

FCC

RF

TEST REPORT

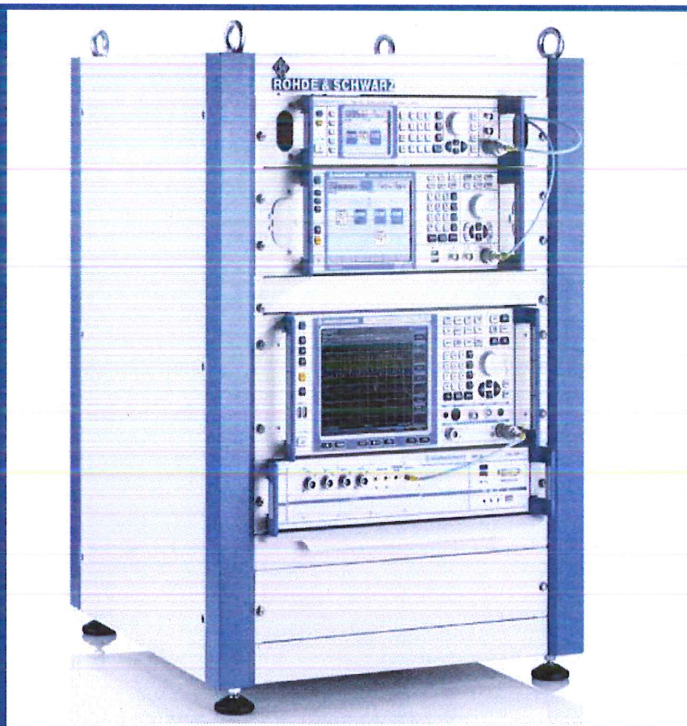
ISSUED BY  
Shenzhen BALUN Technology Co., Ltd.



FOR  
**iApartments Thermostat Node**

ISSUED TO  
iApartments, LLC

201 East Kennedy Blvd Suite 1925, Tampa, FL 33602



Tested by: Ye Hongji  
Date: May 18, 2020



Report No.: BL-SZ19C0523-602  
EUT Name: iApartments Thermostat Node  
Model Name: TN100/24/BK  
Brand Name: iApartments  
Test Standard: 47 CFR Part 15 Subpart C  
FCC ID: 2AVIHTN12A

Test Conclusion: Pass  
Test Date: Dec. 10, 2019 ~ Dec. 24, 2019  
Date of Issue: May 18, 2020

*NOTE: This test report of test results only related to testing samples, which can be duplicated completely for the legal use with the approval of the applicant; it shall not be reproduced except in full, without the written approval of Shenzhen BALUN Technology Co., Ltd. Any objections should be raised within thirty days from the date of issue. To validate the report, please contact us.*

**Revision History**

| <u>Version</u> | <u>Issue Date</u>   | <u>Revisions Content</u> |
|----------------|---------------------|--------------------------|
| <u>Rev. 01</u> | <u>May 18, 2020</u> | <u>Initial Issue</u>     |

**TABLE OF CONTENTS**

|       |                                                          |    |
|-------|----------------------------------------------------------|----|
| 1     | ADMINISTRATIVE DATA (GENERAL INFORMATION) .....          | 4  |
| 1.1   | Identification of the Testing Laboratory .....           | 4  |
| 1.2   | Identification of the Responsible Testing Location ..... | 4  |
| 1.3   | Laboratory Condition .....                               | 4  |
| 1.4   | Announce .....                                           | 4  |
| 2     | PRODUCT INFORMATION .....                                | 5  |
| 2.1   | Applicant Information .....                              | 5  |
| 2.2   | Manufacturer Information .....                           | 5  |
| 2.3   | Factory Information .....                                | 5  |
| 2.4   | General Description for Equipment under Test (EUT) ..... | 5  |
| 2.5   | Technical Information .....                              | 5  |
| 2.6   | Additional Instructions .....                            | 6  |
| 3     | SUMMARY OF TEST RESULTS .....                            | 7  |
| 3.1   | Test Standards .....                                     | 7  |
| 3.2   | Verdict .....                                            | 7  |
| 4     | GENERAL TEST CONFIGURATIONS .....                        | 8  |
| 4.1   | Test Environments .....                                  | 8  |
| 4.2   | Test Equipment List .....                                | 8  |
| 4.3   | Description of Test Setup .....                          | 9  |
| 4.3.1 | For Antenna Port Test .....                              | 9  |
| 4.3.2 | For AC Power Supply Port Test .....                      | 10 |
| 4.3.3 | For Radiated Test (Below 30 MHz) .....                   | 10 |
| 4.3.4 | For Radiated Test (30 MHz-1 GHz) .....                   | 11 |
| 4.3.5 | For Radiated Test (Above 1 GHz) .....                    | 11 |
| 5     | TEST ITEMS .....                                         | 12 |
| 5.1   | Antenna Requirements .....                               | 12 |

