

TEST REPORT

Reference No. : WTS19S05032440W
FCC ID..... : 2AU33ELT100004
Applicant : EII-iot Incorporated
Address : 32 Journey, Aliso Viejo, California, 92656, United States
Manufacturer : Homewell Technology (Shenzhen) Co., Ltd.
Address : No.8, 5th Industrial Zone XiaCun, GongMing Town, GuangMing
New District, Shenzhen City, Guangdong Province, China
Product : HUB Air Quality
Model(s)..... : ELT-100004
Standards : FCC CFR47 Part 15 Section 15.249: 2019
Date of Receipt sample : 2019-11-05
Date of Test..... : 2019-11-06 to 2019-12-17
Date of Issue : 2019-12-25
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.

Prepared By:

Waltek Services (Shenzhen) Co., Ltd.

Address: 1/F., Fukangtai Building, West Baima Road, Songgang Street, Baoan District, Shenzhen, Guangdong, China

Test site/Test location:

Waltek Services (Shenzhen) Co., Ltd.

Address: 1/F., Fukangtai Building, West Baima Road, Songgang Street, Baoan District, Shenzhen, Guangdong, China

Tel :+86-755-83551033

Fax:+86-755-83552400

Compiled by:

Frank Yin

Frank Yin / Test Engineer

Approved by:

 Philo Zhong

Philo Zhong / Manager

1 Contents

	Page
COVER PAGE	1
1 CONTENTS	2
2 REVISION HISTORY	3
3 GENERAL INFORMATION	4
3.1 GENERAL DESCRIPTION OF E.U.T.	4
3.2 DETAILS OF E.U.T.	4
3.3 CHANNEL LIST	4
3.4 STANDARDS APPLICABLE FOR TESTING.....	4
3.5 TEST MODE	5
4 EQUIPMENT USED DURING TEST	6
4.1 EQUIPMENTS LIST	6
4.2 MEASUREMENT UNCERTAINTY	7
4.3 SUBCONTRACTED	7
4.4 TEST FACILITY	7
4.5 TEST EQUIPMENT CALIBRATION.....	7
5 TEST SUMMARY	8
6 CONDUCTED EMISSION	9
6.1 E.U.T. OPERATION	9
6.2 EUT SETUP	9
6.3 MEASUREMENT DESCRIPTION	9
6.4 CONDUCTED EMISSION TEST RESULT	10
7 RADIATION EMISSION TEST	12
7.1 EUT OPERATION	12
7.2 TEST SETUP	13
7.3 SPECTRUM ANALYZER SETUP.....	14
7.4 TEST PROCEDURE	15
7.5 FREQUENCY RANGE OF RADIATED MEASUREMENTS.	15
7.6 TEST RESULT	16
8 PERIODIC OPERATION	18
9 BAND EDGE	19
9.1 TEST PROCEDURE	19
9.2 TEST RESULT	19
10 20 DB BANDWIDTH MEASUREMENT	20
10.1 TEST PROCEDURE	20
10.2 TEST RESULT	20
11 ANTENNA REQUIREMENT	21
12 PHOTOGRAPHS- MODEL ELT-100004 TEST SETUP PHOTOS.....	22
13 PHOTOGRAPHS - CONSTRUCTIONAL DETAILS	22
13.1 EXTERNAL PHOTOS.....	22
13.2 INTERNAL PHOTOS.....	22

2 Revision History

Test Report No.	Date of Receipt Sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS19S05032440W	2019-11-05	2019-11-06 to 2019-12-17	2019-12-25	original	-	Valid

3 General Information

3.1 General Description of E.U.T.

Product: HUB Air Quality
Model(s): ELT-100004
Operation Frequency: 909.3MHz
Antenna installation: Integrated Antenna
Antenna Gain: 2.0dBi
Type of Modulation: Lora

3.2 Details of E.U.T.

Ratings: AC adapter:
Input: 100-240V~, 50/60Hz, 0.4A
Output: DC 5V, 750mA

3.3 Channel List

Channel No.	Frequency (MHz)
1	909.3

3.4 Standards Applicable for Testing

The tests were performed according to following standards:

FCC CFR47 Part 15 Section 15.249: 2019 Telecommunication-RADIO FREQUENCY DEVICES-Intentional Radiators-Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz.

3.5 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests.

And according to FCC 47 CFR Section 15.203(m):

Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle.
1 to 10 MHz	2	1 near top and 1 near bottom.
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

So frequency range over 909.3MHz is 1 MHz or less. Only the Middle of frequency range was recorded and reported.

