TEST REPORT

Reference No......	:	WTF18S03105571W V1
FCC ID.....	:	2AOWW-LZ1
Applicant.....	:	Penrock LLC
Address.....	:	251 Knoxview Lane Mooresville, NC 28117, United States
Manufacturer.....	:	The same as above
Address.....	:	The same as above
Product Name.....	:	Leviosa Zone
Model No.	:	LZ1
Standards.....	:	FCC CFR47 Part 15 Section 15.231: 2016
Date of Receipt sample....	:	Mar. 21, 2018
Date of Test.....	:	Mar. 22– Apr.09, 2018
Date of Issue.....	:	May. 03, 2018
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 Report Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTF18S03105571W	Mar. 21, 2018	Mar. 22–Apr.09, 2018	Apr.10, 2018	original	-	Replaced
WTF18S03105571W V1	Mar. 21, 2018	Mar. 22–Apr.09, 2018	May.10, 2018	Version 1	Updated	Valid

4 General Information

4.1 General Description of E.U.T.

Product Name	:Leviosa Zone
Model No.	: LZ1
Model Difference	: N/A
Type of Modulation	: ASK
Frequency Range	: 433.92 MHz
The Lowest Oscillator	: 433.92 MHz
Antenna installation	: PCB Printed Antenna

4.2 Details of E.U.T.

Ratings:	DC 5V±0.5V,1000mA±50mA, charging from adapter (Adapter Input: 110-240V~50/60Hz, 0.1A)
Adapter:	Manufacturer: Shenzhen HengChangShengDing Electronics Co., Ltd. Model No.: HCSD-11650100 (Sale without adapter)

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

A. Accreditations for Conformity Assessment (International)

Country/Region	Accreditation Body	Scope	Note
USA	**A2LA (Certificate No.: 4243.01)**	FCC ID \ DOC \ VOC	1
Canada		IC ID \ VOC	2
Japan		MIC-T \ MIC-R	-
Europe		EMCD \ RED	-
Taiwan		NCC	-
Hong Kong		OFCA	-
Australia		RCM	-
India	**International Services**	WPC	-
Thailand		NTC	-
Singapore		IDA	-

Note:

1. FCC Designation No.: CN1201. Test Firm Registration No.: 523476.
2. IC Canada Registration No.: 7760A

B. TCBs and Notify Bodies Recognized Testing Laboratory.

Recognized Testing Laboratory of …	Notify body number
TUV Rheinland	Optional.
Intertek	
TUV SUD	
SGS	
Phoenix Testlab GmbH	0700
Element Materials Technology Warwick Ltd	0891
Timco Engineering, Inc.	1177
Eurofins Product Service GmbH	0681

5 Equipment Used during Test

5.1 Equipments List

3m Semi-anechoic Chamber for Radiation Emissions Test site 1#						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	Spectrum Analyzer	R&S	FSP	100091	Apr. 29, 2017	Apr. 28, 2018
2	Amplifier	Agilent	8447D	2944A10178	Jan. 12, 2018	Jan. 11, 2019
3	Active Loop Antenna	Beijing Dazhi	ZN30900A	0703	Oct. 17, 2017	Oct. 16, 2018
4	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Apr. 07, 2018	Apr. 06, 2019
5	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.12, 2017	Sep.11, 2018
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr. 07, 2018	Apr. 06, 2019
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Apr. 07, 2018	Apr. 06, 2019
8	Coaxial Cable (above 1GHz)	Top	1GHz-18GHz	EW02014-7	Apr. 07, 2018	Apr. 06, 2019
3m Semi-anechoic Chamber for Radiation Emissions Test site 2#						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No**	**Last Calibration Date**	**Calibration Due Date**
1	Test Receiver	R&S	ESCI	101296	Apr. 06, 2018	Apr. 05, 2019
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	Apr. 07, 2018	Apr. 06, 2019
3	Amplifier	ANRITSU	MH648A	M43381	Apr. 07, 2018	Apr. 06, 2019
4	Cable	HUBER+SUHNER	CBL2	525178	Apr. 07, 2018	Apr. 06, 2019
RF Conducted Testing						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1.	EMC Analyzer (9k~26.5GHz)	Agilent	E7405A	MY45114943	Sep.12, 2017	Sep.11, 2018
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	Sep.12, 2017	Sep.11, 2018
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	Sep.12, 2017	Sep.11, 2018

5.2 Measurement Uncertainty

Test Item	Frequency Range	Uncertainty	Note
Conducted Emissions	150kHz~30MHz	±3.64dB	(1)
Radiated Spurious Emissions	30MHz~1000MHz	±5.03dB	(1)
	1000M~6000MHz	± 5.47 dB	(1)

(1)This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of 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
Conducted Emissions	15.207	C
Radiated Spurious Emissions	15.205(a) 15.209 15.231(a)	C
Periodic Operation	15.231(a)	C
Emission Bandwidth	15.231(c)	C
Antenna Requirement	15.203	C
SAR	1.1307(b)(1)	C
Note: C=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable		

7 Conducted Emission

Test Requirement: FCC Part 15 Paragraph 15.207

Test Method: ANSI C63.10:2013

Test Result: PASS

Frequency Range: 150kHz to 30MHz

Class/Severity: Class B

Limit:

Frequency (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0.15 to 0.5	66 to 56*	56 to 46
0.5 to 5	56	46
5 to 30	60	50

7.1 E.U.T. Operation

Operating Environment **:**

Temperature: 22.8 °C

Humidity: 52.6 % RH

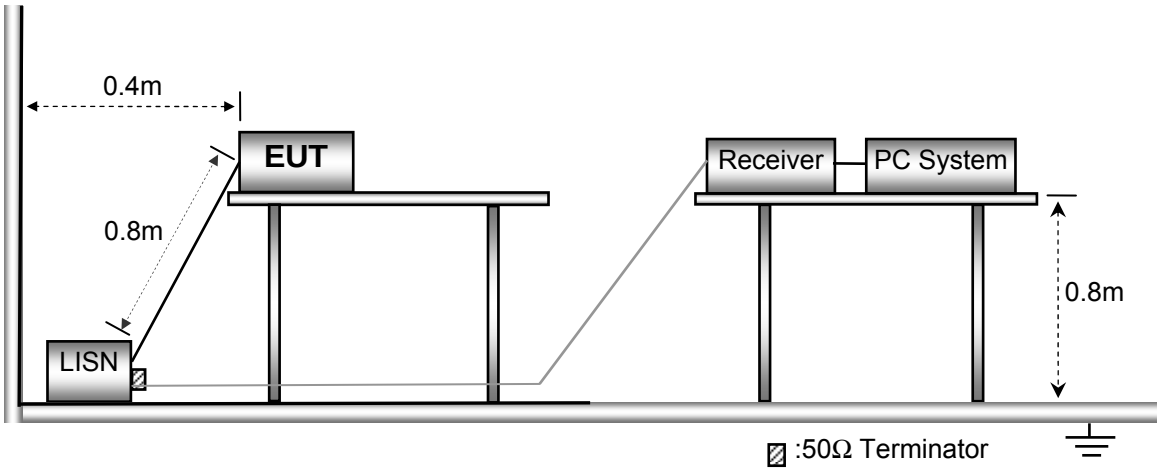
Atmospheric Pressure: 101.2kPa

EUT Operation **:**

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

7.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10: 2013.



