
FCC Part 15C Measurement and Test Report

For

FUZHOU ESUN ELECTRONIC CO.,LTD

FCC ID: 2APN2-EN2056

FCC Rule(s):	<u>FCC Part 15.231(e)</u>
Product Description:	<u>WIRELESS MEAT THERMOMETER</u>
Tested Model:	<u>EN2056</u>
Report No.:	<u>BSL190512549601RF</u>
Tested Date:	<u>May 16~21, 2019</u>
Issued Date:	<u>May 21, 2019</u>
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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: FUZHOU ESUN ELECTRONIC CO.,LTD
Address of applicant: ZONE 3,FLOOR 2,BUILDING 3,GULOU INDUSTRIAL PARK,
 JUYUANZHOU,JIANXIN TOWN,CANGSHAN DISTRICT,
 FUZHOU CITY,FUJIAN PROVINCE,CHINA
Manufacturer: FUZHOU ESUN ELECTRONIC CO.,LTD
Address of manufacturer: ZONE 3,FLOOR 2,BUILDING 3,GULOU INDUSTRIAL PARK,
 JUYUANZHOU,JIANXIN TOWN,CANGSHAN DISTRICT,
 FUZHOU CITY,FUJIAN PROVINCE,CHINA

General Description of EUT	
Product Name:	WIRELESS MEAT THERMOMETER
Trade Name:	ESUN
Model No.:	EN2056
Adding Model(s):	N/A
Rated Voltage:	3.0V by battery
Power Adapter Model:	N/A

Technical Characteristics of EUT	
Frequency Range:	433.92 MHz
Max. Field Strength:	82.72dBuV/m(@1m, peak, Vertical)
Data Rate:	N/A
Modulation:	ASK
Antenna Type:	Spring antenna
Antenna Gain:	0dBi

1.2 Test Standards

The following report is prepared on behalf of the FUZHOU ESUN ELECTRONIC CO.,LTD in accordance with FCC Part 15, Subpart C, and section 15.231, 15.203, 15.205 and 15.209 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart C, and section 15.231, 15.203, 15.205 and 15.209 of the Federal Communication Commissions rules.

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, American National Standard for Testing Unlicensed Wireless Devices, and ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

1.4 Test Facility

BSL Testing Co.,LTD.

NO. 24, ZH Park, Nantou, Shenzhen, 518000 China

Designation Number : CN1217

Test Firm Registration Number: 866035

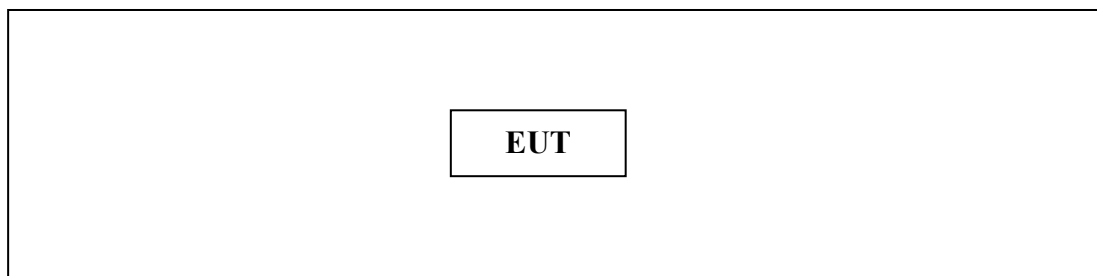
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1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency 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:

TX Mode



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	Modulation
TM2		
TM3		

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	$\pm 2.88\text{dB}$
Transmitter Spurious Emissions	Radiated	$\pm 5.1\text{dB}$