Test mode	Test channel
Transmitting	909.3MHz

4 Equipment Used during Test

4.1 Equipments List

Conducted Emissions at Mains Terminals Disturbance Voltage						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	EMI Test Receiver	R&S	ESCI	100947	2019-09-17	2020-09-16
2	LISN	R&S	ENV216	100115	2019-09-17	2020-09-16
3	Cable	Top	TYPE16(3.5M)	-	2019-09-17	2020-09-16
3m Semi-anechoic Chamber for Radiation Emissions						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	Spectrum Analyzer	R&S	FSP30	100091	2019-04-19	2020-04-18
2	Broad-band Horn Antenna(1-18GHz)	SCHWARZBECK	BBHA 9120 D	667	2019-04-19	2020-04-18
3	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2019-04-19	2020-04-18
4	Coaxial Cable (above 1GHz)	Top	1GHz-18GHz	EW02014-7	2019-04-19	2020-04-18
3m Semi-anechoic Chamber for Radiation Emissions						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	Test Receiver	R&S	ESCI	101296	2019-04-20	2020-04-19
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2019-05-24	2020-05-23
3	Active Loop Antenna	Com-Power Corp.	AL-130R	10160007	2019-04-28	2020-04-27
4	Amplifier	ANRITSU	MH648A	M43381	2019-04-19	2020-04-18
5	Cable	HUBER+SUHNER	CBL2	525178	2019-04-20	2020-04-19
6	Coaxial Cable (below 1GHz)	Top	TYPE16 (13M)	-	2019-09-17	2020-09-16
RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	Spectrum Analyzer	R&S	FSL6	100959	2019-09-17	2020-09-16
2	Coaxial Cable	Top	10Hz-30GHz	-	2019-09-17	2020-09-16
3	Antenna Connector*	Realacc	45RSm	-	2019-09-17	2020-09-16
4	DC Block	Gwave	GDCB-3G-N-SMA	140307001	2019-09-17	2020-09-16

4.2 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 (Bilog antenna 30M~1000MHz)
	± 5.47 dB (Horn antenna 1000M~25000MHz)

4.3 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: N/A

Lab address: N/A

Test items: N/A

4.4 Test Facility

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

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

4.5 Test Equipment Calibration

All the test equipments used are valid and calibrated by GUANG ZHOU GRG METROLOGY & TEST CO., LTD. address is No.163, Pingyun Rd. West of Huangpu Ave, Tianhe District, Guangzhou, Guangdong, China.

5 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207	Pass
Radiated Emission	15.249(a) 15.209 15.205(a)	Pass
Periodic Operation	15.35(c)	Pass
Band Edge	15.249 15.205 15.209	Pass
20dB Bandwidth	15.215(c)	Pass
Antenna Requirement	15.203	Pass
Note: Pass=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable.		

6 Conducted Emission

Test Requirement:	FCC CFR 47 Part 15 Section 15.207
Test Method:	ANSI C63.10:2013
Test Result:	PASS
Frequency Range:	150kHz to 30MHz
Class/Severity:	Class B
Limit:	66-56 dB μ V between 0.15MHz & 0.5MHz 56 dB μ V between 0.5MHz & 5MHz 60 dB μ V between 5MHz & 30MHz
Detector:	Peak for pre-scan (9kHz Resolution Bandwidth)

6.1 E.U.T. Operation

Operating Environment:

Temperature: 21.5 °C

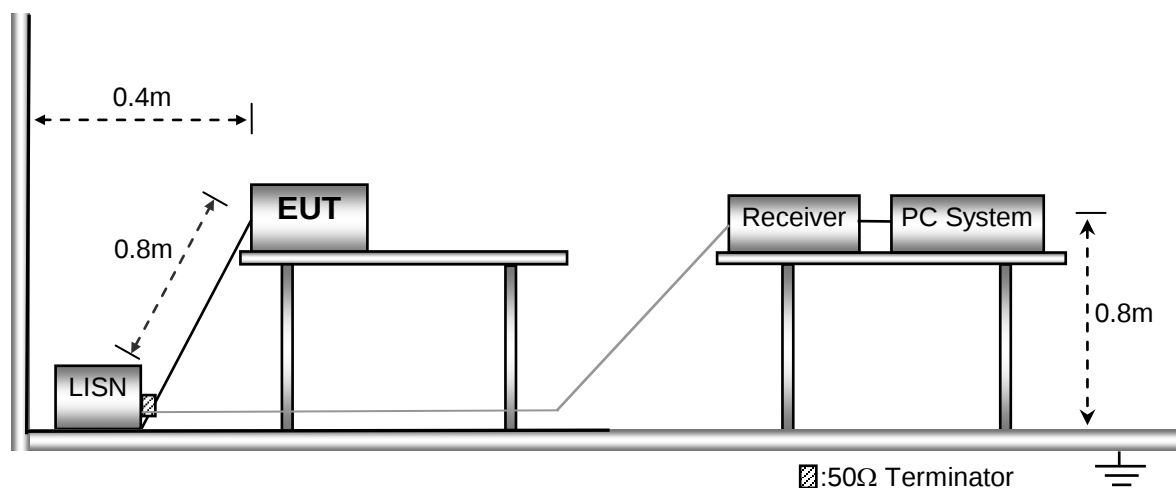
Humidity: 51.9 % RH

Atmospheric Pressure: 101.2kPa

EUT Operation: The test was performed in Transmitting mode, the test data were shown in the report.

