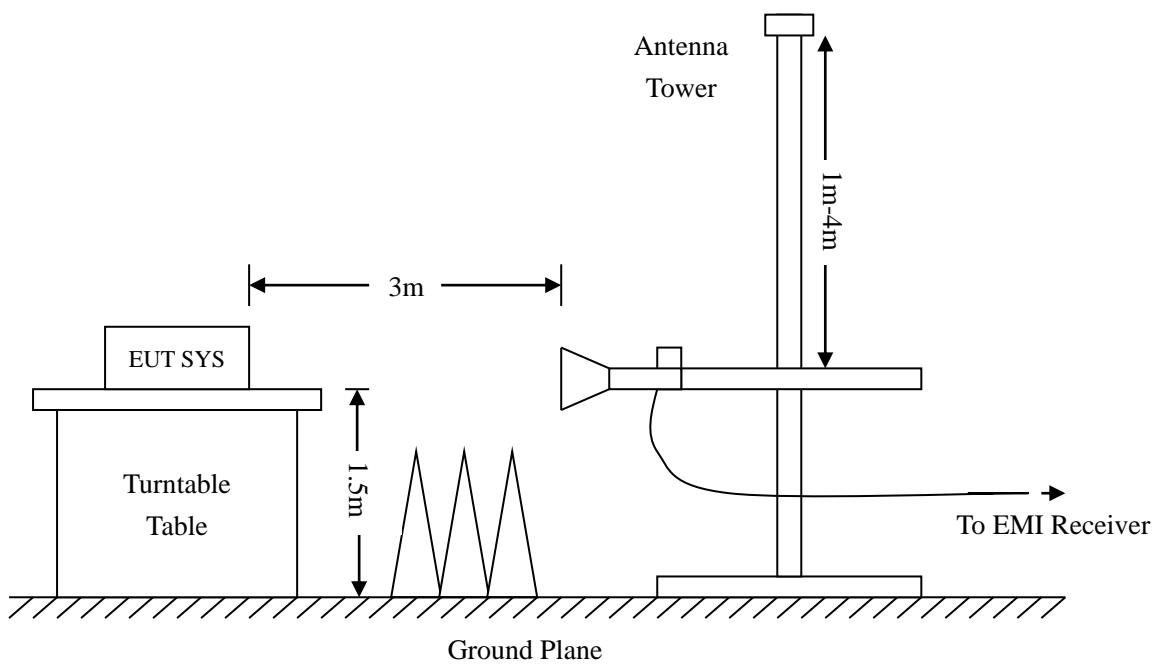
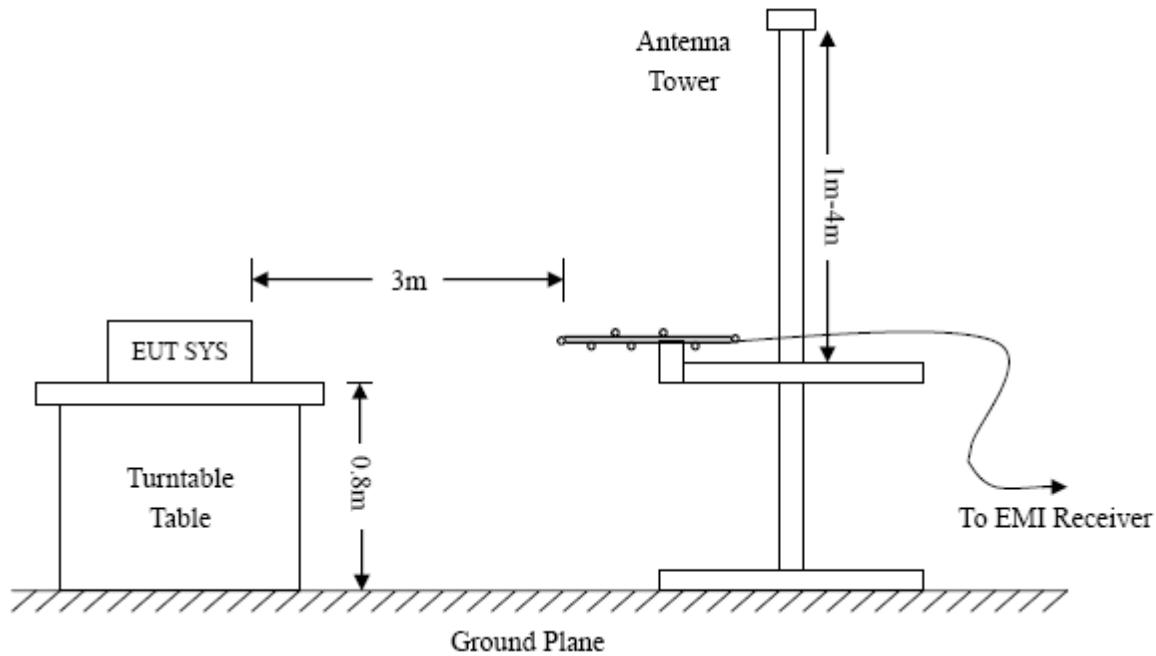
The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209,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