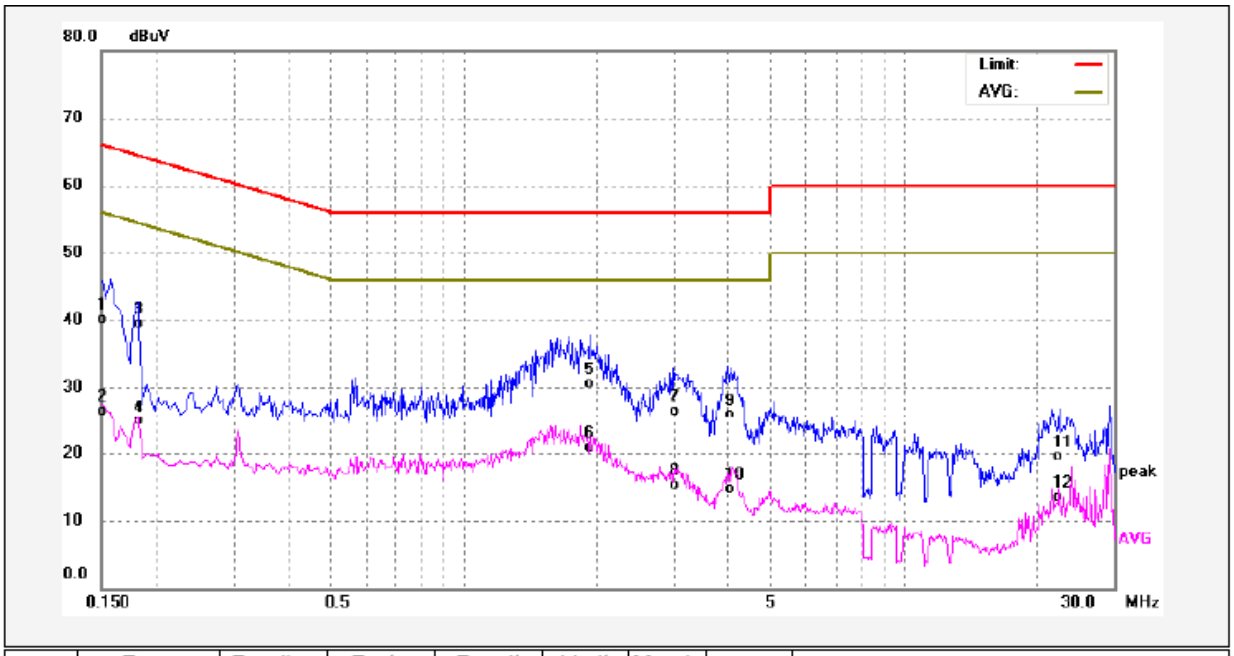
7.3 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

7.4 Conducted Emission Test Result

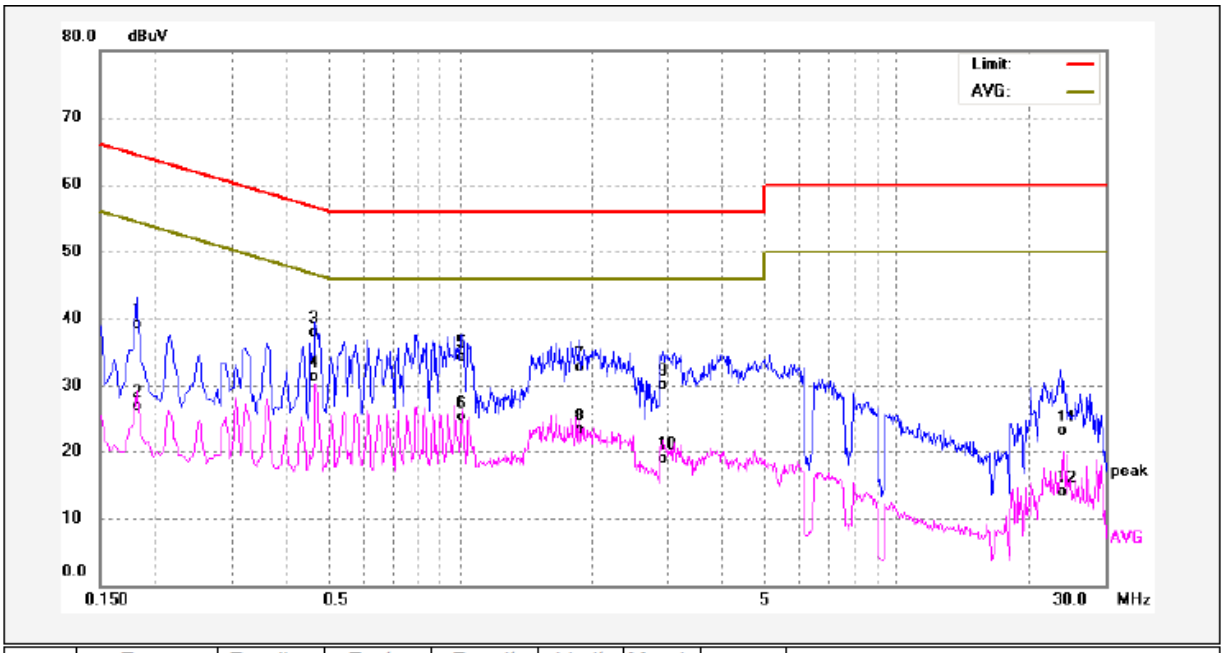
Remark: only the worst data (GFSK modulation Low channel mode) were reported

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	30.11	10.06	40.17	65.99	-25.82	QP	
2	0.1500	16.35	10.06	26.41	55.99	-29.58	AVG	
3	0.1819	29.53	9.88	39.41	64.39	-24.98	QP	
4	0.1819	14.99	9.88	24.87	54.39	-29.52	AVG	
5	1.9340	20.40	10.19	30.59	56.00	-25.41	QP	
6	1.9340	10.74	10.19	20.93	46.00	-25.07	AVG	
7	2.9860	16.19	10.24	26.43	56.00	-29.57	QP	
8	2.9860	5.01	10.24	15.25	46.00	-30.75	AVG	
9	3.9660	15.64	10.27	25.91	56.00	-30.09	QP	
10	3.9660	4.40	10.27	14.67	46.00	-31.33	AVG	
11	22.5780	8.94	10.52	19.46	60.00	-40.54	QP	
12	22.5780	2.91	10.52	13.43	50.00	-36.57	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1819	29.24	9.88	39.12	64.39	-25.27	QP	
2	0.1819	17.01	9.88	26.89	54.39	-27.50	AVG	
3	0.4660	27.87	10.06	37.93	56.58	-18.65	QP	
4	0.4660	21.25	10.06	31.31	46.58	-15.27	AVG	
5	1.0100	24.18	10.12	34.30	56.00	-21.70	QP	
6	1.0100	15.19	10.12	25.31	46.00	-20.69	AVG	
7	1.8700	22.47	10.19	32.66	56.00	-23.34	QP	
8	1.8700	13.11	10.19	23.30	46.00	-22.70	AVG	
9	2.9060	19.84	10.24	30.08	56.00	-25.92	QP	
10	2.9060	8.62	10.24	18.86	46.00	-27.14	AVG	
11	23.7060	12.64	10.54	23.18	60.00	-36.82	QP	
12	23.7060	3.31	10.54	13.85	50.00	-36.15	AVG	

8 Radiated Spurious Emissions

Test Requirement: FCC Part15 Paragraph 15.231(a)