6.2 EUT Setup

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



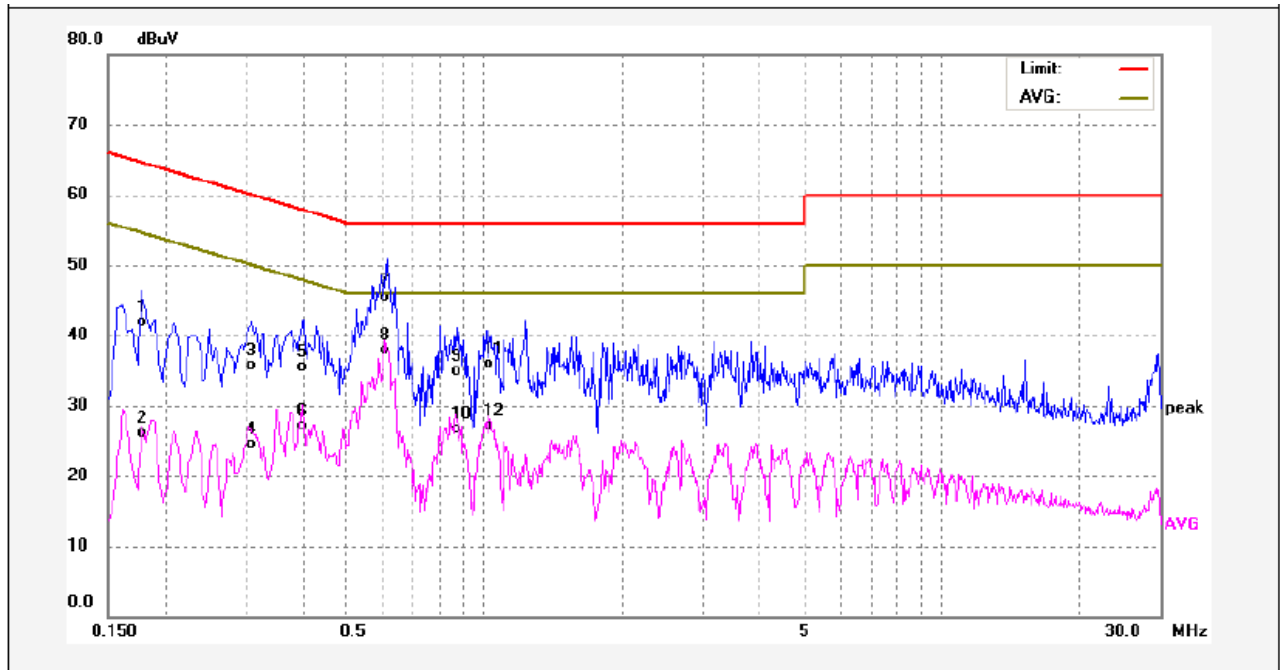
6.3 Measurement Description

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.