1.7 Test Equipment List and Details

Description	Manufacturer	Model	Serial No.	Cal Date	Due. Date
Communication Tester	Rohde & Schwarz	CMW500	100358	2018-11-08	2019-11-07
Spectrum Analyzer	R&S	FSP40	100550	2018-10-08	2019-10-07
Test Receiver	R&S	ESCI7	US47140102	2018-10-08	2019-10-07
Signal Generator	HP	83630B	3844A01028	2018-10-08	2019-10-07
Test Receiver	R&S	ESPI-3	100180	2018-10-08	2019-10-07
Amplifier	Agilent	8449B	4035A00116	2018-10-08	2019-10-07
Amplifier	HP	8447E	2945A02770	2018-10-08	2019-10-07
Signal Generator	IFR	2023A	202307/242	2018-10-08	2019-10-07
Broadband Antenna	SCHAFFNER	2774	2774	2018-11-06	2019-11-05
Biconical and log periodic antennas	ELECTRO-METRICS	EM-6917B-1	171	2018-10-21	2019-10-20
Horn Antenna	R&S	HF906	100253	2018-10-21	2019-10-20
Horn Antenna	EM	EM-6961	6462	2018-11-03	2019-11-02
LISN	R&S	ESH3-Z5	100196	2018-10-08	2019-10-07
LISN	COM-POWER	LI-115	02027	2018-10-08	2019-10-07
3m Semi-Anechoic Chamber	Chengyu Electron	9 (L)*6 (W)* 6 (H)	BSL086	2018-10-08	2019-10-07
Horn Antenna	Schwarzbeck	BBHA9170	00814	2018-10-21	2019-10-20
Loop Antenna	Schwarz beck	FMZB 1519B	9773	2018-10-21	2019-10-20

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 15.203	Antenna Requirement	Compliant
§ 15.207(e)	Conducted Emission	N/A
§15.231(e)	Release Time	Compliant
	Radiation Emission	Compliant
	20 dB Bandwidth	Compliant
	Duty Cycle	Compliant

Note: PASS: applicable, 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 Spring antenna, fulfill the requirement of this section.

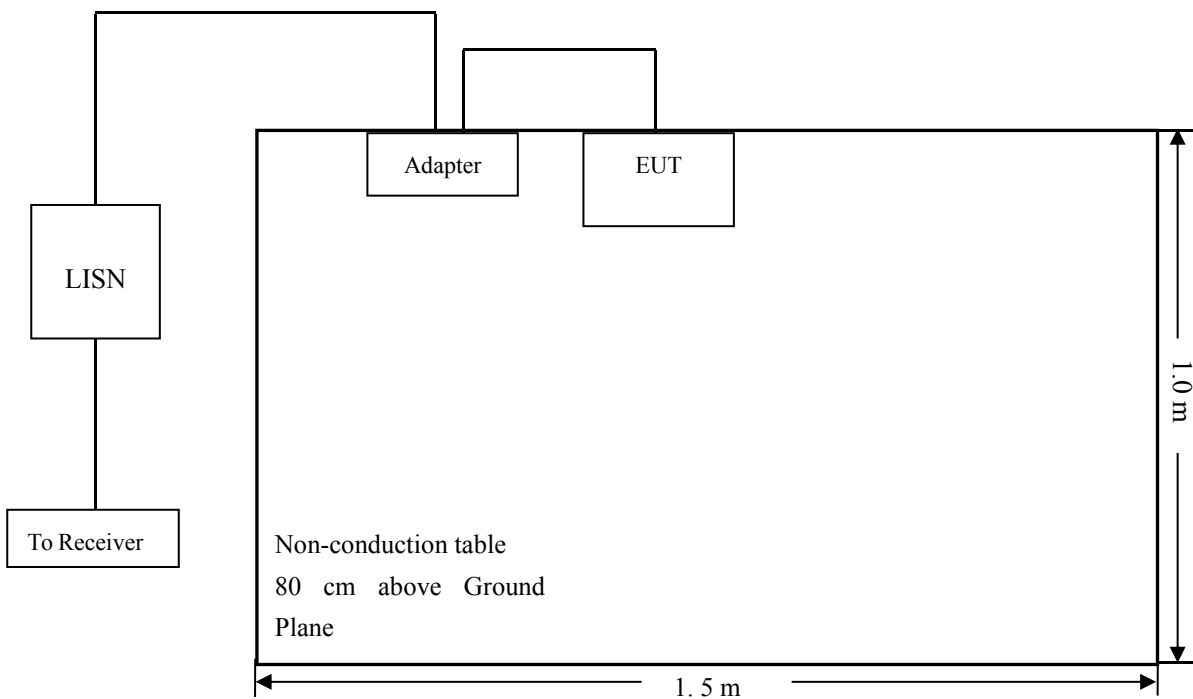
4. Conducted Emissions

4.1 Test Procedure

The setup of EUT is according with per ANSI C63.4-2014 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 40 cm long in the middle. The spacing between the peripherals was 10 cm.