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				

8.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

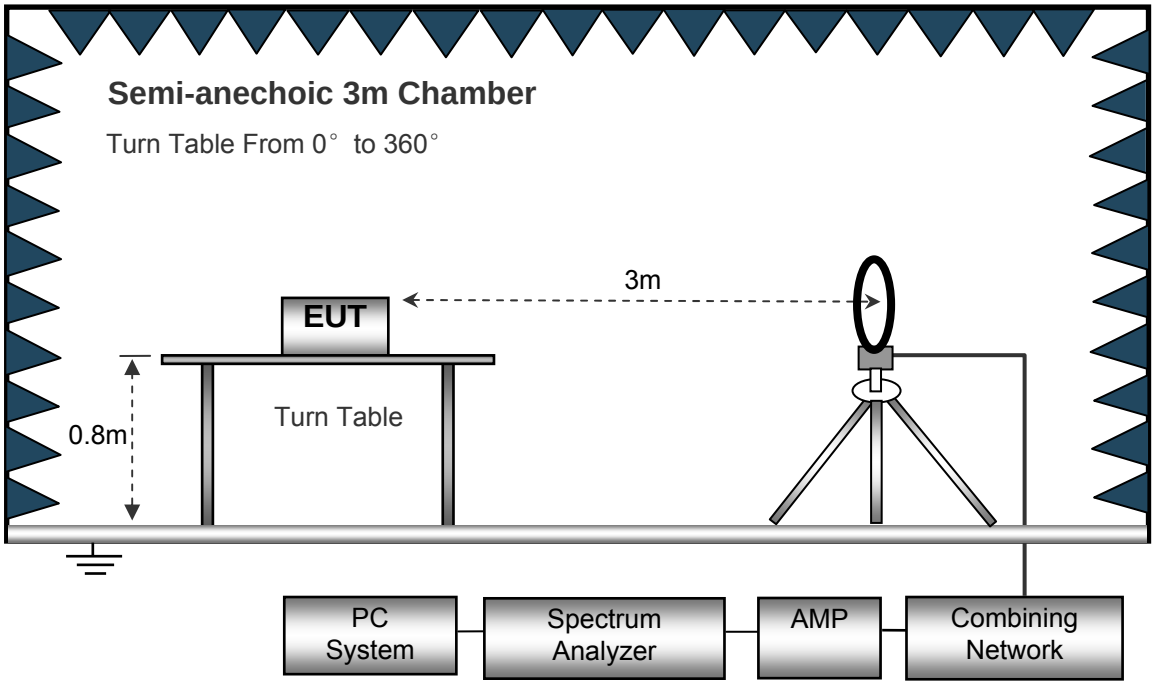
EUT Operation :

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

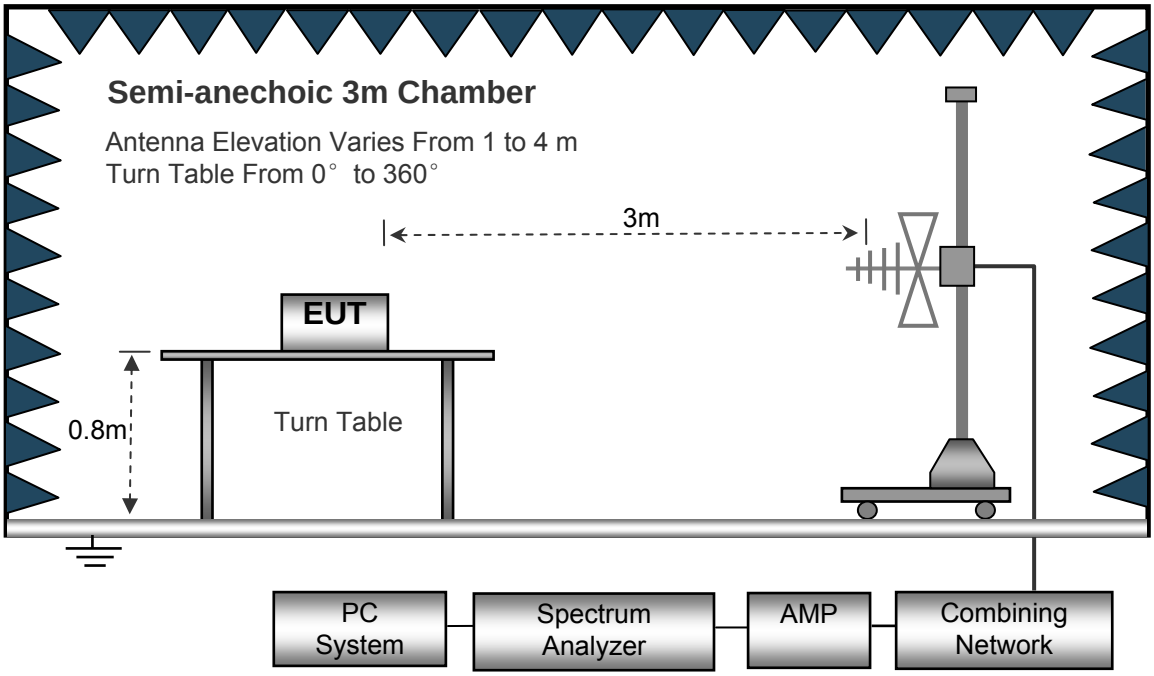
8.2 Test Setup

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

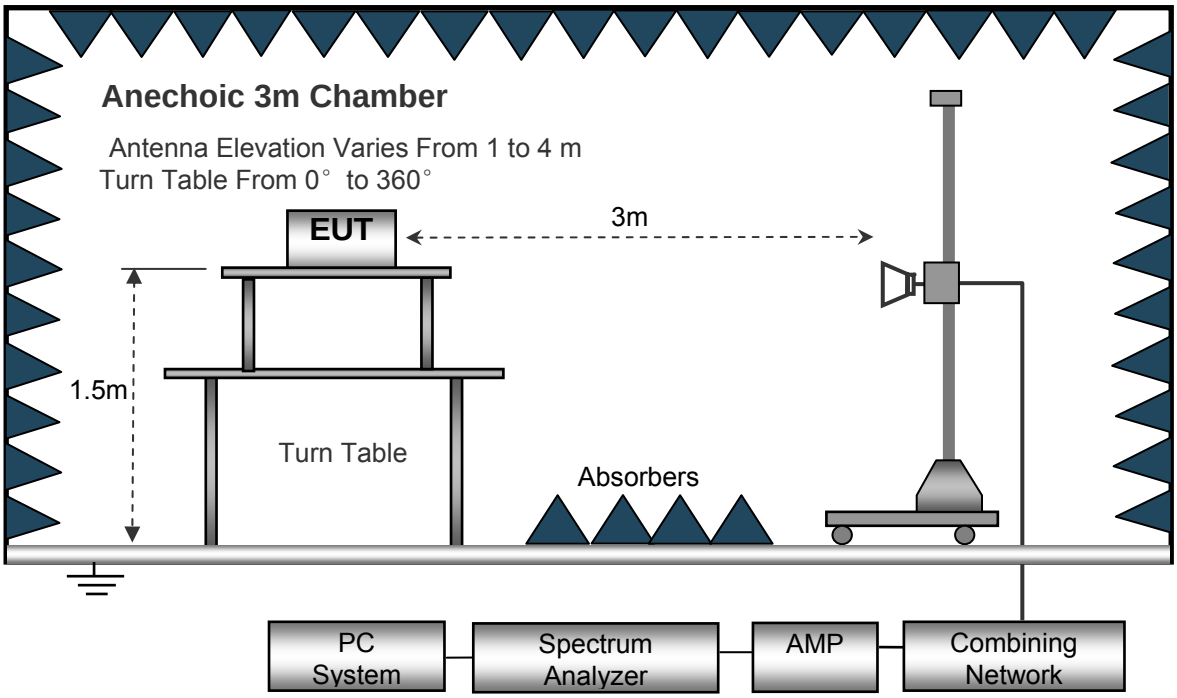
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



8.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed ..... Auto
IF Bandwidth..... 10kHz
Video Bandwidth..... 10kHz

Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 100kHz
Video Bandwidth..... 300kHz

Above 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 3MHz

8.4 Test Procedure

1. The EUT is placed on a turntable. For below 1GHz, the EUT is 0.8m above ground plane; For above1GHz, 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.