6.4 Conducted Emission Test Result

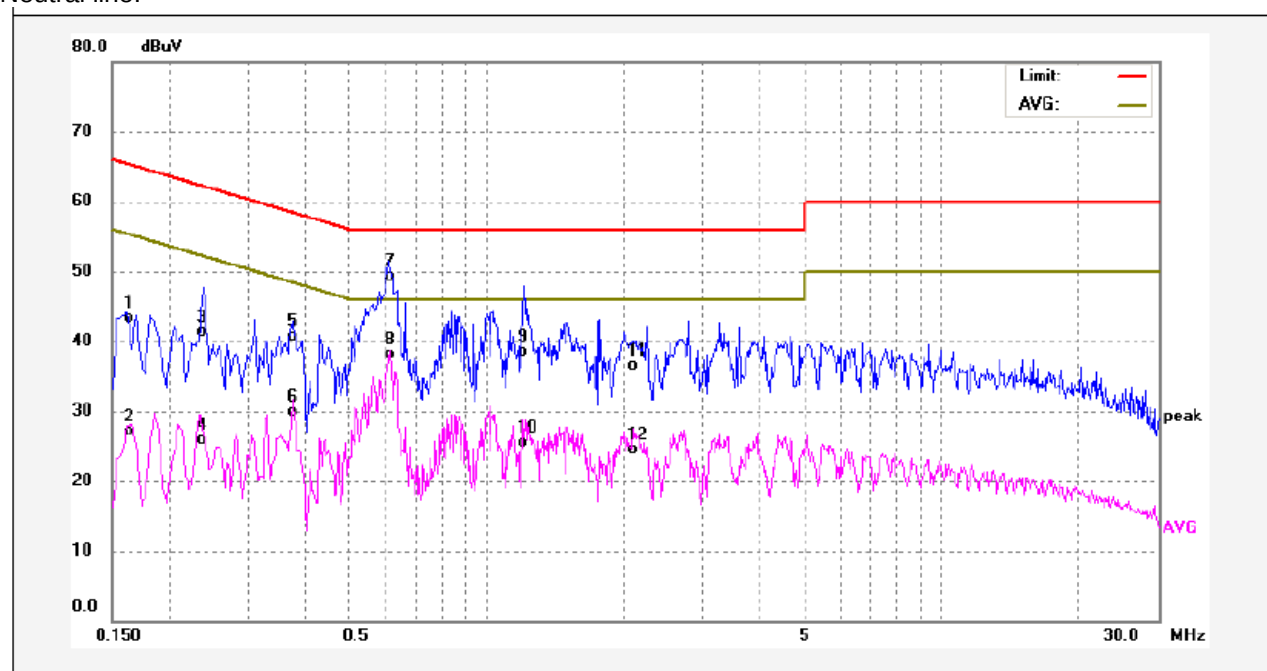
An initial pre-scan was performed on the live and neutral lines.

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1780	32.05	9.78	41.83	64.57	-22.74	QP	
2	0.1780	16.27	9.78	26.05	54.57	-28.52	AVG	
3	0.3100	25.81	9.82	35.63	59.97	-24.34	QP	
4	0.3100	14.64	9.82	24.46	49.97	-25.51	AVG	
5	0.4020	25.65	9.83	35.48	57.81	-22.33	QP	
6	0.4020	17.34	9.83	27.17	47.81	-20.64	AVG	
7	0.6140	35.69	9.84	45.53	56.00	-10.47	QP	
8	0.6140	28.16	9.84	38.00	46.00	-8.00	AVG	
9	0.8700	25.05	9.87	34.92	56.00	-21.08	QP	
10	0.8700	16.79	9.87	26.66	46.00	-19.34	AVG	
11	1.0220	26.08	9.86	35.94	56.00	-20.06	QP	
12	1.0220	17.25	9.86	27.11	46.00	-18.89	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Remark
1	0.1620	33.46	9.77	43.23	65.36	-22.13	QP	
2	0.1620	17.41	9.77	27.18	55.36	-28.18	AVG	
3	0.2380	31.51	9.76	41.27	62.16	-20.89	QP	
4	0.2380	16.13	9.76	25.89	52.16	-26.27	AVG	
5	0.3740	30.94	9.81	40.75	58.41	-17.66	QP	
6	0.3740	20.01	9.81	29.82	48.41	-18.59	AVG	
7	0.6100	39.37	9.84	49.21	56.00	-6.79	QP	
8	0.6100	28.35	9.84	38.19	46.00	-7.81	AVG	
9	1.2140	28.67	9.90	38.57	56.00	-17.43	QP	
10	1.2140	15.68	9.90	25.58	46.00	-20.42	AVG	
11	2.1060	26.46	9.96	36.42	56.00	-19.58	QP	
12	2.1060	14.52	9.96	24.48	46.00	-21.52	AVG	

7 Radiation Emission Test

Test Requirement: FCC Part15 Paragraph 15.249&15.209&15.205

Test Method: ANSI 63.10: 2013

Measurement Distance: 3m

Test Result: ☒ Pass ☐ Fail

15.249(a)Limit:

Fundamental frequency	Field strength of fundamental		Field strength of harmonics	
	mV/m	dBuV/m	uV/m	dBuV/m
902-928 MHz	50	94	500	54
2400-2483.5 MHz	50	94	500	54
5725-5875 MHz	50	94	500	54
24.0-24.25 GHz	250	108	2500	68

15.209 Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	$2400/F(\text{kHz})$	300	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	$24000/F(\text{kHz})$	30	$100 * 24000/F(\text{kHz})$	$20\log^{(24000/F(\text{kHz}))} + 40$
1.705 ~ 30	30	30	$100 * 30$	$20\log^{(30)} + 40(29.54+40)$
30 ~ 88	100	3	100	$20\log^{(100)} = (40)$
88 ~ 216	150	3	150	$20\log^{(150)} = (43.5)$
216 ~ 960	200	3	200	$20\log^{(200)} = (46)$
Above 960	500	3	500	$20\log^{(500)} = (54)$