|         |                                                          |    |
|---------|----------------------------------------------------------|----|
| 5.1.1   | Relevant Standards.....                                  | 12 |
| 5.1.2   | Antenna Anti-Replacement Construction .....              | 12 |
| 5.1.3   | Antenna Gain .....                                       | 12 |
| 5.2     | 20 dB and 99% Bandwidth .....                            | 13 |
| 5.2.1   | Limit.....                                               | 13 |
| 5.2.2   | Test Setups .....                                        | 13 |
| 5.2.3   | Test Procedure.....                                      | 13 |
| 5.2.4   | Test Result .....                                        | 13 |
| 5.3     | AC Conducted Emission .....                              | 14 |
| 5.3.1   | Limit.....                                               | 14 |
| 5.3.2   | Test Setups .....                                        | 14 |
| 5.3.3   | Test Procedure.....                                      | 14 |
| 5.3.4   | Test Result .....                                        | 14 |
| 5.4     | field strength of Fundamental emissions.....             | 15 |
| 5.4.1   | Limit.....                                               | 15 |
| 5.4.2   | Test Setups .....                                        | 15 |
| 5.4.3   | Test Procedure.....                                      | 15 |
| 5.4.4   | Test Result .....                                        | 15 |
| 5.5     | Radiated Spurious Emission and Bandedge Measurement..... | 16 |
| 5.5.1   | Limit.....                                               | 16 |
| 5.5.2   | Test Setups .....                                        | 16 |
| 5.5.3   | Test Procedure.....                                      | 16 |
| 5.5.4   | Test Result .....                                        | 17 |
| ANNEX A | TEST RESULT .....                                        | 18 |
| A.1     | 20dB bandwidth and 99% bandwidth .....                   | 18 |
| A.2     | AC Conducted Emission .....                              | 19 |
| A.3     | Field Strength of Fundamental Emissions.....             | 21 |
| A.4     | Radiated Emission and Bandedge Measurement.....          | 22 |
| ANNEX B | TEST SETUP PHOTOS .....                                  | 25 |
| ANNEX C | EUT EXTERNAL PHOTOS .....                                | 25 |
| ANNEX D | EUT INTERNAL PHOTOS .....                                | 25 |



## 1 ADMINISTRATIVE DATA (GENERAL INFORMATION)

### 1.1 Identification of the Testing Laboratory

|              |                                                                                                                                 |
|--------------|---------------------------------------------------------------------------------------------------------------------------------|
| Company Name | Shenzhen BALUN Technology Co., Ltd.                                                                                             |
| Address      | Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China |
| Phone Number | +86 755 6685 0100                                                                                                               |

### 1.2 Identification of the Responsible Testing Location

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Location             | Shenzhen BALUN Technology Co., Ltd.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Address                   | Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Accreditation Certificate | <p>The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1.</p> <p>The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196.</p> <p>The laboratory is a testing organization accredited by American Association for Laboratory Accreditation(A2LA) according to ISO/IEC 17025.The accreditation certificate is 4344.01.</p> <p>The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.</p> |
| Description               | All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

### 1.3 Laboratory Condition

|                           |                    |
|---------------------------|--------------------|
| Ambient Temperature       | 20°C to 25°C       |
| Ambient Relative Humidity | 45% to 55%         |
| Ambient Pressure          | 100 kPa to 102 kPa |

### 1.4 Announce

- (1) The test report reference to the report template version v2.5.
- (2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.
- (3) The test report is invalid if there is any evidence and/or falsification.
- (4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.
- (5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.
- (6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.
- (7) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