8.5 Summary of Test Results

Test Frequency: 30MHz ~ 5GHz

channel: 433.92MHz

Frequency	Receiver Reading (PK)	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude (PK)	FCC Part 15.231/15.209/205	
			Height	Polar			Limit	Margin
(MHz)	(dBμV)	Degree	(m)	(H/V)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)
433.92	73.23	124	1.2	H	-7.84	65.39	100.83	-35.44
433.92	94.82	146	1.8	V	-7.84	86.98	100.83	-13.85
867.84	59.23	95	1.1	H	-0.91	58.32	80.83	-22.51
867.84	62.73	252	1.9	V	-0.91	61.82	80.83	-19.01
1825.80	50.32	228	2.0	H	-16.38	33.94	74.00	-40.06
1825.80	44.61	254	1.3	V	-16.38	28.23	74.00	-45.77
2794.20	42.17	346	1.9	H	-14.87	27.30	74.00	-46.70
2794.20	47.96	46	1.2	V	-14.87	33.09	74.00	-40.91

AV = Peak +20Log$_{10}$(duty cycle) =PK+(-10.42) [refer to section 8 for more detail]

Frequency	PK	RX Antenna Polar	Duty cycle Factor	Calculated AV	FCC Part 15.231/209/205	
					Limit	Margin
(MHz)	(dBμV/m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
433.92	65.39	H	-10.42	54.97	80.83	-25.86
433.92	86.98	V	-10.42	76.56	80.83	-4.27
867.84	58.32	H	-10.42	47.90	60.83	-12.93
867.84	61.82	V	-10.42	51.40	60.83	-9.43
1825.80	33.94	H	-10.42	23.52	54.00	-30.48
1825.80	28.23	V	-10.42	17.81	54.00	-36.19
2794.20	27.30	H	-10.42	16.88	54.00	-37.12
2794.20	33.09	V	-10.42	22.67	54.00	-31.33

9 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 * %

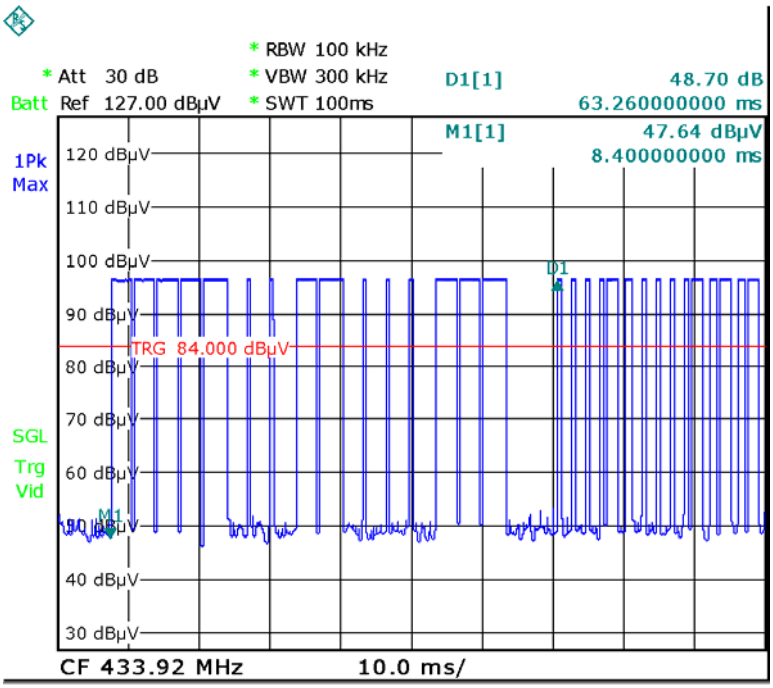
Duty Cycle Correction Factor(dB)=20 * Log_{10}(Duty Cycle(%))

Total transmission time(ms)	10*3.3+1.5*4+16*0.5=47.00
Length of a complete transmission period(ms)	100
Duty Cycle(%)	47.00
Duty Cycle Correction Factor(dB)	-6.55

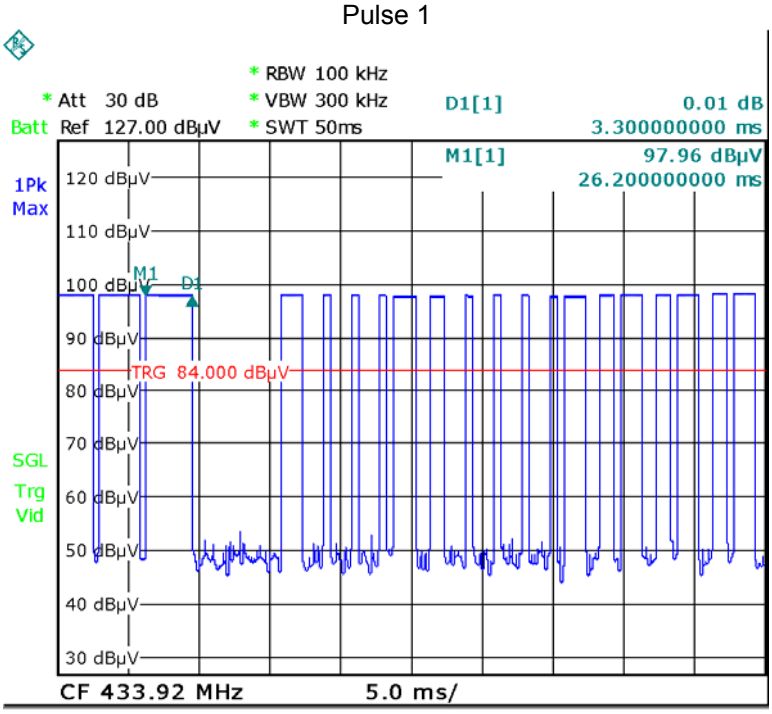
Refer to the duty cycle plot (as below),This device meets the FCC requirement.

Length of a complete pulse train:

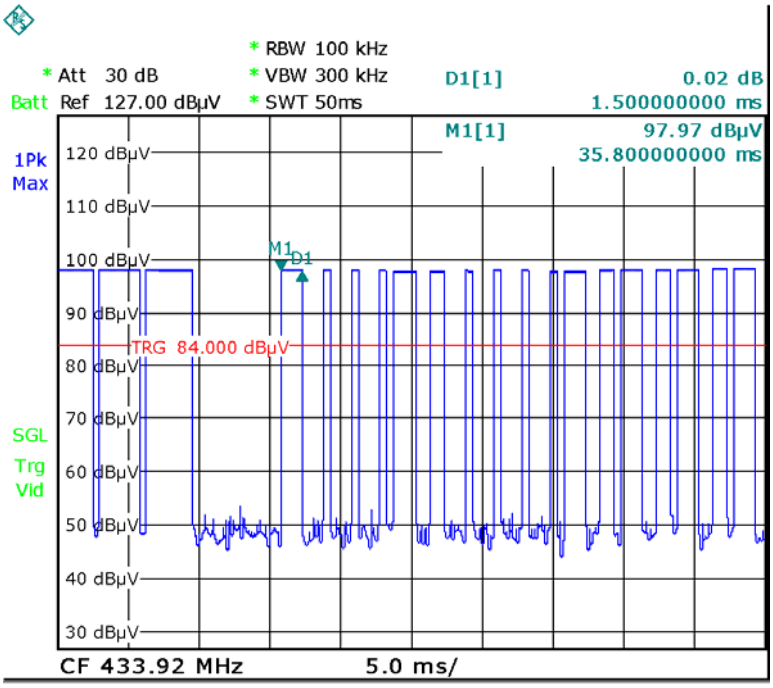
Remark: FCC part15.35(c) required that a complete pulse train is more than 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.