Note: RF Voltage(dBuV)=20 log₁₀ RF Voltage(uV)

7.1 EUT Operation

Operating Environment :

Temperature: 23.1 °C

Humidity: 53.6 % RH

Atmospheric Pressure: 101.3kPa

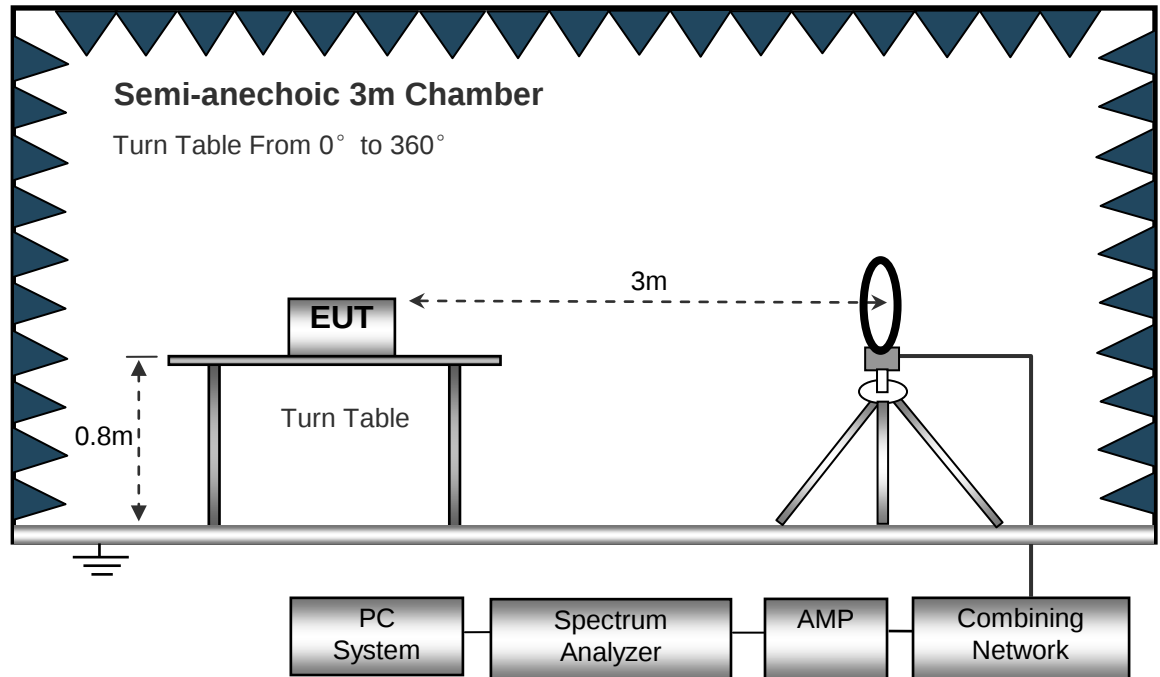
EUT Operation :

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

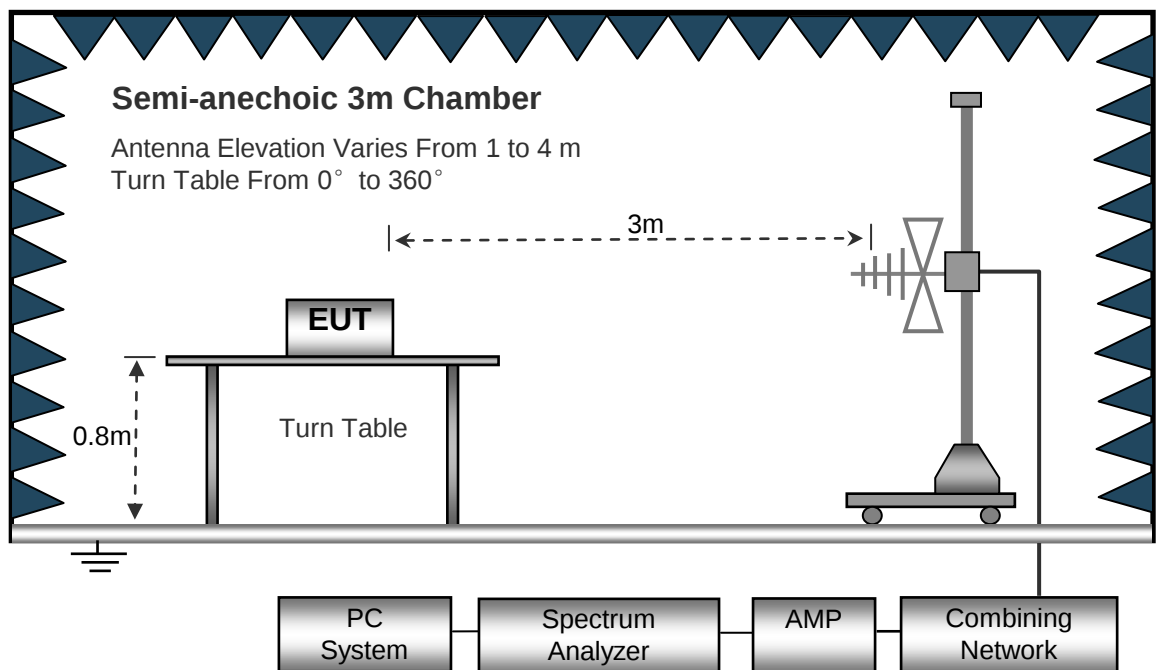
7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10: 2013.