4.2 Basic Test Setup Block Diagram



4.3 Environmental Conditions

Temperature:	25 °C
Relative Humidity:	52%
ATM Pressure:	1012 mbar

4.4 Test Receiver Setup

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

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

Quasi-Peak Adapter Mode.....Normal

4.5 Summary of Test Results/Plots

According to the data in section 4.7, the EUT complied with the FCC Part 15.207 Conducted margin for a Class B device, with the *worst* margin reading of:

-12.74 dB at 1.462 MHz in the **Neutral** mode, **Average** detector, 0.15-30MHz

4.6 Conducted Emissions Test Data

The test not applicable.

5. Radiated Emissions

5.1 Standard Applicable

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

Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission (microvolts/meter)
40.66-40.70	1,000	100
70-130	500	50
130-174	500 to 1,500 ¹	50 to 150 ¹
174-260	1,500	150
260-470	1,500 to 5,000 ¹	150 to 500 ¹
Above 470	5,000	500

¹Linear interpolations.

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.

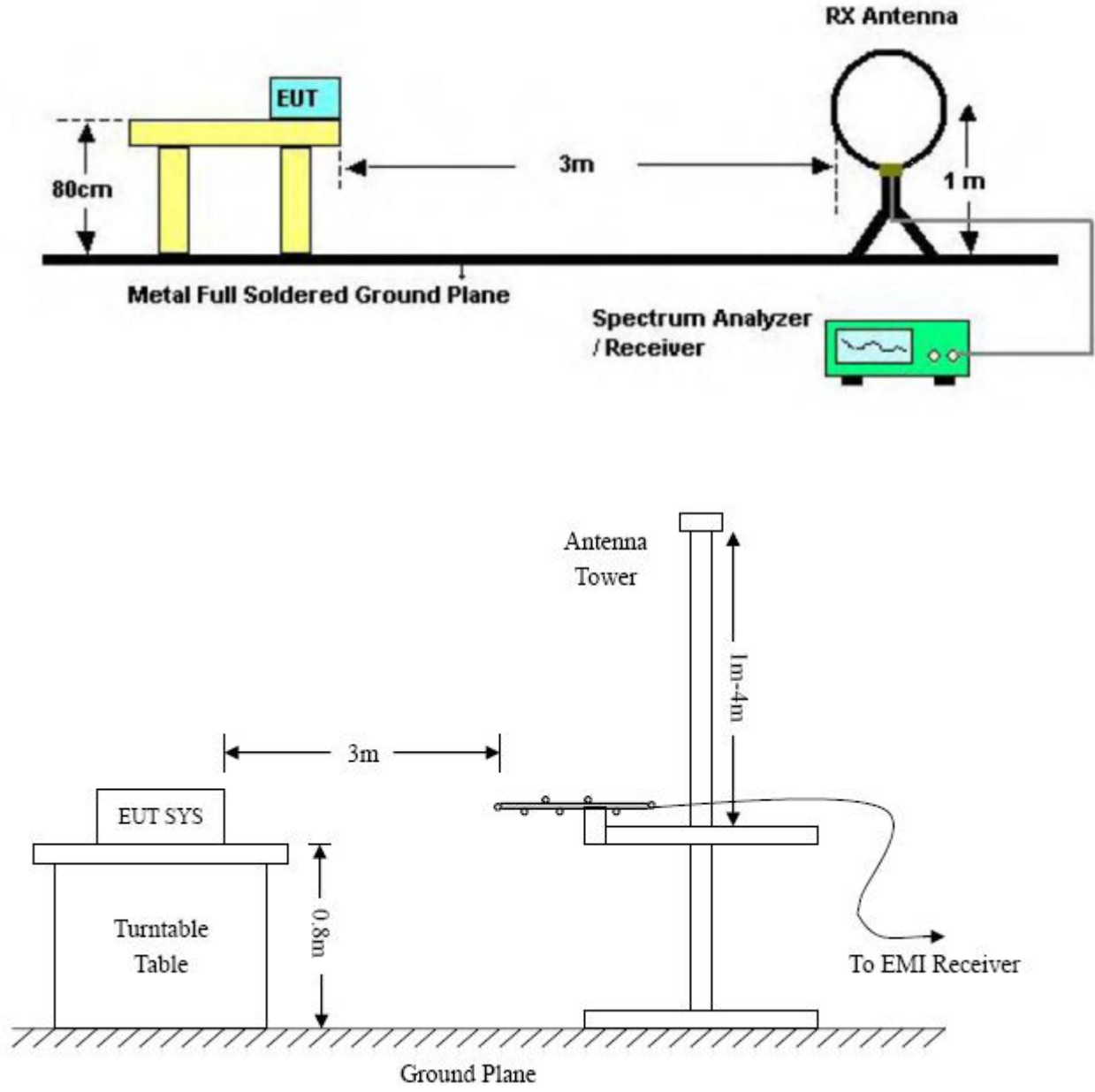
The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209,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