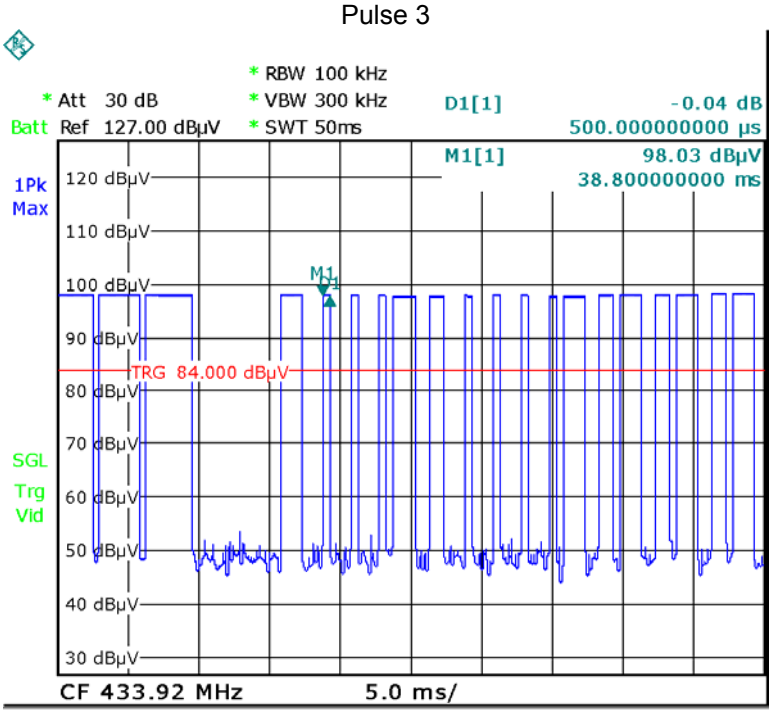
Pulse 1



Pulse 2

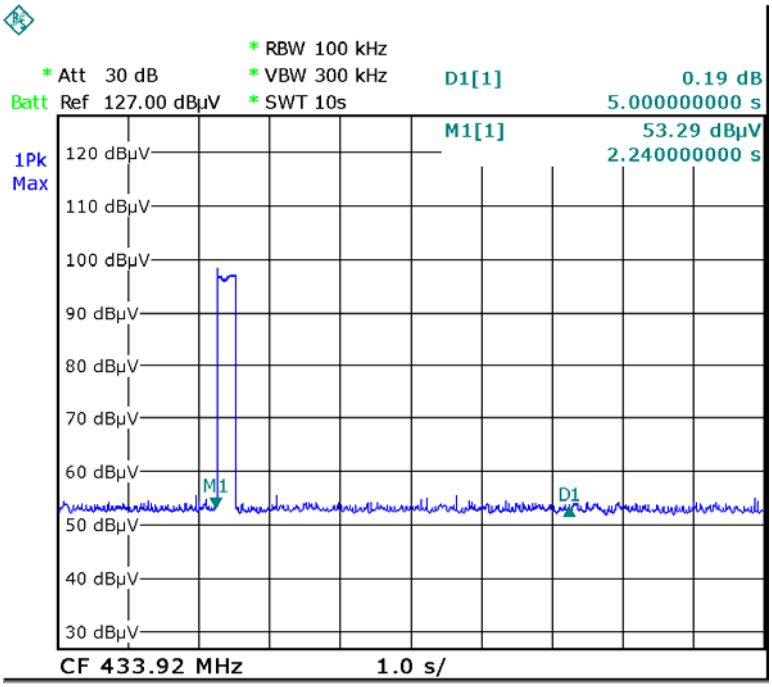


Pulse 3



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.



10 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.

10.1 Test Procedure

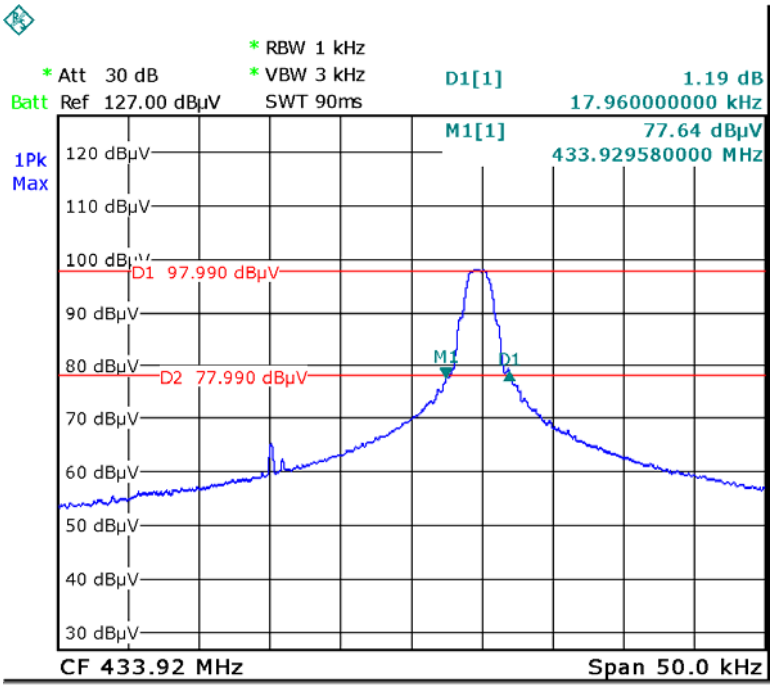
1. The transmitter output (antenna port) was connected to the spectrum analyzer.EUT and its simulators are placed on a table, let EUT working in test mode, then test it.
2. The bandwidth of the fundamental frequency was measure by spectrum analyser with 3 kHz RBW and 10 kHz VBW. The 20 dB bandwidth was recorded.

10.2 Test Result

Frequency (MHz)	20dB Bandwidth Emission(KHz)	Limit (KHz)	Result
433.92	17.96	1085	Compliance