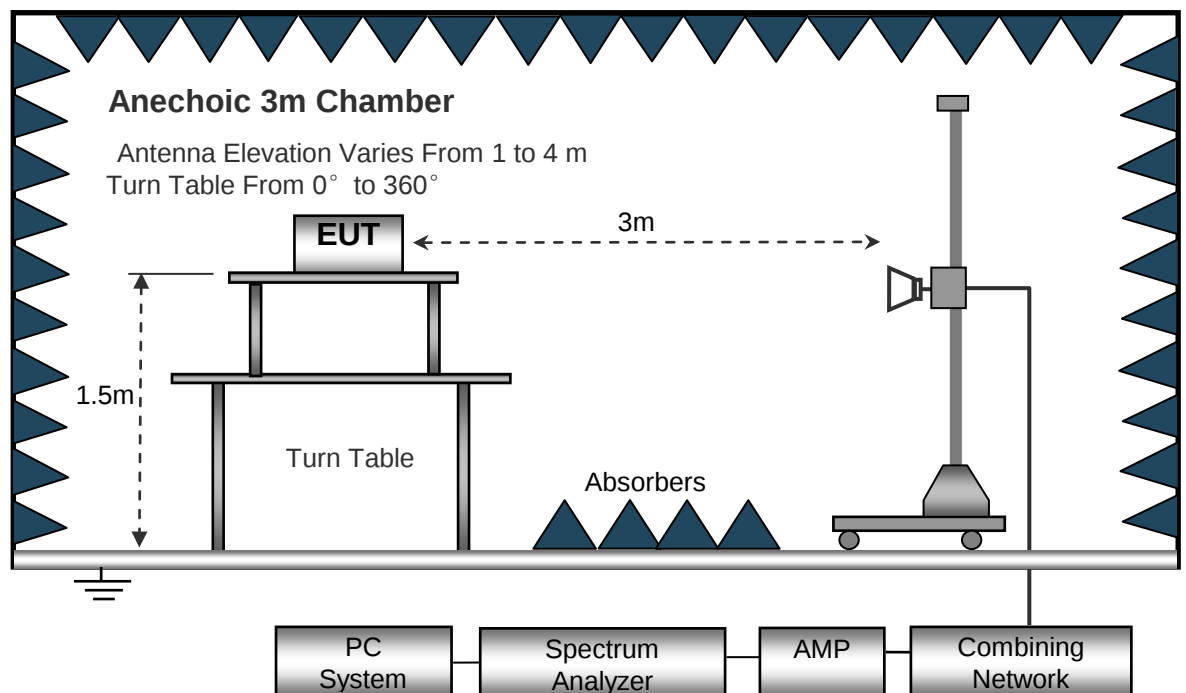
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



7.3 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
 Detector Ave.
 Resolution Bandwidth 1MHz
 Video Bandwidth 10Hz

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 Frequency range of radiated measurements.

According to FCC 47 CFR Section 15.33:

(a) For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:

(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(2) If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

(3) If the intentional radiator operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.

(4) If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to the range specified in paragraphs (a)(1) through (a)(3) of this section or the range applicable to the digital device, as shown in paragraph (b)(1) of this section, whichever is the higher frequency range of investigation.

7.6 Test Result

Test Frequency: 9 kHz ~ 10GHz

Only the worst case and the worst frequency test data were recorded in the report, other frequency are attenuate more than 20dB below the permissible value and not reported.

