

# FCC TEST REPORT

**Product Name:** Smart Thermostat  
**Trade Mark:** Hailin  
**Model No.:** BluStat  
**Add. Model No.:** N/A  
**Report Number:** 200303008RFC-1  
**Test Standards:** FCC 47 CFR Part 15 Subpart C  
**FCC ID:** 2AJ5K-BLUSTAT  
**Test Result:** PASS  
**Date of Issue:** June 17, 2020

Prepared for:

**Beijing Hailin Energy Saving Technology Inc**  
**Huilongguan International Information Industry Base, Changping**  
**District, Beijing,China**

Prepared by:

**Shenzhen UnionTrust Quality and Technology Co., Ltd.**  
**16/F, Block A, Building 6, Baoneng Science and Technology Park,**  
**Qingxiang Road No.1, Longhua New District, Shenzhen, China**  
**TEL: +86-755-2823 0888**  
**FAX: +86-755-2823 0886**

Prepared by: \_\_\_\_\_

*Tony*  
 Tony Kang  
 Project Engineer

Reviewed by: \_\_\_\_\_

*Kevin Liang*  
 Kevin Liang  
 Assistant Manager

Approved by: \_\_\_\_\_



Technical Director

Date: \_\_\_\_\_

June 17, 2020

**Shenzhen UnionTrust Quality and Technology Co., Ltd.**

**Version**

Version No.	Date	Description
V1.0	March 27, 2020	Original
V1.1	June 17, 2020	1. FCC ID change from 2AJ5K-BluStat to 2AJ5K-BLUSTAT 2. Update applicant information 3. input the peak and average value in page 41 and 43



## CONTENTS

<b>1. GENERAL INFORMATION</b>	<b>4</b>
<b>1.1 CLIENT INFORMATION</b>	<b>4</b>
<b>1.2 EUT INFORMATION</b>	<b>4</b>
1.2.1 GENERAL DESCRIPTION OF EUT	4
1.2.2 DESCRIPTION OF ACCESSORIES	4
<b>1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD</b>	<b>4</b>
<b>1.4 OTHER INFORMATION</b>	<b>5</b>
<b>1.5 DESCRIPTION OF SUPPORT UNITS</b>	<b>5</b>
<b>1.6 TEST LOCATION</b>	<b>5</b>
<b>1.7 TEST FACILITY</b>	<b>5</b>
<b>1.8 DEVIATION FROM STANDARDS</b>	<b>5</b>
<b>1.9 ABNORMALITIES FROM STANDARD CONDITIONS</b>	<b>5</b>
<b>1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER</b>	<b>6</b>
<b>1.11 MEASUREMENT UNCERTAINTY</b>	<b>6</b>
<b>2. TEST SUMMARY</b>	<b>7</b>
<b>3. EQUIPMENT LIST</b>	<b>8</b>
<b>4. TEST CONFIGURATION</b>	<b>9</b>
<b>4.1 ENVIRONMENTAL CONDITIONS FOR TESTING</b>	<b>9</b>
4.1.1 NORMAL OR EXTREME TEST CONDITIONS	9
4.1.2 RECORD OF NORMAL ENVIRONMENT	9
<b>4.2 TEST CHANNELS</b>	<b>9</b>
<b>4.3 EUT TEST STATUS</b>	<b>10</b>
<b>4.4 PRE-SCAN</b>	<b>10</b>
<b>4.5 TEST SETUP</b>	<b>11</b>
4.5.1 FOR RADIATED EMISSIONS TEST SETUP	11
4.5.2 FOR CONDUCTED EMISSIONS TEST SETUP	12
4.5.3 FOR CONDUCTED RF TEST SETUP	13
<b>4.6 SYSTEM TEST CONFIGURATION</b>	<b>13</b>
<b>4.7 DUTY CYCLE</b>	<b>14</b>
<b>5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION</b>	<b>16</b>
<b>5.1 REFERENCE DOCUMENTS FOR TESTING</b>	<b>16</b>
<b>5.2 ANTENNA REQUIREMENT</b>	<b>16</b>
<b>5.3 CONDUCTED PEAK OUTPUT POWER</b>	<b>17</b>
<b>5.4 6 DB BANDWIDTH</b>	<b>18</b>
<b>5.5 POWER SPECTRAL DENSITY</b>	<b>21</b>
<b>5.6 CONDUCTED OUT OF BAND EMISSION</b>	<b>24</b>
<b>5.7 RADIATED SPURIOUS EMISSIONS</b>	<b>31</b>
<b>5.8 BAND EDGE MEASUREMENTS (RADIATED)</b>	<b>37</b>
<b>5.9 CONDUCTED EMISSION</b>	<b>44</b>
<b>APPENDIX 1 PHOTOS OF TEST SETUP</b>	<b>47</b>
<b>APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS</b>	<b>47</b>