## 2 PRODUCT INFORMATION

### 2.1 Applicant Information

|           |                                                   |
|-----------|---------------------------------------------------|
| Applicant | iApartments, LLC                                  |
| Address   | 201 East Kennedy Blvd Suite 1925, Tampa, FL 33602 |

### 2.2 Manufacturer Information

|              |                                                                                                          |
|--------------|----------------------------------------------------------------------------------------------------------|
| Manufacturer | SUN WEALTH TECHNOLOGY CORPORATION LIMITED                                                                |
| Address      | ROOM 605, NO.1, QIANJIN ROAD, THE ORIENTAL PEARL BUSINESS BUILDING, BAOAN DISTRICT, SHENZHEN CITY, CHINA |

### 2.3 Factory Information

|         |                                                                         |
|---------|-------------------------------------------------------------------------|
| Factory | PROPCBA TECHNOLOGY CO, LTD.                                             |
| Address | 2F-3, NO.66, SEC.2, NANKAN RD., LUZHU DIST., TAOYUAN CITY 33855 TAIWAN. |

### 2.4 General Description for Equipment under Test (EUT)

|                                           |                             |
|-------------------------------------------|-----------------------------|
| EUT Name                                  | iApartments Thermostat Node |
| Model Name Under Test                     | TN100/24/BK                 |
| Series Model Name                         | N/A                         |
| Description of Model name differentiation | N/A                         |
| Hardware Version                          | V1.6                        |
| Software Version                          | 1.4.0                       |
| Dimensions (Approx.)                      | N/A                         |
| Weight (Approx.)                          | N/A                         |

### 2.5 Technical Information

|                                   |                                          |
|-----------------------------------|------------------------------------------|
| Network and Wireless connectivity | WIFI 802.11b, 802.11g, 802.11n<br>Z-WAVE |
|-----------------------------------|------------------------------------------|

The requirement for the following technical information of the EUT was tested in this report:

|                   |                                                                                                                          |
|-------------------|--------------------------------------------------------------------------------------------------------------------------|
| Modulation Type   | ASK                                                                                                                      |
| Product Type      | <input type="checkbox"/> Mobile<br><input type="checkbox"/> Portable<br><input checked="" type="checkbox"/> Fix Location |
| Frequency Range   | The frequency range used is 902 MHz to 928 MHz.                                                                          |
| Number of channel | 1                                                                                                                        |
| Tested Channel    | 916 MHz                                                                                                                  |
| Antenna Type      | Helical Antenna                                                                                                          |
| Antenna Gain      | -3.7 dBi (In test items related to antenna gain, the final results reflect this figure.)                                 |

## 2.6 Additional Instructions

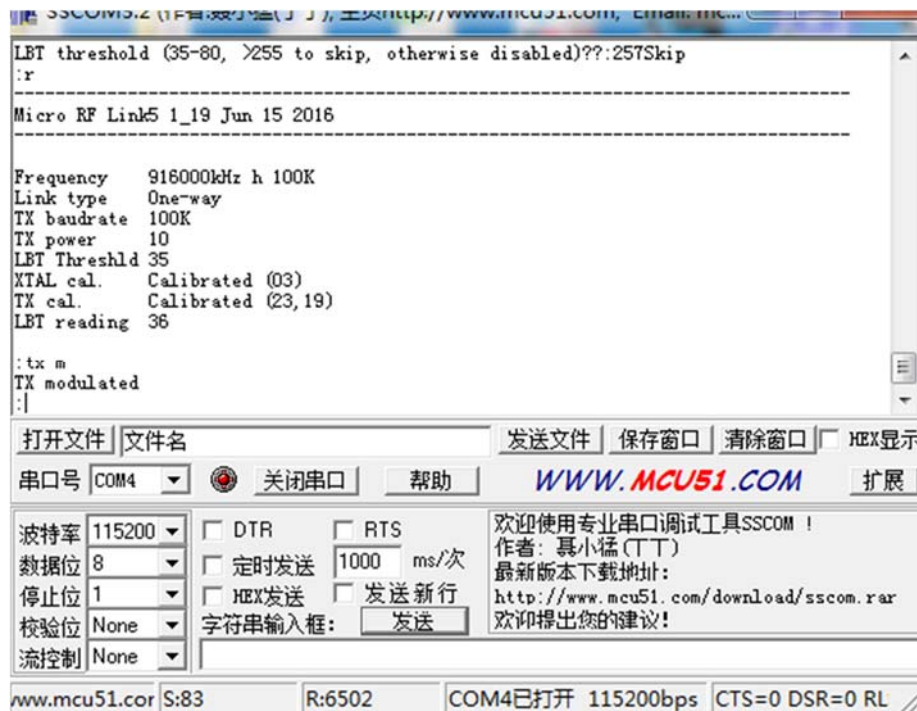
EUT Software Settings:

|      |                                                                                                                                                                                                            |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mode | <input checked="" type="checkbox"/> Special software is used.<br>The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually. |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

| Power level setup in software                  |             |              |       |
|------------------------------------------------|-------------|--------------|-------|
| Test Software Version                          | SSCOM       |              |       |
| Support Units<br>(Software installation media) | Description | Manufacturer | Model |
|                                                | Notebook    | Asus         | N/A   |
| Mode                                           | Channel     | Soft Set     |       |
| Z-WAVE                                         | ALL         | 10           |       |

Run Software



### 3 SUMMARY OF TEST RESULTS

#### 3.1 Test Standards

| No. | Identity                     | Document Title                                                                                    |
|-----|------------------------------|---------------------------------------------------------------------------------------------------|
| 1   | 47 CFR Part 15,<br>Subpart C | Miscellaneous Wireless Communications Services                                                    |
| 2   | ANSI C63.10-2013             | American National Standard of Procedures for Compliance Testing of<br>Unlicensed Wireless Devices |

#### 3.2 Verdict

| No. | Description                                     | FCC Part No.                     | Test Result | Verdict | Remark            |
|-----|-------------------------------------------------|----------------------------------|-------------|---------|-------------------|
| 1   | Antenna Requirement                             | 15.203                           | --          | Pass    | Note <sup>1</sup> |
| 2   | 20 dB and 99% Bandwidth                         | 15.215(c)                        | ANNEX A.1   | Pass    | --                |
| 3   | AC Conducted Emission                           | 15.207                           | ANNEX A.2   | Pass    | --                |
| 4   | Field Strength of Fundamental Emissions         | 15.249(a)                        | ANNEX A.3   | Pass    | --                |
| 5   | Radiated Emission Test<br>Band Edge Measurement | 15.249(a)<br>15.249(d)<br>15.209 | ANNEX A.4   | Pass    | Note <sup>2</sup> |

Note<sup>1</sup>: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.

Note<sup>2</sup>: The limit is 50dB less than the peak value of fundamental frequency or meet radiated emission limit in section 15.209

## 4 GENERAL TEST CONFIGURATIONS

### 4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

|                            |                         |                |
|----------------------------|-------------------------|----------------|
| Relative Humidity          | 45% to 55%              |                |
| Atmospheric Pressure       | 100 kPa to 102 kPa      |                |
| Temperature                | NT (Normal Temperature) | +22°C to +25°C |
| Working Voltage of the EUT | NV (Normal Voltage)     | 24 V           |