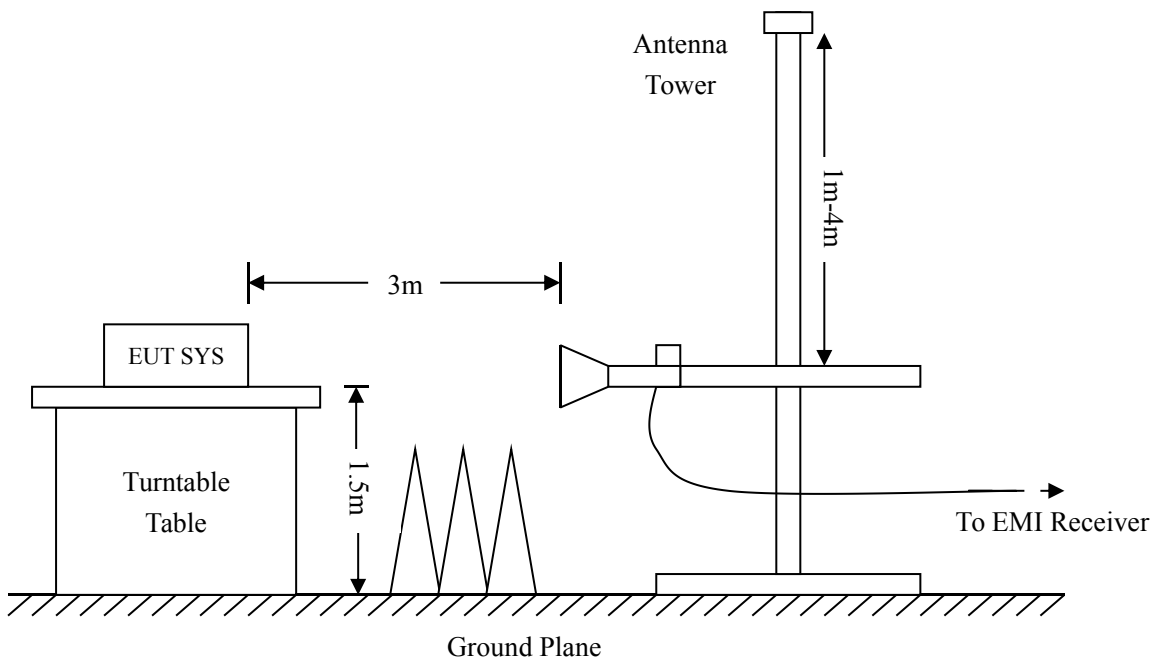
The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

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

5.2 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(e) and FCC Part 15.209 Limit.