Limit=Center Frequency*0.25%

Test Plot



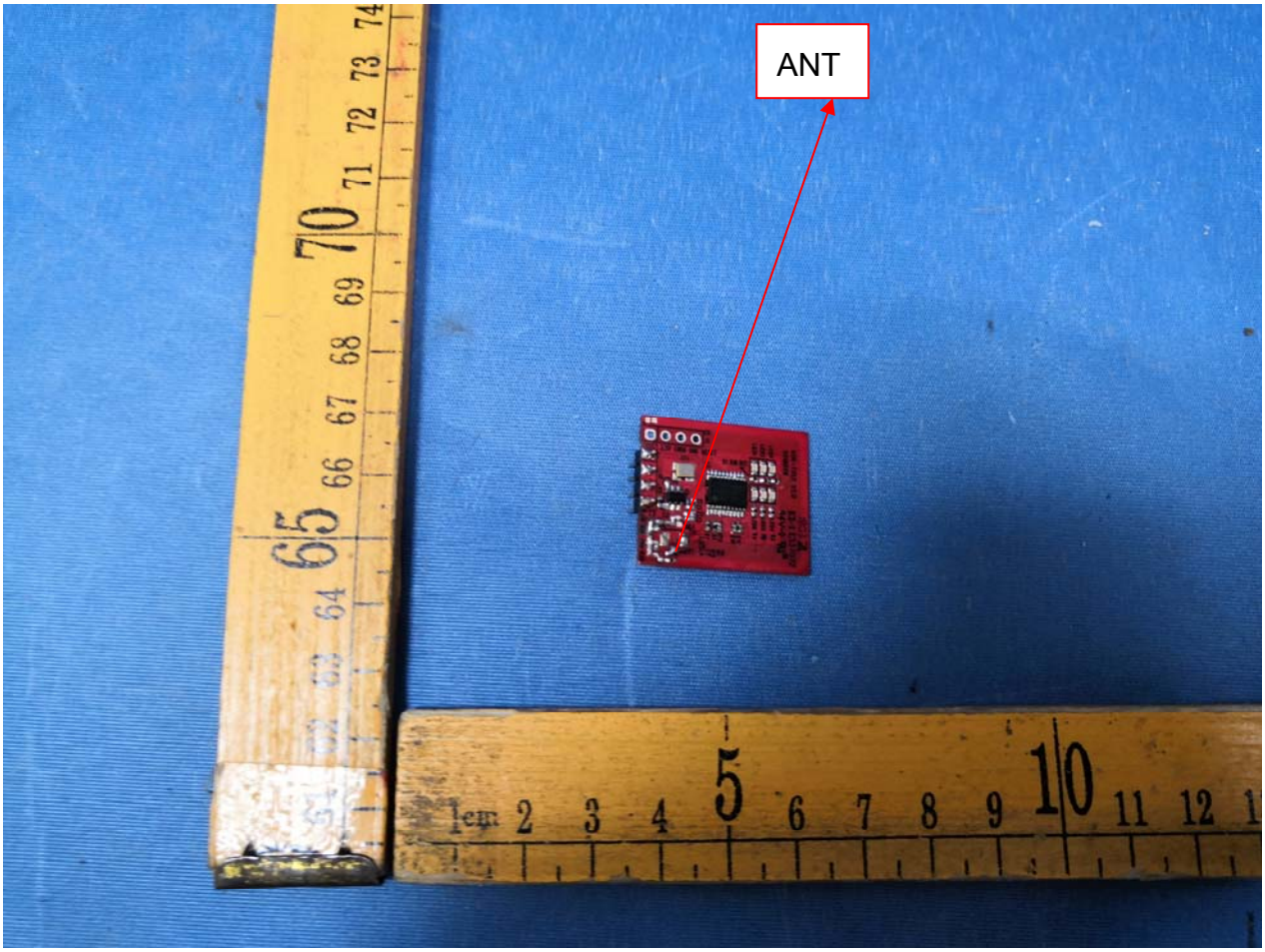
11 Antenna Requirement

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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

For intentional device, according to FCC 47 CFR Section 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.

Result:

The EUT has one Integrated Antenna, the gain is 0 dBi. meets the requirements of FCC 15.203.