## 1. GENERAL INFORMATION

### 1.1 CLIENT INFORMATION

<b>Applicant:</b>	Beijing Hailin Energy Saving Technology Inc
<b>Address of Applicant:</b>	Huilongguan International Information Industry Base, Changping District, Beijing, China
<b>Manufacturer:</b>	Beijing Hailin Energy Saving Technology Inc
<b>Address of Manufacturer:</b>	Huilongguan International Information Industry Base, Changping District, Beijing, China

### 1.2 EUT INFORMATION

#### 1.2.1 General Description of EUT

<b>Product Name:</b>	Smart Thermostat	
<b>Model No.:</b>	BluStat	
<b>Add. Model No.:</b>	N/A	
<b>Trade Mark:</b>	Hailin	
<b>DUT Stage:</b>	Identical Prototype	
<b>EUT Supports Function:</b>	2.4 GHz ISM Band:	IEEE 802.11b/g/n
<b>Sample Received Date:</b>	March 10, 2020	
<b>Sample Tested Date:</b>	March 10, 2020 to March 27, 2020	

#### 1.2.2 Description of Accessories

N/A

### 1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

<b>Frequency Band:</b>	2400 MHz to 2483.5 MHz
<b>Frequency Range:</b>	2412 MHz to 2462 MHz
<b>Support Standards:</b>	IEEE 802.11b, IEEE 802.11g, IEEE 802.11n-HT20
<b>Type of Modulation:</b>	IEEE 802.11b: DSSS(CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM(64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT20: OFDM(64-QAM, 16-QAM, QPSK, BPSK)
<b>Data Rate:</b>	IEEE 802.11b: Up to 11 Mbps IEEE 802.11g: Up to 54 Mbps IEEE 802.11n-HT20: Up to MCS7(64 Mbps)
<b>Number of Channels:</b>	IEEE 802.11b: 11 IEEE 802.11g: 11 IEEE 802.11n-HT20: 11
<b>Channel Separation:</b>	5 MHz
<b>Antenna Type:</b>	Integral Antenna
<b>Antenna Gain:</b>	2 dBi
<b>Maximum Peak Power:</b>	IEEE 802.11b: 16.62 dBm IEEE 802.11g: 19.66 dBm IEEE 802.11n-HT20: 18.59 dBm
<b>Normal Test Voltage:</b>	AC 24 V

### 1.4 OTHER INFORMATION

Operation Frequency Each of Channel	
IEEE 802.11b, IEEE 802.11g, IEEE 802.11n-HT20	$f = 2407 + 5k \text{ MHz}, k = 1, \dots, 11$
Note: <b>f</b> is the operating frequency (MHz); <b>k</b> is the operating channel.	

### 1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested independently

### 1.6 TEST LOCATION

**Shenzhen UnionTrust Quality and Technology Co., Ltd.**

Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China 518109  
 Telephone: +86 (0) 755 2823 0888  
 Fax: +86 (0) 755 2823 0886

### 1.7 TEST FACILITY

The test facility is recognized, certified, or accredited by the following organizations:

**CNAS-Lab Code: L9069**

The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC/EN 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

**A2LA-Lab Certificate No.: 4312.01**

Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

**ISED Wireless Device Testing Laboratories**

CAB identifier: CN0032

**FCC Accredited Lab.**

Designation Number: CN1194  
 Test Firm Registration Number: 259480

### 1.8 DEVIATION FROM STANDARDS

None.