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:

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

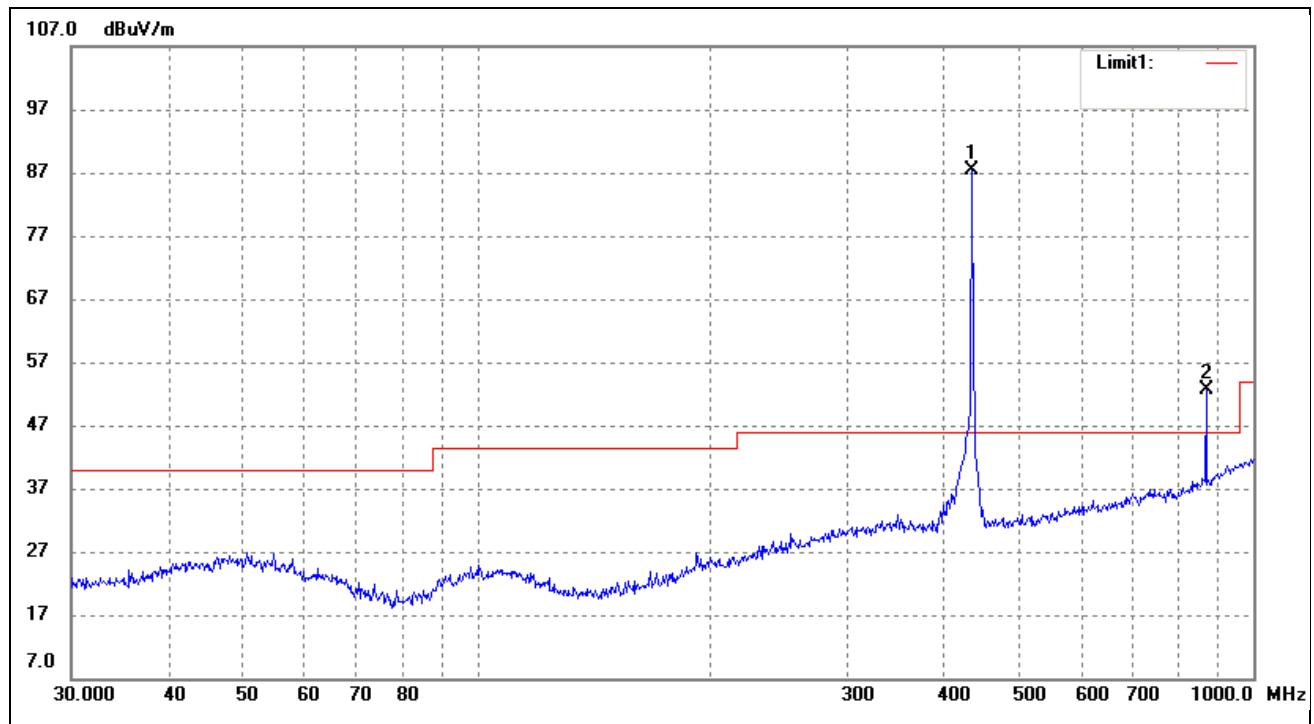
The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of $-6\text{dB}\mu\text{V}$ means the emission is $6\text{dB}\mu\text{V}$ below the maximum limit. The equation for margin calculation is as follows:

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

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
-----------	-----	-----------	------------

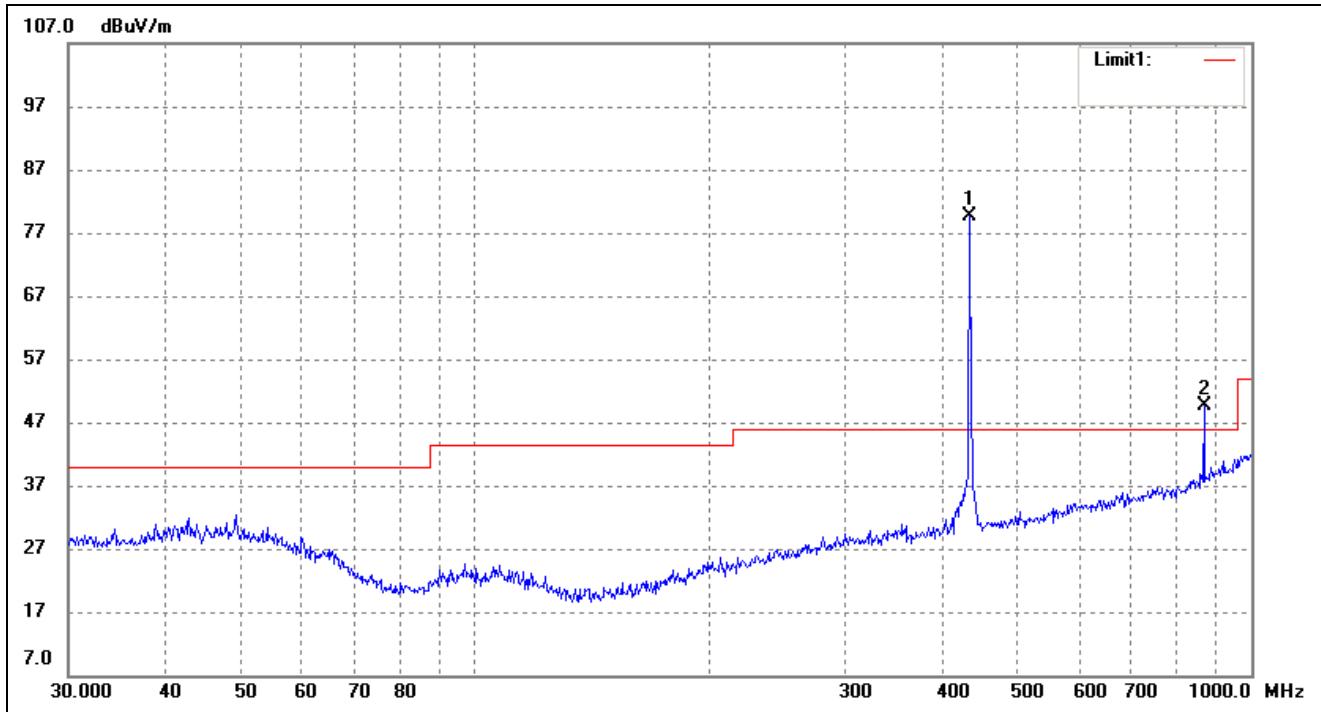


No.	Frequency	Reading	Corr.	Dutycycle	Result	Limit	Margin	Deg.	Height	Remark
	MHz	dBuV/m	Factor(dB)	Factor (dB)	dBuV/m	dBuV/m	(dB)	(°)	(cm)	
1	433.92	94.33	-6.99	N/A	87.34	100.82	-13.48	92	100	peak
	433.92	/	/	-12.00	75.34	80.82	-5.48	92	100	Ave
2	867.84	52.19	0.42	N/A	52.61	80.82	-28.21	92	100	peak
	867.84	/	/	-12.00	40.61	60.82	-20.21	92	100	Ave

Above 1GHz

No.	Frequency	Reading	Corr.	Dutycycle	Result	Limit	Margin	Deg.	Height	Remark
	MHz	dBuV/m	Factor	Factor	dBuV/m	dBuV/m	dB	(°)	(cm)	
1	1301.76	53.06	-8.44	N/A	44.62	74.00	-29.38	92	150	Peak
	1301.76	/	/	-12.00	32.62	54.00	-21.38	92	150	Ave
2	1735.68	52.37	-9.93	N/A	42.44	74.00	-31.56	92	150	Peak
	1735.68	/	/	-12.00	30.44	54.00	-23.56	92	150	Ave