5.3 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:

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

5.4 Environmental Conditions

Temperature:	21° C
Relative Humidity:	50%
ATM Pressure:	1011 mbar

5.5 Summary of Test Results/Plots

According to the data below, the FCC Part 15.205, 15.209 and 15.231 standards, and had the worst margin of:

-4.63 dB at 433.92 MHz in the Horizontal polarization, Peak Detector, 9 kHz to 5 GHz, 1 Meters

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

Horizontal

Below 1GHz									
Frequency	Reading	Corr.	Duty cycle	Result	Limit	Margin	Deg.	Height	Remark
MHz	dBuV/m	Factor(dB)	Factor(dB)	dBuV/m	dBuV/m	(dB)	(°)	(cm)	
433.9200	82.15	-2.19	N/A	79.96	92.87	-12.91	152	150	peak
433.9200	/	/	-8.55	71.41	72.87	-1.46	12	150	Ave
867.8400	47.73	4.63	N/A	52.36	72.87	-20.51	152	150	peak
867.8400	/	/	-8.55	43.81	52.87	-9.06	114	150	Ave
Above 1GHz									
1301.760	55.44	-12.91	N/A	42.53	74.00	-31.47	110	150	Peak
1301.760	/	/	-8.55	33.98	54.00	-20.02	185	150	Ave
1735.680	50.79	-9.20	N/A	41.59	72.87	-31.28	23	150	Peak
1735.680	/	/	-8.55	33.04	52.87	-19.83	196	150	Ave

Vertical

Below 1GHz									
Frequency	Reading	Corr.	Duty cycle	Result	Limit	Margin	Deg.	Height	Remark
MHz	dBuV/m	Factor(dB)	Factor(dB)	dBuV/m	dBuV/m	(dB)	(°)	(cm)	
433.9200	82.72	-2.19	N/A	80.53	92.87	-12.34	251	100	peak
433.9200		/	-8.55	71.98	72.87	-0.89	153	100	Ave
867.8400	55.39	4.63	N/A	60.02	72.87	-12.85	15	100	peak
867.8400		/	-8.55	51.47	52.87	-1.40	156	100	Ave
Above 1GHz									
1301.760	65.25	-12.91	N/A	52.34	74.00	-21.66	231	100	Peak
1301.760	/	/	-8.55	43.79	54.00	-10.21	152	100	Ave
1735.680	51.78	-9.20	N/A	42.58	72.87	-30.29	142	100	Peak
1735.680	/	/	-8.55	34.03	52.87	-18.84	146	100	Ave

Note: Testing is carried out with frequency rang 9kHz 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 measurements greater than 20dB below the limit from 9kHz to 30MHz..

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

6. 20dB Bandwidth

6.1 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.

6.1 Test Procedure

With the EUT's antenna attached, the EUT's 20dBc 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.