### 1.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

**Shenzhen UnionTrust Quality and Technology Co., Ltd.**

### 1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

### 1.11 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

No.	Item	Measurement Uncertainty
1	Conducted emission 9KHz-150KHz	±3.8 dB
2	Conducted emission 150KHz-30MHz	±3.4 dB
3	Radiated emission 9KHz-30MHz	±4.9 dB
4	Radiated emission 30MHz-1GHz	±4.7 dB
5	Radiated emission 1GHz-18GHz	±5.1 dB
6	Radiated emission 18GHz-26GHz	±5.2 dB
7	Radiated emission 26GHz-40GHz	±5.2 dB

## 2. TEST SUMMARY

FCC 47 CFR Part 15 Subpart C Test Cases			
Test Item	Test Requirement	Test Method	Result
Antenna Requirement	FCC 47 CFR Part 15 Subpart C Section 15.203/15.247 (c)	N/A	PASS
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013 Clause 6.2	PASS
Conducted Peak Output Power	FCC 47 CFR Part 15 Subpart C Section 15.247 (b)(3)	ANSI C63.10-2013 Clause 11.9.1.3	PASS
6dB Bandwidth	FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2)	ANSI C63.10-2013 Clause 11.8.1	PASS
Power Spectral Density	FCC 47 CFR Part 15 Subpart C Section 15.247 (e)	ANSI C63.10-2013 Clause 11.10.2	PASS
Conducted Out of Band Emission	FCC 47 CFR Part 15 Subpart C Section 15.247(d)	ANSI C63.10-2013 Clause 11.11	PASS
Radiated Spurious Emissions	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2013 Clause 11.11 & Clause 11.12	PASS
Band Edge Measurements (Radiated)	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2013 Clause 11.13	PASS
<b>Note:</b> 1) N/A: In this whole report not applicable.			

### 3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
<input checked="" type="checkbox"/>	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	N/A	Dec. 03, 2018	Dec. 03, 2021
<input checked="" type="checkbox"/>	Receiver	R&S	ESIB26	100114	Nov. 24, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	Loop Antenna	ETS-LINDGREN	6502	00202525	Nov. 16, 2019	Nov. 15, 2020
<input checked="" type="checkbox"/>	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Nov. 16, 2019	Nov. 15, 2020
<input checked="" type="checkbox"/>	6dB Attenuator	Talent	RA6A5-N-18	18103001	Nov. 16, 2019	Nov. 15, 2020
<input checked="" type="checkbox"/>	Preamplifier	HP	8447F	2805A02960	Nov. 24, 2019	Nov. 23, 2020
<input type="checkbox"/>	Broadband Antenna (Pre-amplifier)	ETS-LINDGREN	3142E-PA	00201891	Nov. 24, 2019	Nov. 23, 2020
<input type="checkbox"/>	6dB Attenuator	Talent	RA6A5-N-18	18103002	Nov. 24, 2019	Nov. 23, 2020
<input type="checkbox"/>	Horn Antenna	ETS-LINDGREN	3117	00164202	Nov. 16, 2019	Nov. 15, 2020
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	May 18, 2019	May 18, 2020
<input type="checkbox"/>	Horn Antenna	ETS-LINDGREN	3116C	00200180	Jun. 23, 2019	Jun. 23, 2020
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	Jan. 05, 2019	Jan. 05, 2020
<input checked="" type="checkbox"/>	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
<input checked="" type="checkbox"/>	Test Software	Audix	e3	Software Version: 9.160323		

Conducted Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
<input checked="" type="checkbox"/>	Receiver	R&S	ESR7	1316.3003K07-101181-K3	Nov. 24, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	Nov. 24, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	LISN	R&S	ESH2-Z5	860014/024	Nov. 24, 2019	Nov. 23, 2020
<input type="checkbox"/>	LISN	ETS-Lindgren	3816/2SH	00201088	Nov. 24, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	Test Software	Audix	e3	Software Version: 9.160323		

Conducted RF test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
<input checked="" type="checkbox"/>	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Nov. 24, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	Nov. 24, 2019	Nov. 23, 2020
<input type="checkbox"/>	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	Nov. 24, 2019	Nov. 23, 2020

**Shenzhen UnionTrust Quality and Technology Co., Ltd.**

Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China

Tel: +86-755-28230888

Fax: +86-755-28230886

E-mail: info@uttlab.com

<http://www.uttlab.com>

UTTR-RF-FCCPART15.247-V1.0



## 4. TEST CONFIGURATION

### 4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

#### 4.1.1 Normal or Extreme Test Conditions

Environment Parameter	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage (V)	Relative Humidity (%)
NT/NV	+15 to +35	AC 24V	20 to 75
<b>Remark:</b>			
1) NV: Normal Voltage; NT: Normal Temperature			