Test Mode	TM1	Polarity:	Vertical
-----------	-----	-----------	----------



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	433.92	86.50	-6.99	N/A	79.51	100.82	-21.31	180	100	peak
	433.92	/	/	-12.00	67.51	80.82	-13.31	180	100	Ave
2	867.84	49.19	0.42	N/A	49.61	80.82	-31.21	180	100	peak
	867.84	/	/	-12.00	37.61	60.82	-23.21	180	100	Ave

Above 1GHz

No.	Frequency	Reading	Corr.	Dutycycle	Result	Limit	Margin	Deg.	Height	Remark
	MHz	dBuV/m	Factor	Factor	dBuV/m	dBuV/m	dB	(°)	(cm)	
1	1301.76	51.52	-8.44	N/A	43.08	74.00	-30.92	180	150	Peak
	1301.76	/	/	-12.00	31.08	54.00	-22.92	180	150	Ave
2	1735.68	50.39	-9.93	N/A	40.46	74.00	-33.54	180	100	Peak
	1735.68	/	/	-12.00	28.46	54.00	-25.54	180	100	Ave

Note: Testing is carried out with frequency rang 30MHz to the tenth harmonics, which above 5th Harmonics are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

The fundamental frequency is 433.92MHz, so the fundamental and spurious emissions radiated limit base on the the operating frequency 433.92MHz.

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 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

5.2 Test Procedure

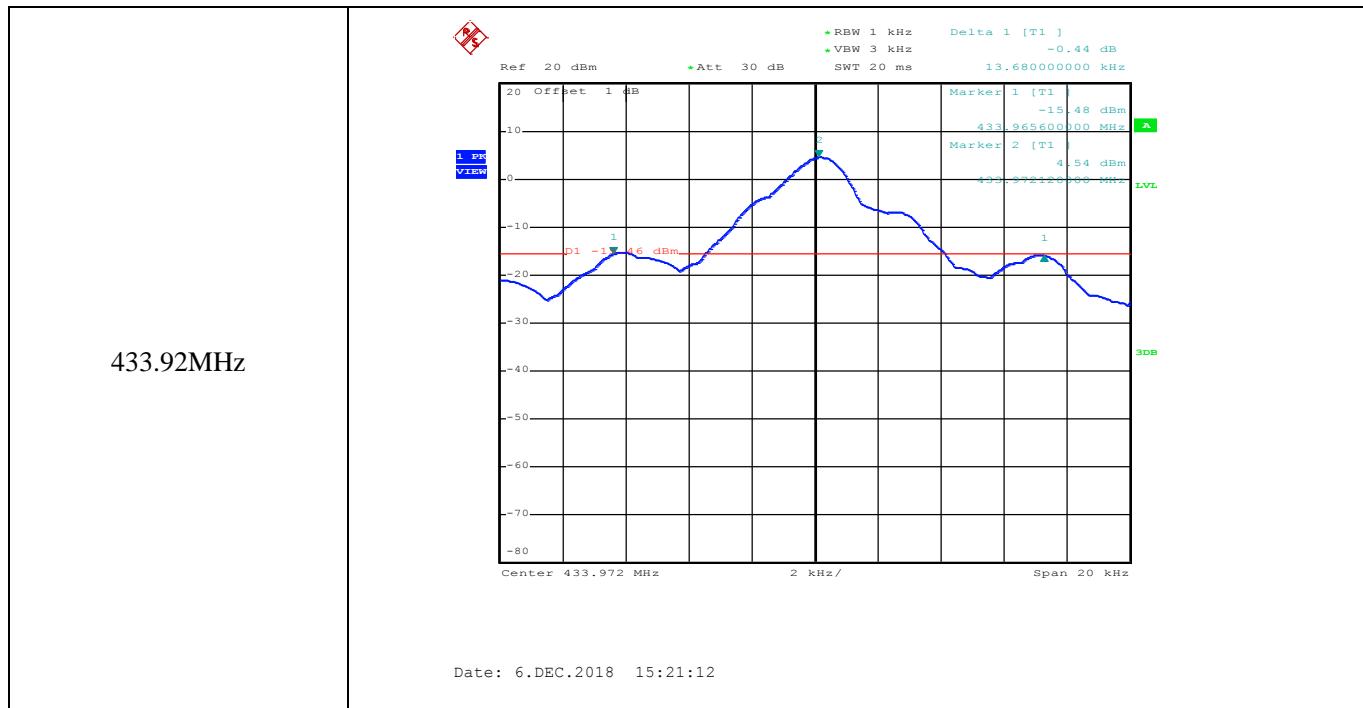
With the EUT's antenna attached, the EUT's 20dB Bandwidth power was received by the test antenna, which was connected to the spectrum analyzer with the START, and STOP frequencies set to the EUT's operation band.