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.249/209/205	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP)	Degree	(m)	(H/V)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)
37.68	37.42	QP	214	1.6	H	-16.62	20.80	40.00	-19.20
37.68	51.02	QP	296	1.9	V	-16.62	34.40	40.00	-5.60
909.30	99.84	PK	276	1.8	H	-2.98	96.86	114.00	-17.14
909.30	93.11	PK	356	1.7	V	-2.98	90.13	114.00	-23.87
1818.60	60.24	PK	50	1.6	H	-9.93	50.31	74.00	-23.69
1818.60	58.39	PK	256	1.1	V	-9.93	48.46	74.00	-25.54
3637.20	48.26	PK	63	1.5	H	-5.83	42.43	74.00	-31.57
3637.20	54.17	PK	100	1.5	V	-5.83	48.34	74.00	-25.66
5455.80	47.42	PK	304	1.5	H	-2.27	45.15	74.00	-28.85
5455.80	45.12	PK	247	1.7	V	-2.27	42.85	74.00	-31.15

$AV = \text{Peak} + 20\log_{10}(\text{duty cycle}) = PK + (-5.71)$ [refer to section 8 for more detail]

Frequency	PK	RX Antenna Polar	Duty cycle Factor	AV	FCC Part 15.249/209/205	
					Limit	Margin
(MHz)	(dBμV/m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
909.30	96.86	H	-5.71	91.15	94.00	-2.85
909.30	90.13	V	-5.71	84.42	94.00	-9.58
1818.60	50.31	H	-5.71	44.60	54.00	-9.40
1818.60	48.46	V	-5.71	42.75	54.00	-11.25
3637.20	42.43	H	-5.71	36.72	54.00	-17.28
3637.20	48.34	V	-5.71	42.63	54.00	-11.37
5455.80	45.15	H	-5.71	39.44	54.00	-14.56
5455.80	42.85	V	-5.71	37.14	54.00	-16.86

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

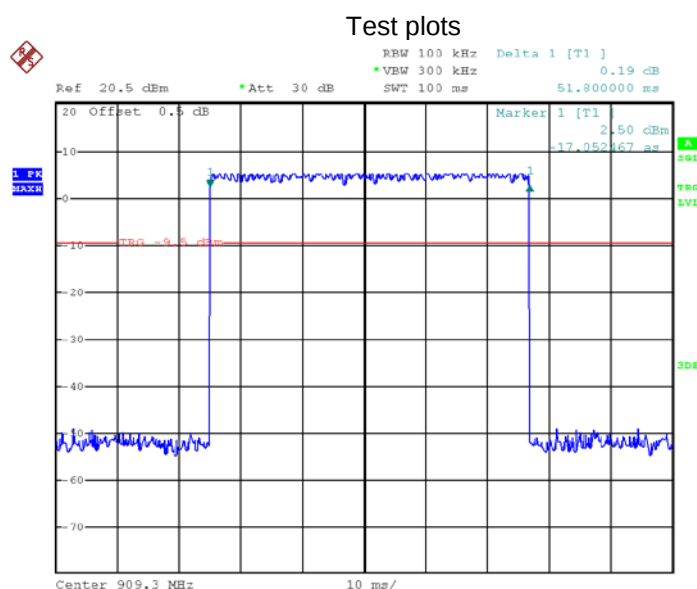
Duty Cycle(%)=Total On interval in a complete pulse train/ Length of a complete pulse train * %

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

Test channel	Low Channel
Total transmission time(ms)	51.8
Length of a complete transmission period(ms)	100*
Duty Cycle(%)	51.8
Duty Cycle Correction Factor(dB)	-5.71

(* Note: the transmitter operates for longer 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. So the Length of a complete transmission period=100ms)

Refer to the duty cycle plot (as below)



Date: 16.DEC.2019 01:21:13

9 Band Edge

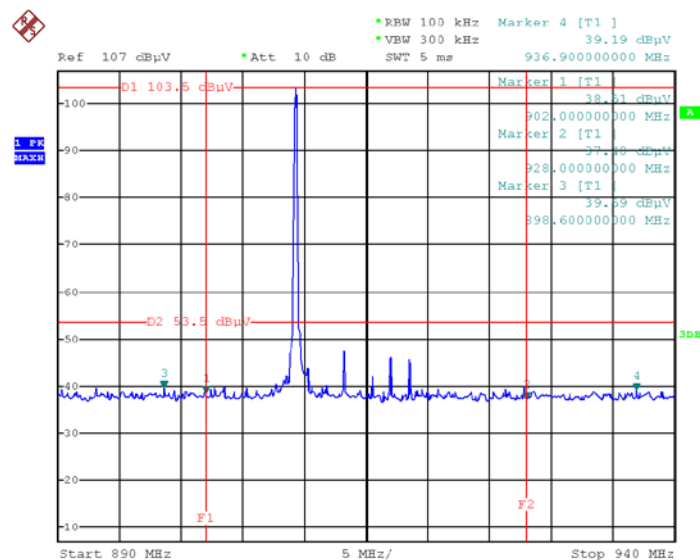
Test Requirement:	15.249(d):Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
Test Method:	ANSI C63.10:2013
Test Mode:	Transmitting