#### 4.1.2 Record of Normal Environment

Test Item	Temperature (°C)	Relative Humidity (%)	Pressure (kPa)	Tested by
AC Power Line Conducted Emission	23.6	45	100.43	Bert Xiong
Conducted Peak Output Power	24.5	51	99.98	Fire Huo
6dB Bandwidth				
Power Spectral Density				
Conducted Out of Band Emission	25.5	51	100.30	Andy Lin
Radiated Spurious Emissions				
Band Edge Measurements (Radiated)				

## 4.2 TEST CHANNELS

Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
IEEE 802.11b	2412 MHz to 2462 MHz	Channel 1	Channel 6	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11g	2412 MHz to 2462 MHz	Channel 1	Channel 6	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11n-HT20	2412 MHz to 2462 MHz	Channel 1	Channel 6	Channel 11
		2412 MHz	2437 MHz	2462 MHz

### 4.3 EUT TEST STATUS

Mode	Tx Function	Description
IEEE 802.11b IEEE 802.11g IEEE 802.11n-HT20	1Tx	1. Keep the EUT in continuously transmitting with modulation test single.

Power Setting	
Mode	Channel 1 -11
IEEE 802.11b	66
IEEE 802.11g	50
IEEE 802.11n-HT20	50

Test Software
Eneter Engineer Mode

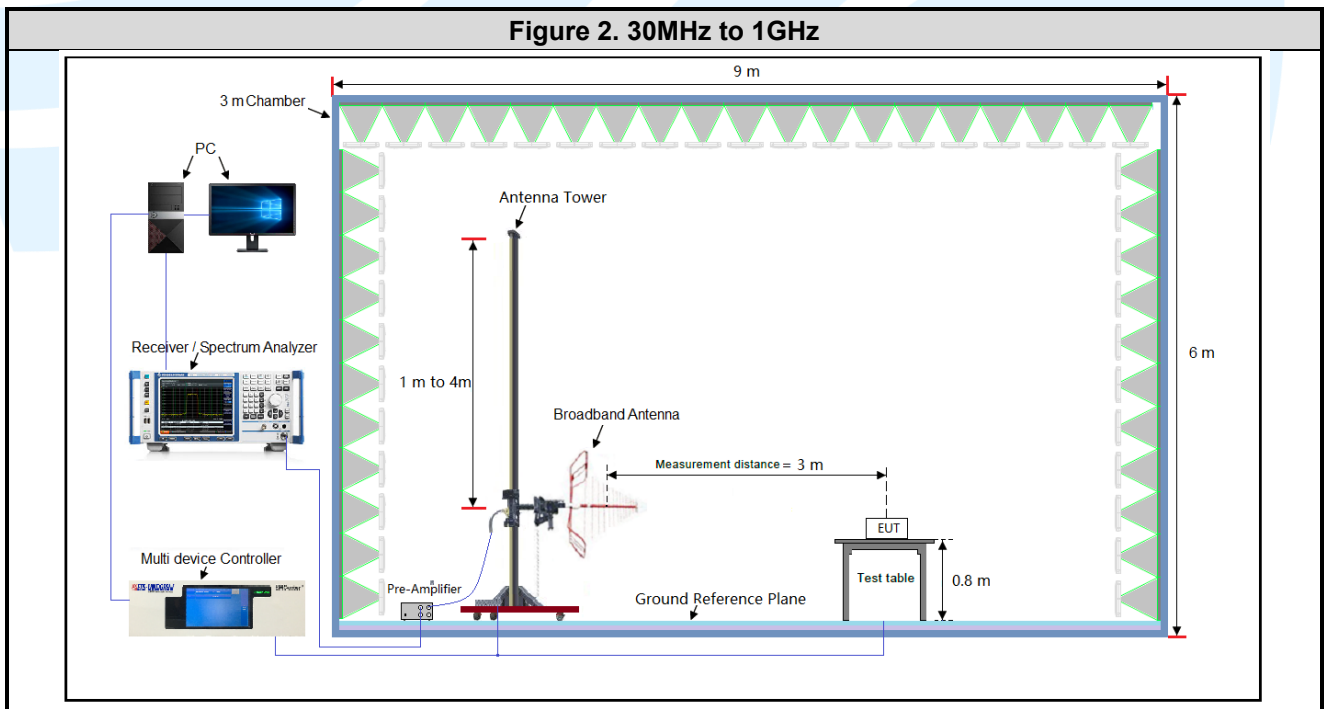
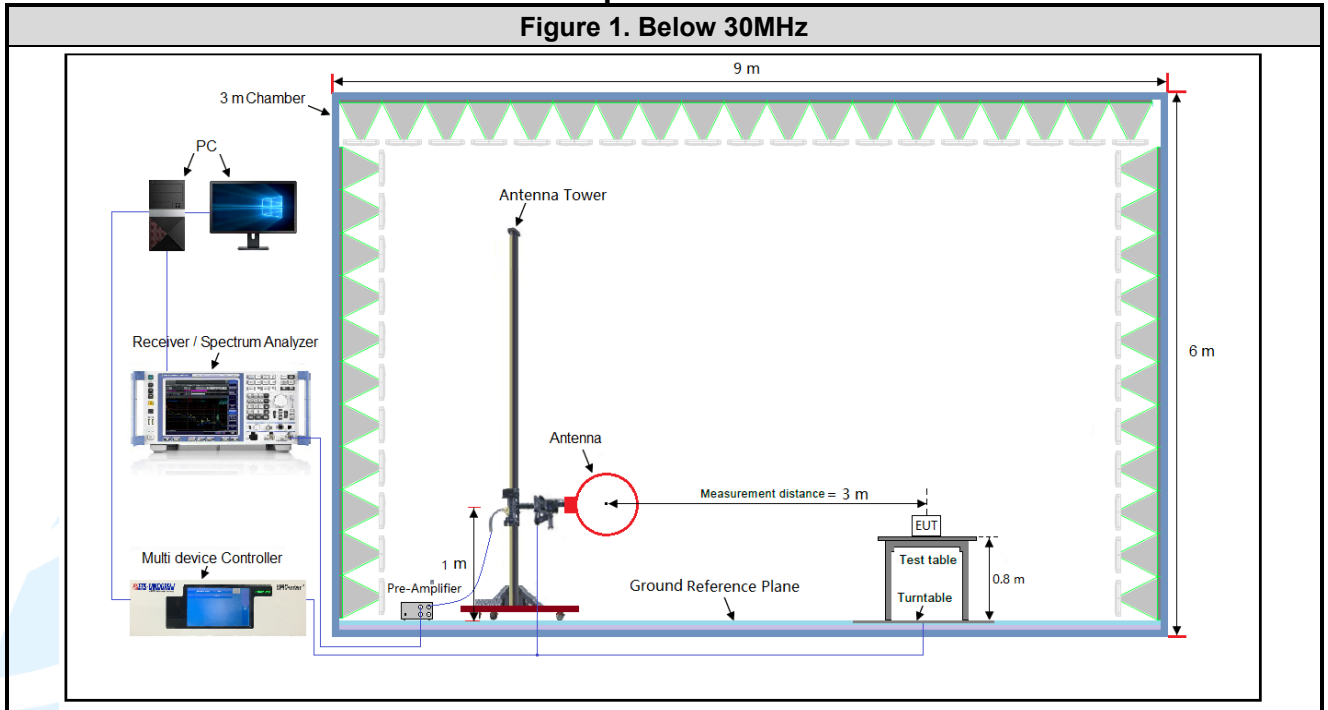
### 4.4 PRE-SCAN