6.2 Environmental Conditions

Temperature:	21° C
Relative Humidity:	52%
ATM Pressure:	1011 mbar

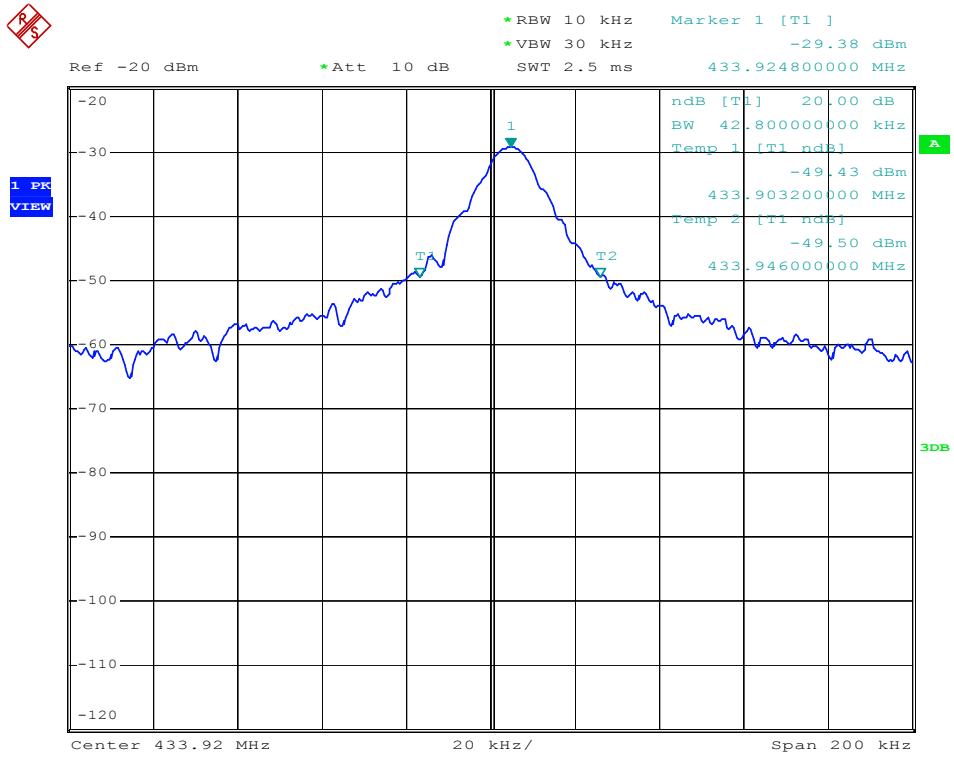
6.3 Summary of Test Results/Plots

Test Frequency MHz	20dBc Bandwidth kHz	Limit kHz	Result
433.92	42.8	1084	Pass

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

Please refer to the attached plots.

20dBc Bandwidth Test Plot



7. Transmission Time

7.1 Standard Applicable

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

- 1) According to FCC Part 15.231 (e), 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.

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 Environmental Conditions

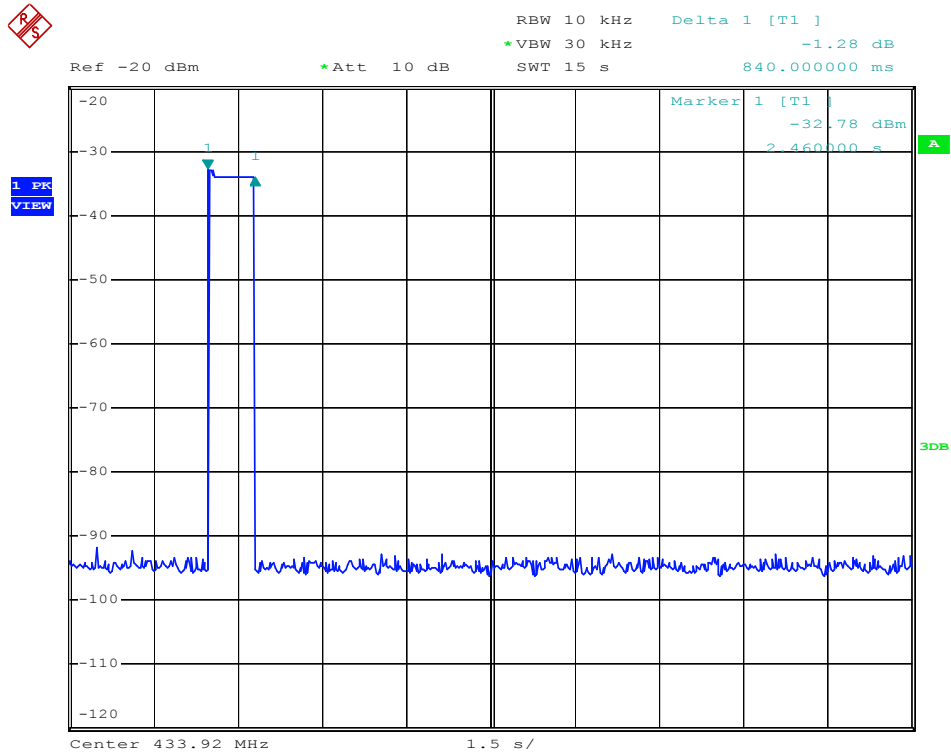
Temperature:	20° C
Relative Humidity:	52%
ATM Pressure:	1011 mbar