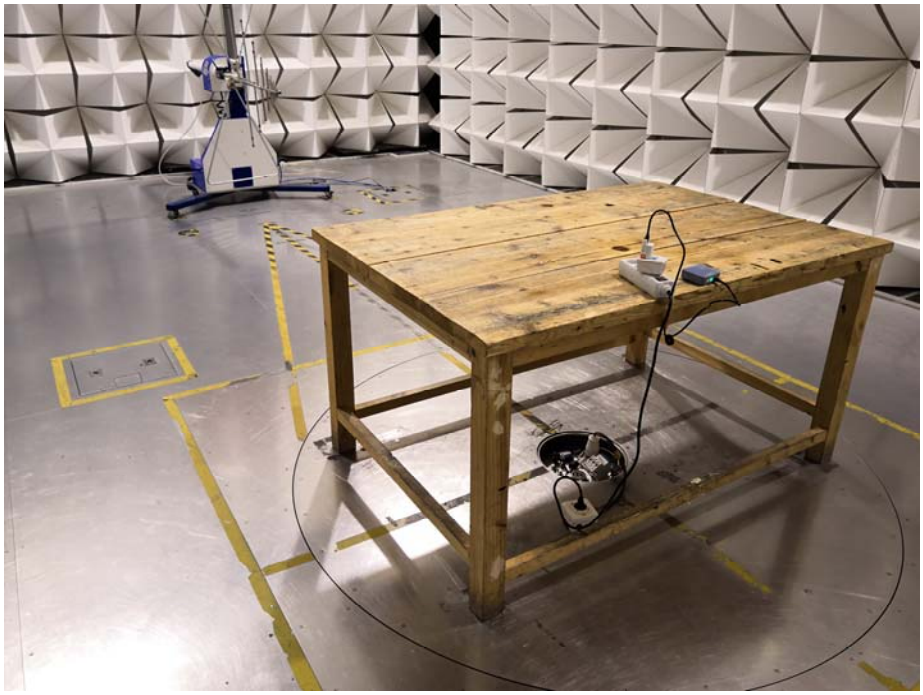
12 RF Exposure

Remark: NA

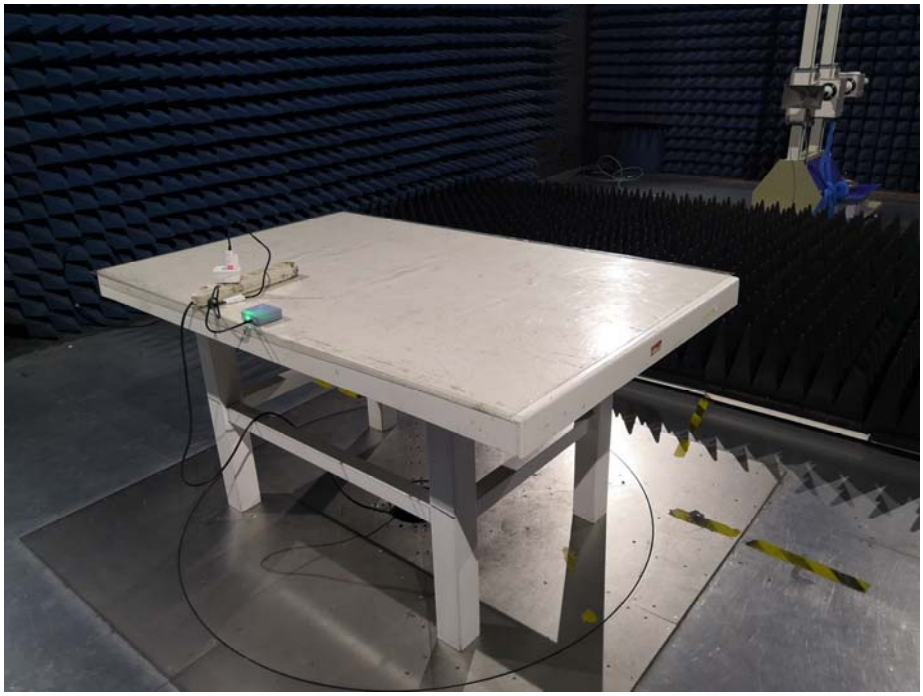
13 Photographs – Model LZ1 Test Setup

13.1 Photograph – Radiation Spurious Emission Test Setup

From 30MHz to 1GHz at test site 2#

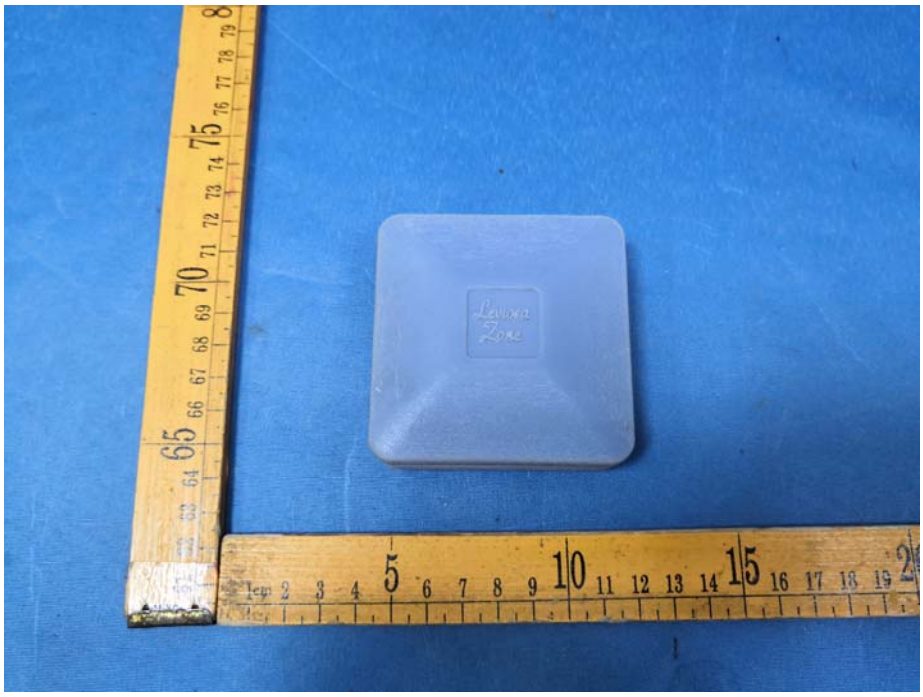


From 1GHz to 6GHz at test site 1#



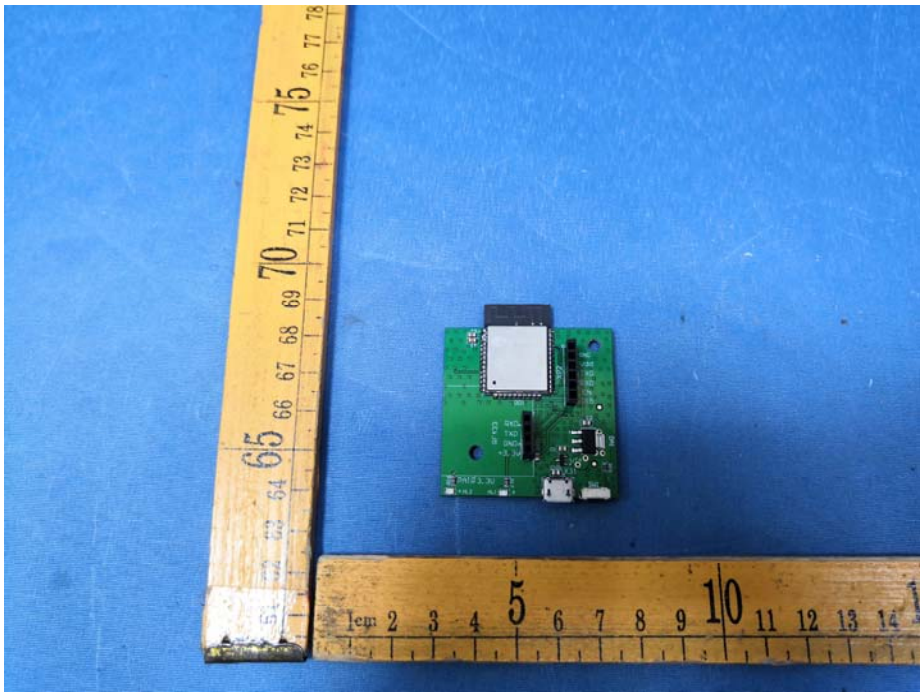
14 Photographs - Constructional Details

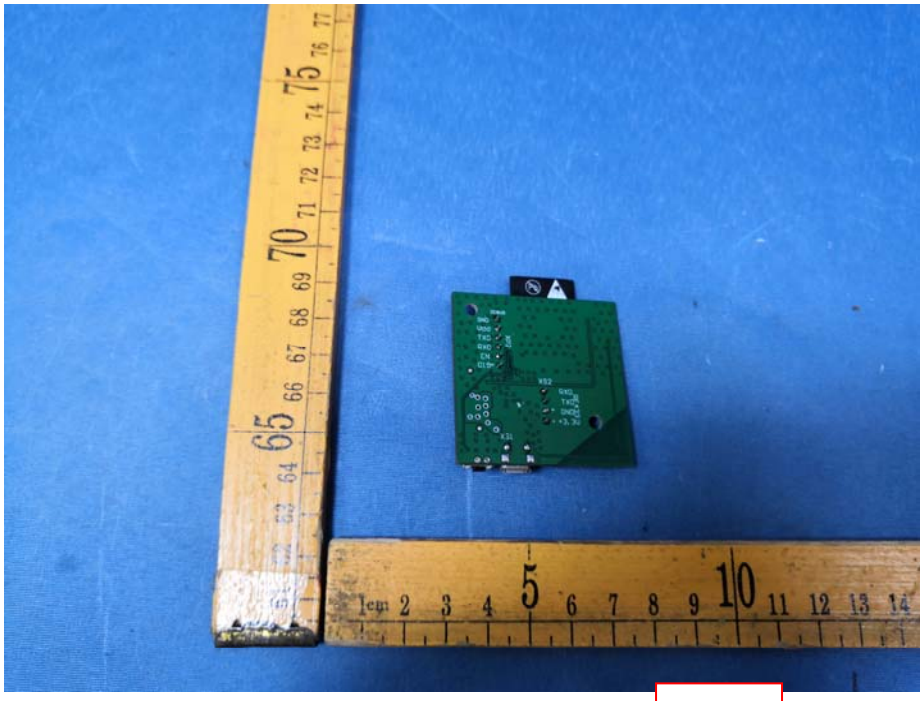
14.1 Model LZ1 - External Photos