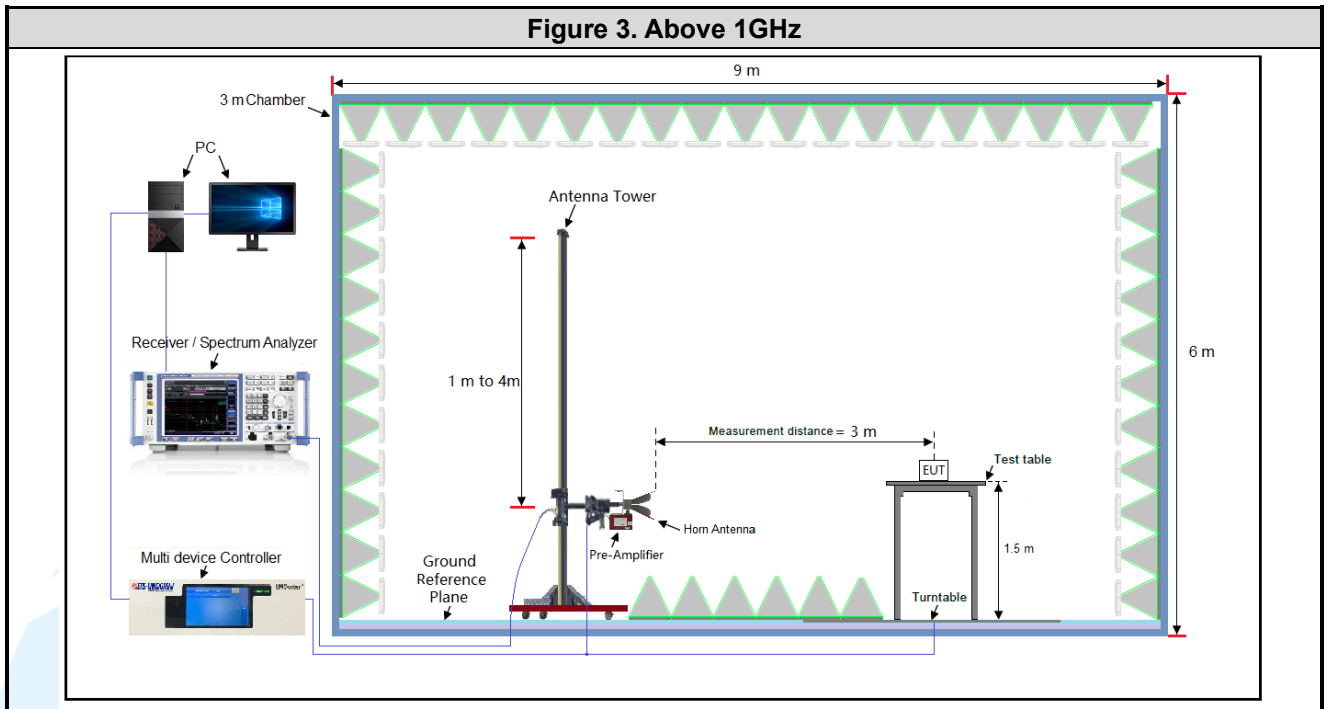
Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate. Following data rate was (were) selected for the final test as listed below