### 4.2 Test Equipment List

| Description                       | Manufacturer            | Model             | Serial No. | Cal. Date  | Cal. Due   |
|-----------------------------------|-------------------------|-------------------|------------|------------|------------|
| Spectrum Analyzer                 | ROHDE&SCHWARZ           | FSV-30            | 103118     | 2019.06.13 | 2020.06.12 |
| Switch Unit with OSP-B157         | ROHDE&SCHWARZ           | OSP120            | 101270     | 2019.06.13 | 2020.06.12 |
| EMI Receiver                      | KEYSIGHT                | N9038A            | MY53220118 | 2019.10.29 | 2020.10.28 |
| EMI Receiver                      | ROHDE&SCHWARZ           | ESRP              | 101036     | 2019.06.13 | 2020.06.12 |
| LISN                              | SCHWARZBECK             | NSLK 8127         | 8127-687   | 2019.06.13 | 2020.06.12 |
| Bluetooth Tester                  | ROHDE&SCHWARZ           | CBT               | 101005     | 2019.06.15 | 2020.06.14 |
| DC Power Supply                   | ROHDE&SCHWARZ           | HMP2020           | 018141664  | 2019.06.18 | 2020.06.17 |
| Power Splitter                    | KMW                     | DCPD-LDC          | 1305003215 | --         | --         |
| Power Sensor                      | ROHDE&SCHWARZ           | NRP-Z21           | 103971     | 2019.06.15 | 2020.06.14 |
| Attenuator (20 dB)                | KMW                     | ZA-S1-201         | 110617091  | --         | --         |
| Attenuator (6 dB)                 | KMW                     | ZA-S1-61          | 1305003189 | --         | --         |
| Temperature Chamber               | AHK                     | SP20              | 1412       | 2019.06.24 | 2020.06.23 |
| Test Antenna-Loop(9 kHz-30 MHz)   | SCHWARZBECK             | FMZB 1519         | 1519-037   | 2017.11.09 | 2020.11.08 |
| Test Antenna-Bi-Log(30 MHz-3 GHz) | SCHWARZBECK             | VULB 9163         | 9163-624   | 2018.08.22 | 2020.08.21 |
| Test Antenna-Horn(1-18 GHz)       | SCHWARZBECK             | BBHA 9120D        | 9120D-1148 | 2019.07.22 | 2021.07.21 |
| Test Antenna-Horn (18-40 GHz)     | A-INFO                  | LB-180400KF       | J211060273 | 2019.01.06 | 2021.01.05 |
| Anechoic Chamber                  | RAINFORD                | 9m*6m*6m          | N/A        | 2017.02.21 | 2022.02.20 |
| Anechoic Chamber                  | EMC Electronic Co., Ltd | 20.10*11.60*7.35m | N/A        | 2018.07.19 | 2020.07.18 |
| Shielded Enclosure                | ChangNing               | CN-130701         | 130703     | --         | --         |
| Signal Generator                  | ROHDE&SCHWARZ           | SMB100A           | 177746     | 2019.08.23 | 2020.08.22 |
| Power Amplifier                   | OPHIR RF                | 5225F             | 1037       | 2020.02.19 | 2021.02.18 |
| Power Amplifier                   | OPHIR RF                | 5273F             | 1016       | 2020.02.19 | 2021.02.18 |
| Directional Coupler               | Werlantone              | C5982-10          | 109275     | N/A        | N/A        |
| Directional Coupler               | Werlantone              | CHP-273E          | S00801z-01 | N/A        | N/A        |
| Sound Level Meter                 | B&K                     | NL-20             | 00844023   | 2019.11.12 | 2020.11.11 |
| Ear Simulator                     | B&K                     | 4185              | 2409449    | 2019.11.12 | 2020.11.11 |



| Description    | Manufacturer | Model  | Serial No. | Cal. Date  | Cal. Due   |
|----------------|--------------|--------|------------|------------|------------|
| Ear Simulator  | B&K          | 4195   | 2418189    | 2019.11.12 | 2020.11.11 |
| Audio analyzer | B&K          | UPL 16 | 100129     | 2019.11.12 | 2020.11.11 |