5.3 Summary of Test Results/Plots

Test Frequency MHz	20dB Bandwidth kHz	Limit kHz	Result
433.92	13.68	1084.8	Pass

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

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.

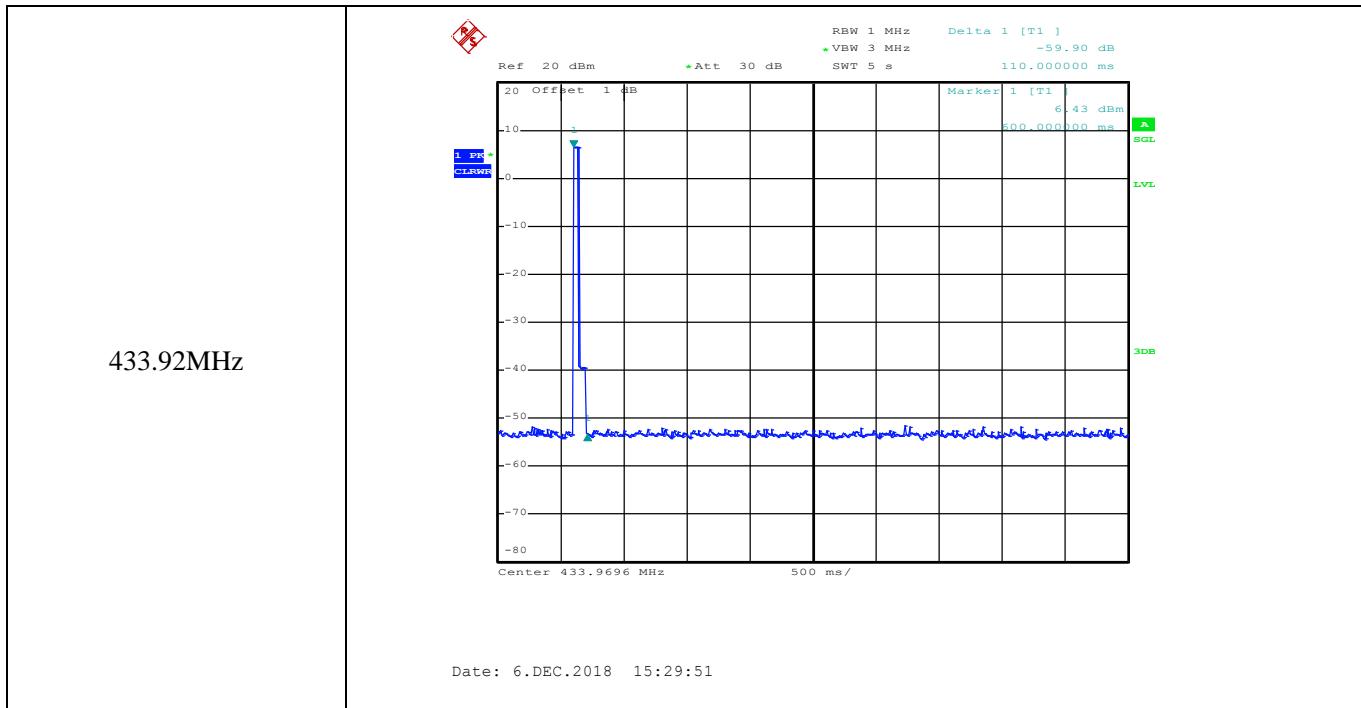
6.2 Test Procedure

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	0.11	5	Pass

Please refer to the attached plots.