Mode	Worst-case data rates
IEEE 802.11b	1 Mbps
IEEE 802.11g	6 Mbps
IEEE 802.11n-HT20	MCS0

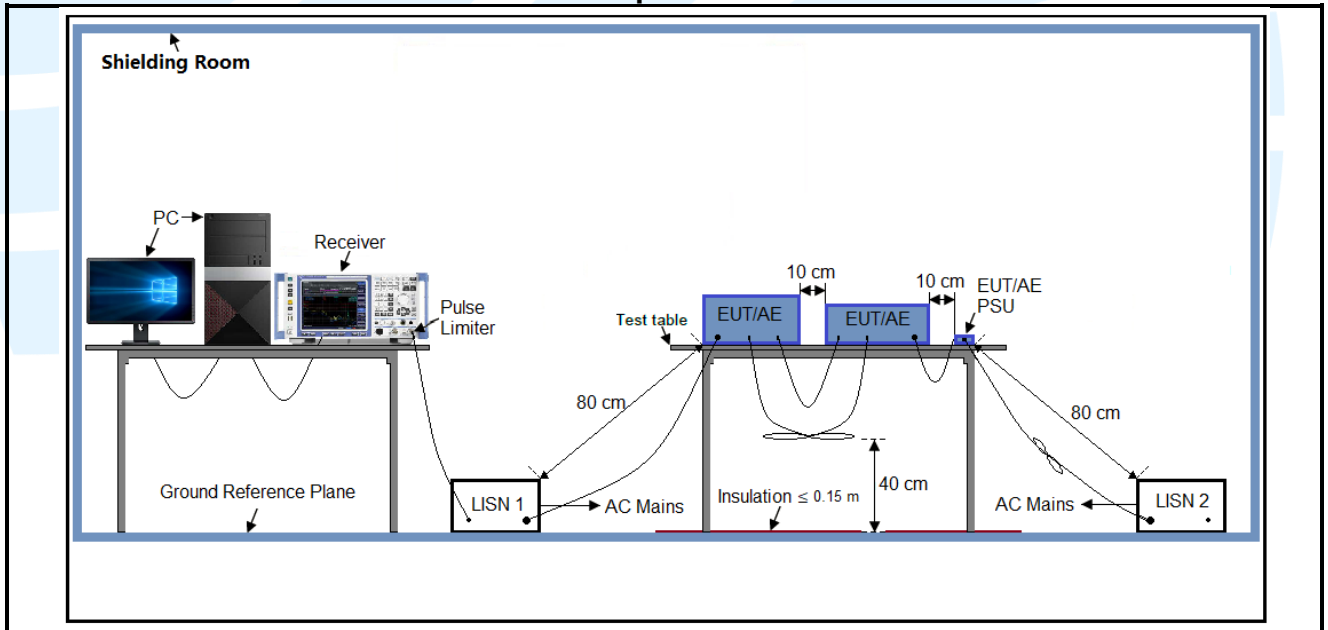
### 4.5 TEST SETUP

#### 4.5.1 For Radiated Emissions test setup

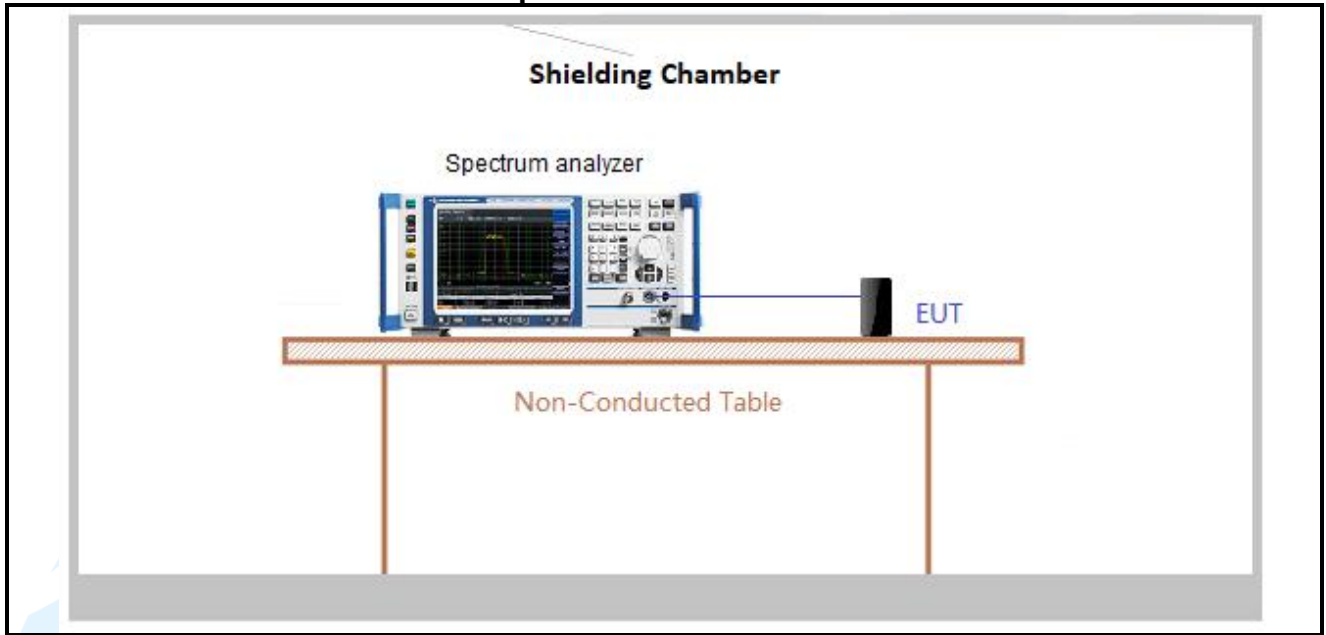




**4.5.2 For Conducted Emissions test setup**



4.5.3 For Conducted RF test setup



4.6 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. It was powered by AC 24V. Only the worst case data were recorded in this test report.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

Frequency	Mode	Antenna Port	Worst-case axis positioning
Above 1GHz	1TX	Chain 0	X axis

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

### 4.7 DUTY CYCLE

Test Procedure: ANSI C63.10-2013 Clause 11.6.

#### Test Results

Mode	Data rates (Mbps)	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
IEEE 802.11b	1	32.89	33.22	0.99	99.01	0.00	0.01	-0.09
IEEE 802.11g	6	5.48	5.74	0.95	95.47	0.20	0.18	-0.40
IEEE 802.11n-HT20	MCS0	5.06	5.34	0.95	94.76	0.23	0.20	-0.47

#### Remark:

- 1) Duty cycle= On Time/ Period;
- 2) Duty Cycle factor = 10 \* log(1/ Duty cycle);
- 3) Average factor = 20 log<sub>10</sub> Duty Cycle.

The test plots as follows