7.4 Summary of Test Results/Plots

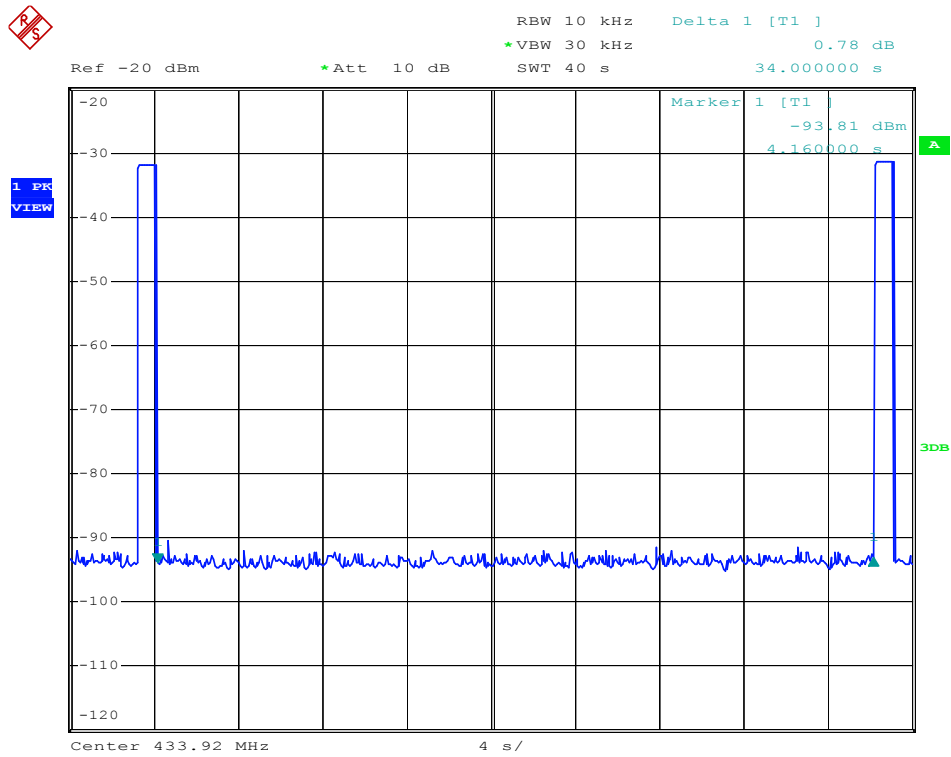
Release Time(s)	Limit(s)	Result
0.84	1	PASS
Silent period(s)	Limit(s)	Result
34	>10s >30* Release Time	PASS
Note: 30* Release Time=25.2s		

Please refer to the attached plots.

Transmission Time:



Silent period:



8. Duty Cycle

8.1 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.

8.2 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.

8.3 Environmental Conditions

Temperature:	20° C
Relative Humidity:	52%
ATM Pressure:	1011 mbar

8.4 Summary of Test Results

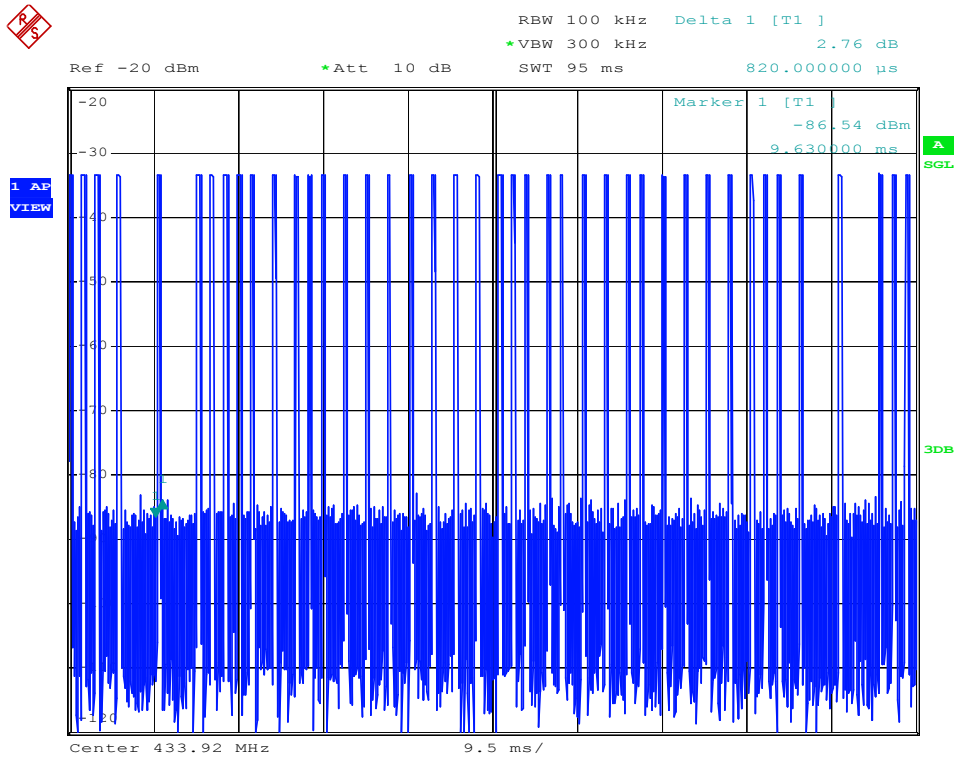
Type of Pulse	Width of Pulse ms	Quantity of Pulse	Transmission Time ms	Total Time (T _{on}) ms
Pulse	0.82	35	18	28.7