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:

Type of Pulse	Width of Pulse (ms)	Quantity of Pulse	Transmission Time (ms)	Total Time (T _{on}) (ms)
Pulse 1 (Wide)	0.24	25	6	19.6
Pulse 2 (Narrow)	0.8	17	13.6	

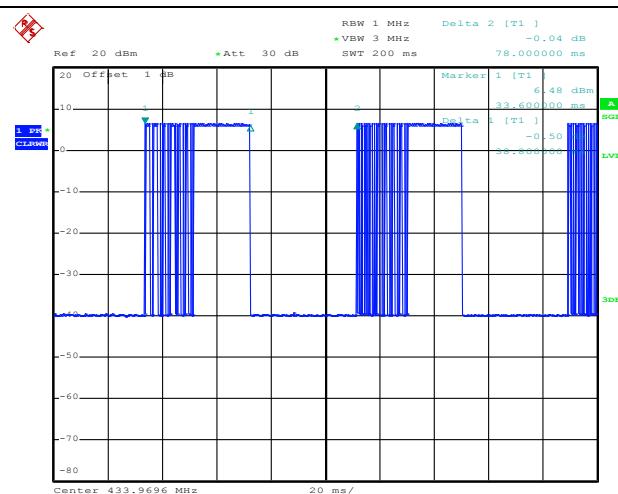
Test Period (T _p)	Total Time (T _{on})	Duty Cycle	Duty Cycle Factor
ms	ms	%	dB
78	19.6	25.13	-12.00

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

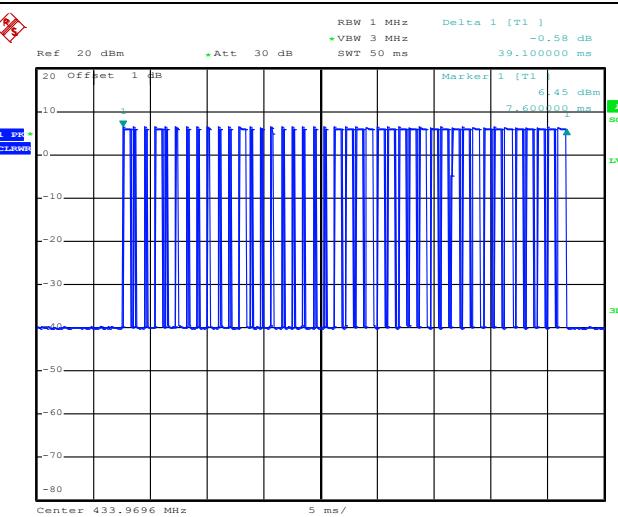
Please refer to the attached test plots

433.92MHz

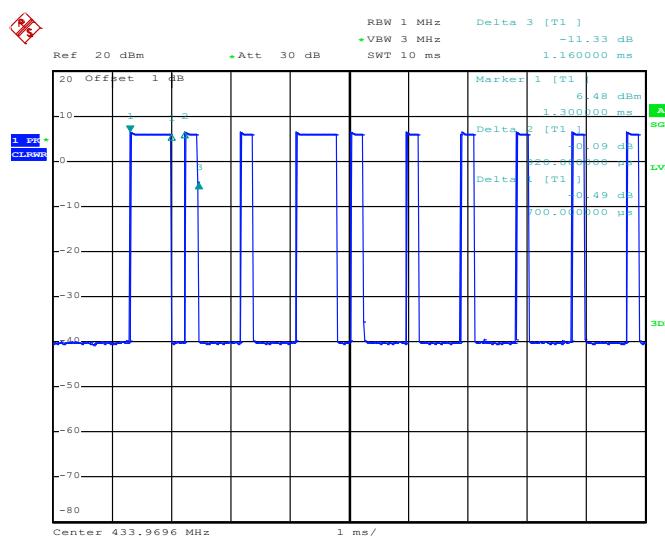
Test Period



Pulse Number



Pulse 1 and Pulse 2



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