9.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold

9.2 Test Result

Test plots



Date: 28.NOV.2019 01:19:18

10 20 dB Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.215(c)

Test Method: ANSI C63.10:2013

Test Mode: Transmitting

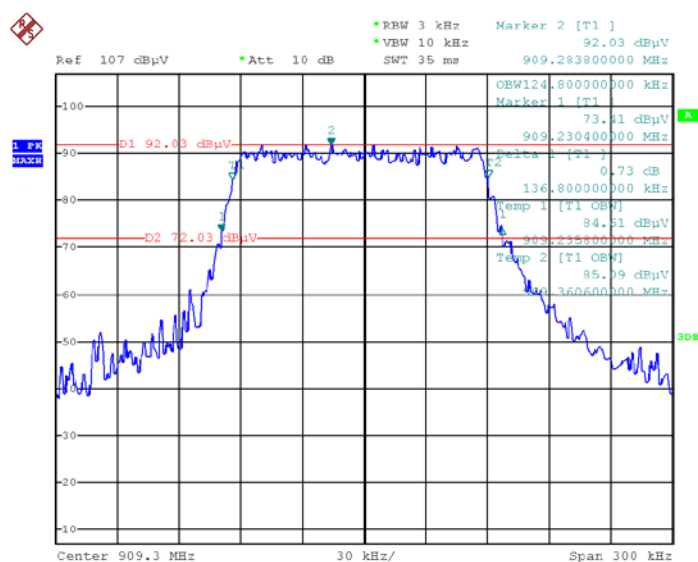
10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 3kHz, VBW = 10kHz

10.2 Test Result

Test channel	Frequency (MHz)	20dB Bandwidth Emission(kHz)
	909.3	124.80

Test plots



Date: 3.DEC.2019 23:53:20

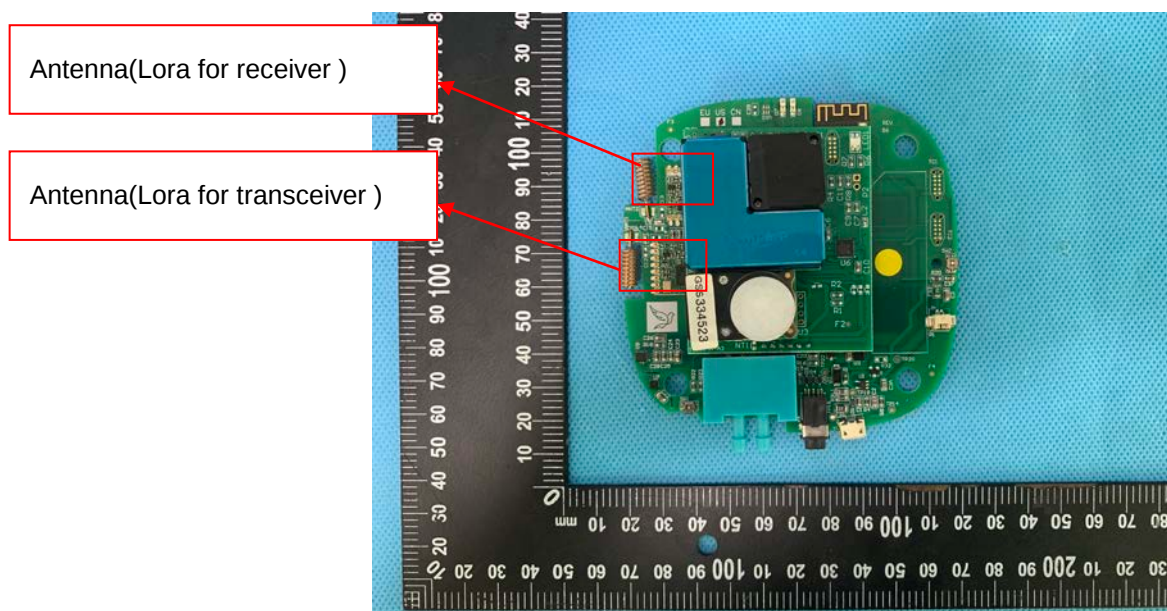
11 Antenna Requirement

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 2.0dBi. meets the requirements of FCC 15.203.



12 Photographs- Model ELT-100004 Test Setup Photos

Note: Please refer to Photos: ELT-100004_Test Setup Photos.

13 Photographs - Constructional Details

13.1 External Photos

Note: Please refer to Photos: ELT-100004_External Photos.

13.2 Internal Photos

Note: Please refer to Photos: ELT-100004_Internal Photos.

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