Test Period (T _p) ms	Total Time (T _{on}) ms	Duty Cycle %	Duty Cycle Factor dB
76.8	28.7	37.37	-8.55

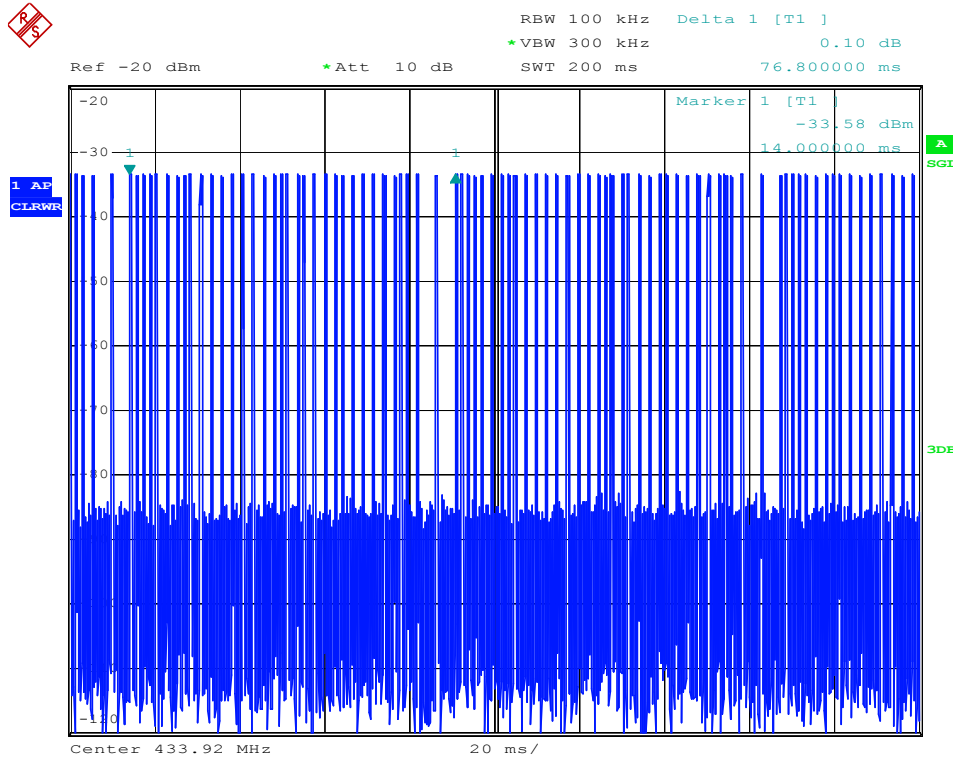
Duty Cycle Factor=20 log(Duty Cycle)=-8.55

Please refer to the attached test plots

Pulse:



Test Period:



****END REPORT****