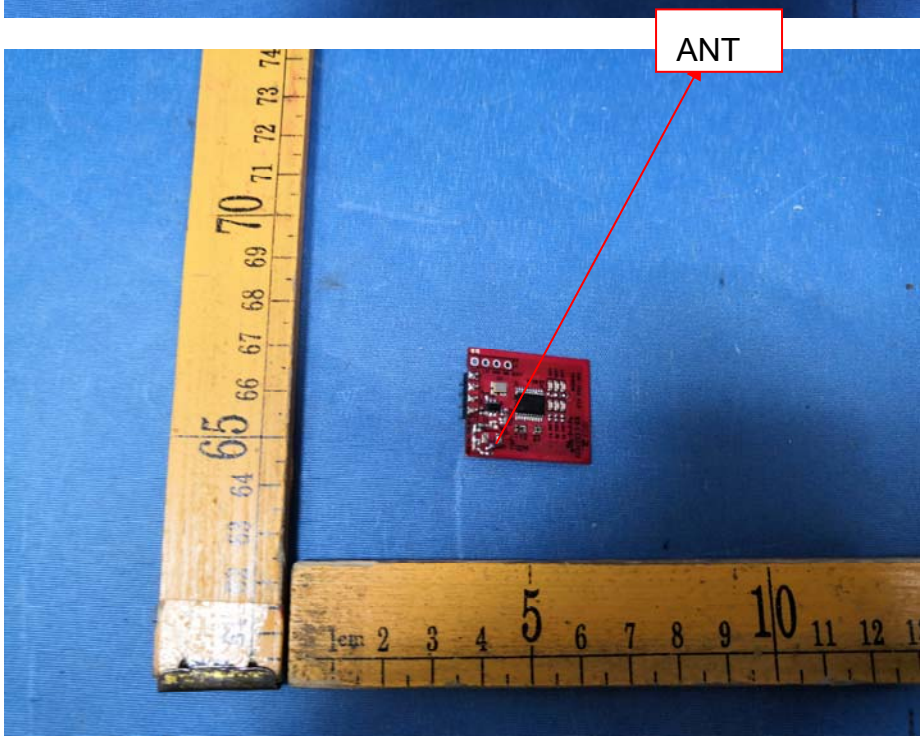


POWER ADAPTER

14.2 Model LZ1 - Internal Photos



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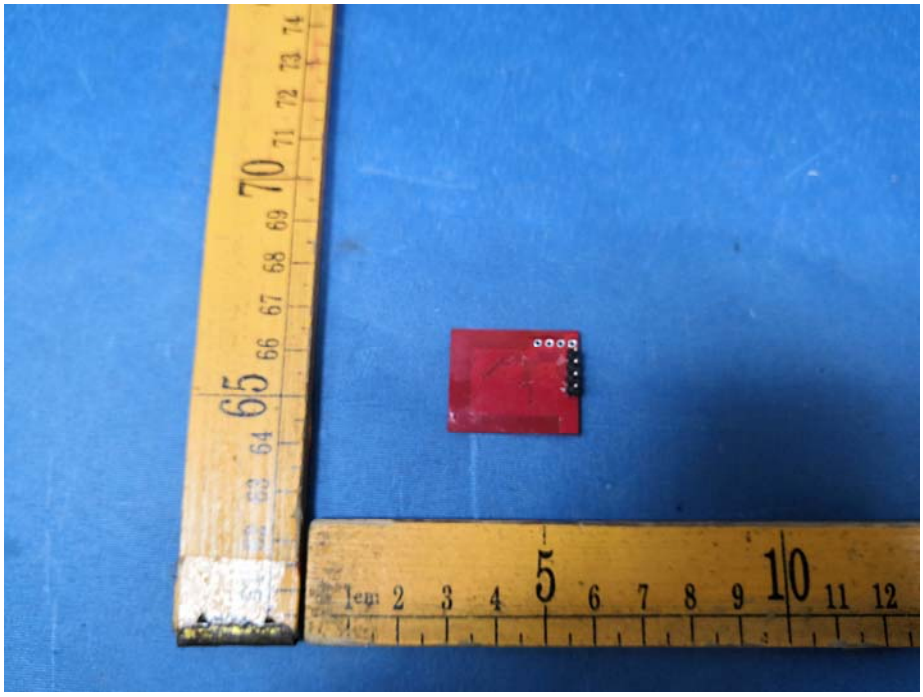
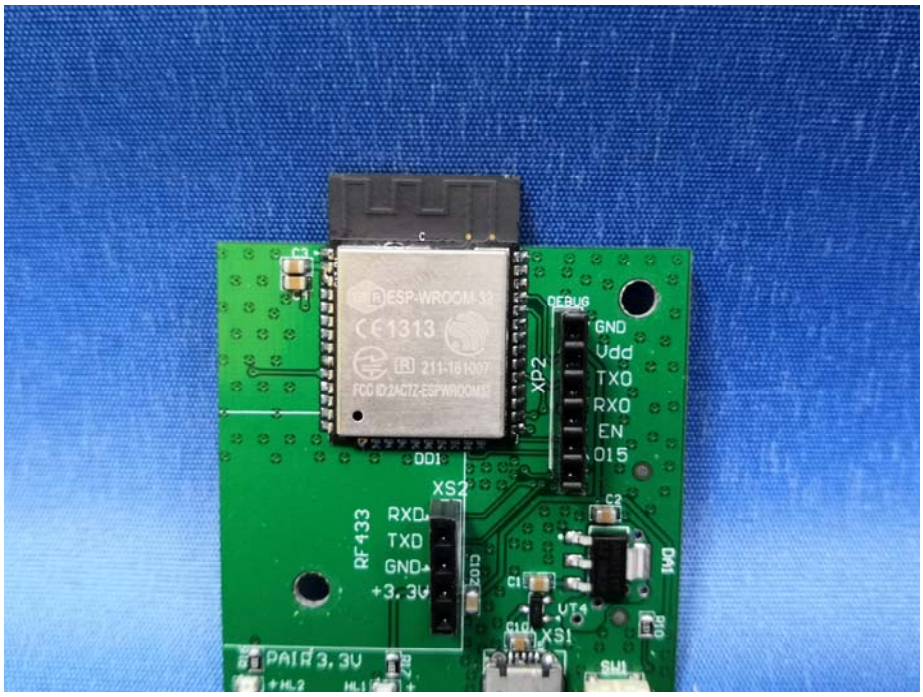
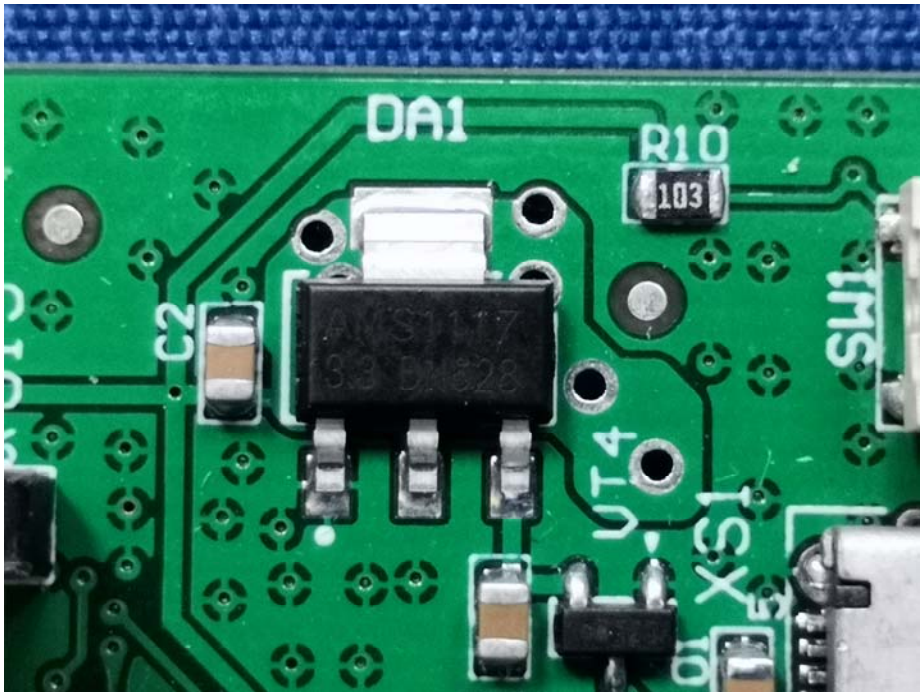
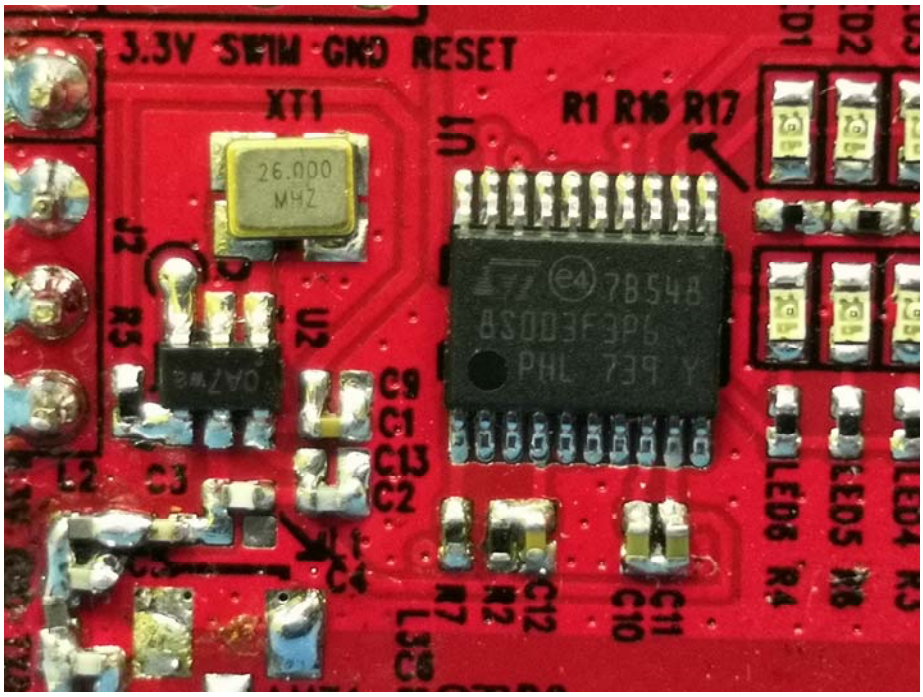



ESP-WROOM-32
CE1313
DEBUG
GND
Udd
TXO
RXO
EN
O15
XP2
XS2
RXD
TXD
GND
+3.3V
RF433
PAIR
3.3V
XS1
SW1





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