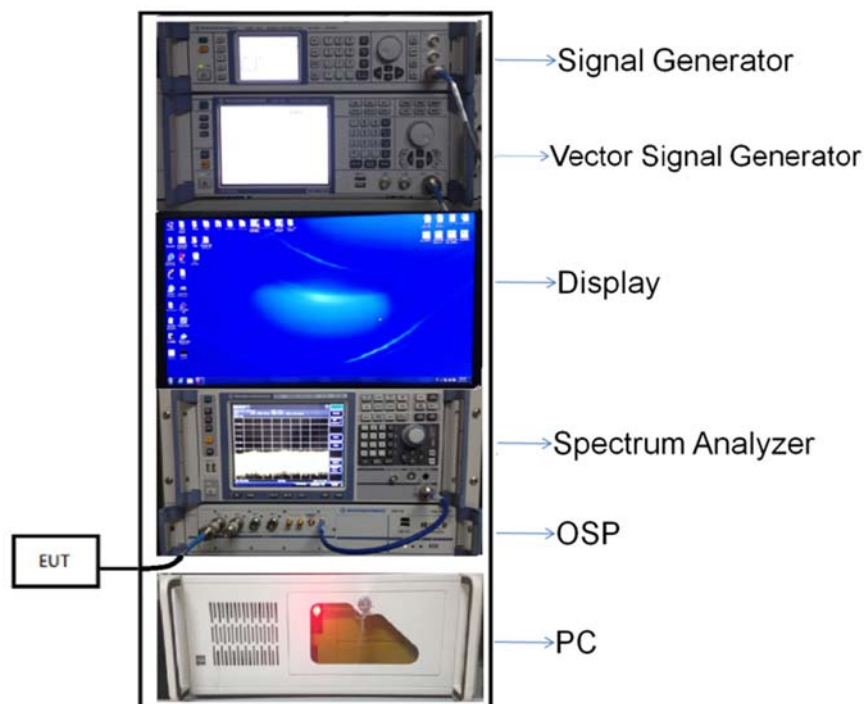
### 4.3 Description of Test Setup

#### 4.3.1 For Antenna Port Test

Conducted value (dBm) = Measurement value (dBm) + cable loss (dB)

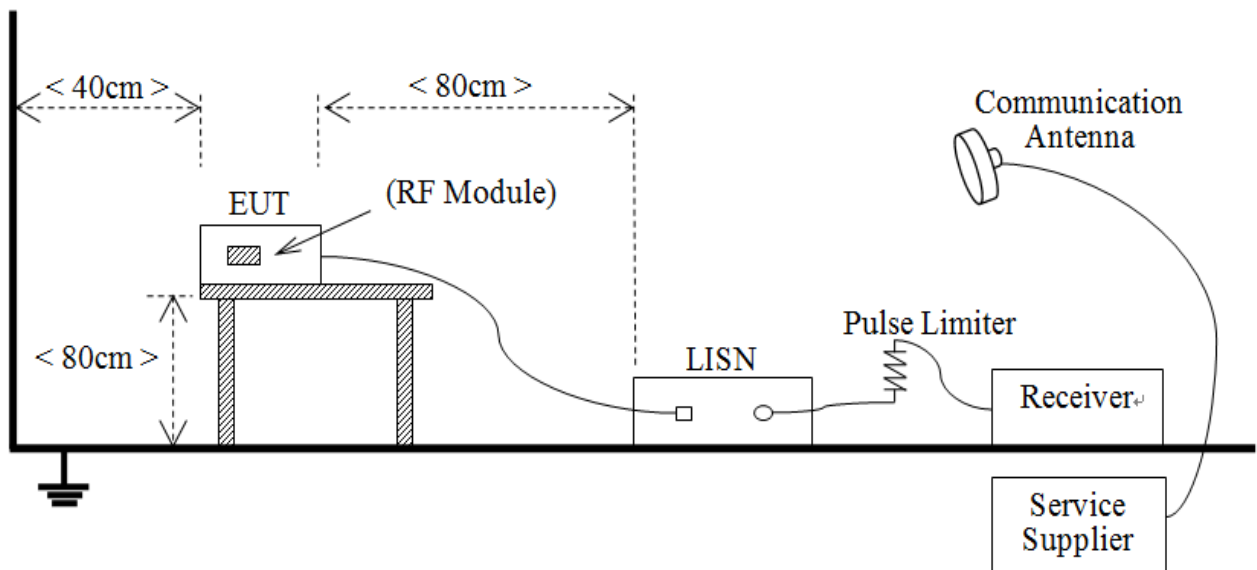
For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT:

Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm



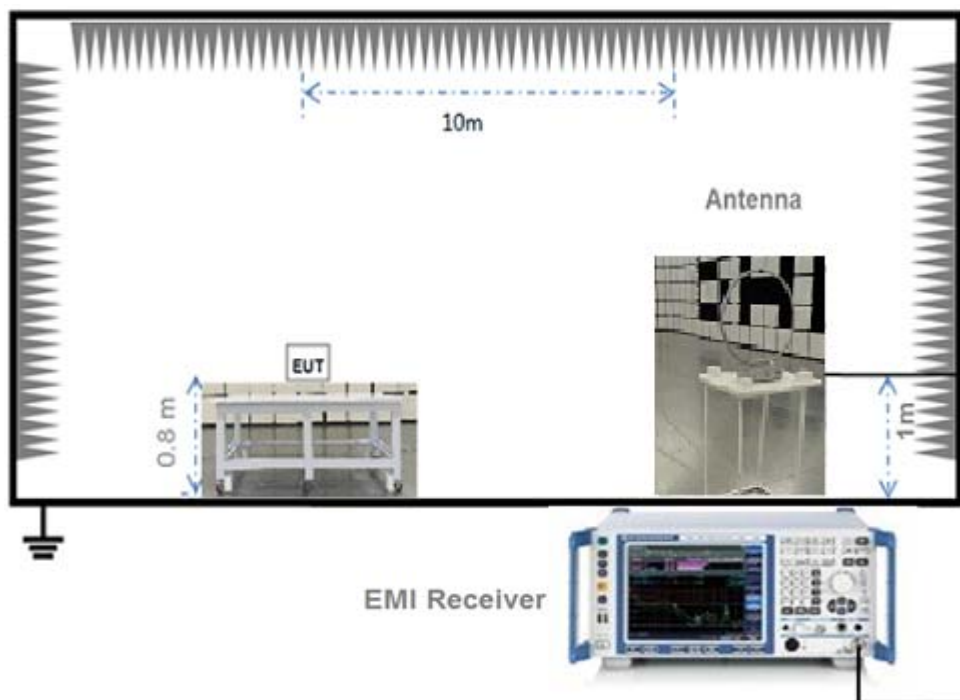
(Diagram 1)

#### 4.3.2 For AC Power Supply Port Test



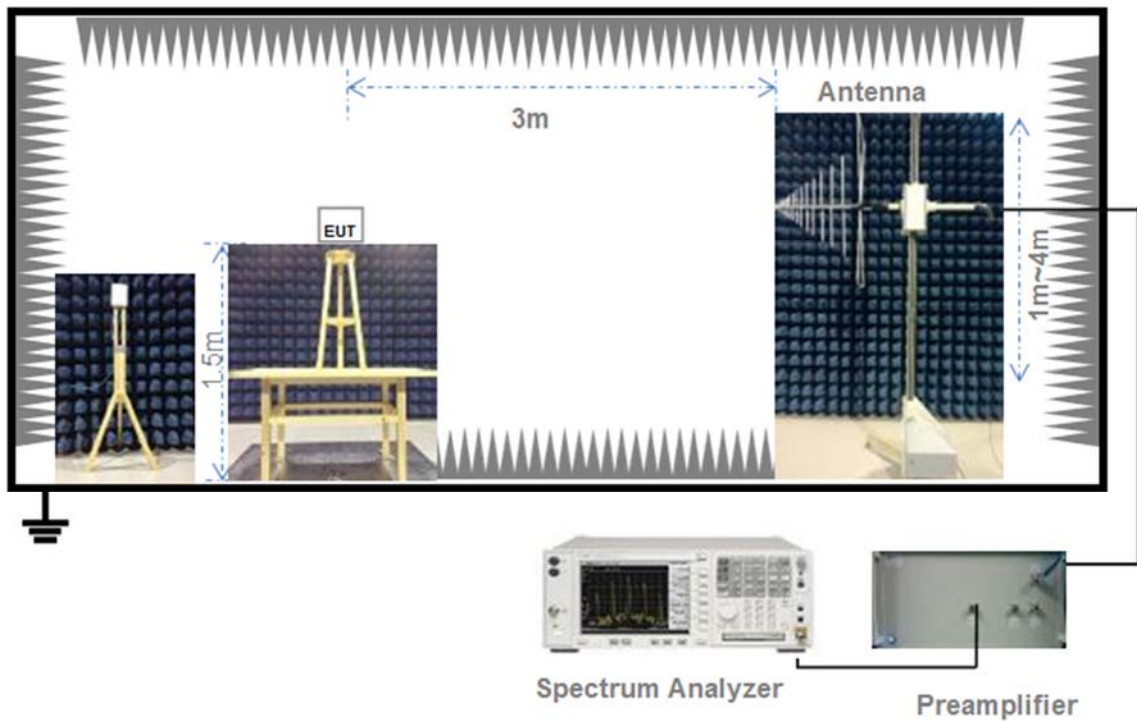
(Diagram 2)

#### 4.3.3 For Radiated Test (Below 30 MHz)



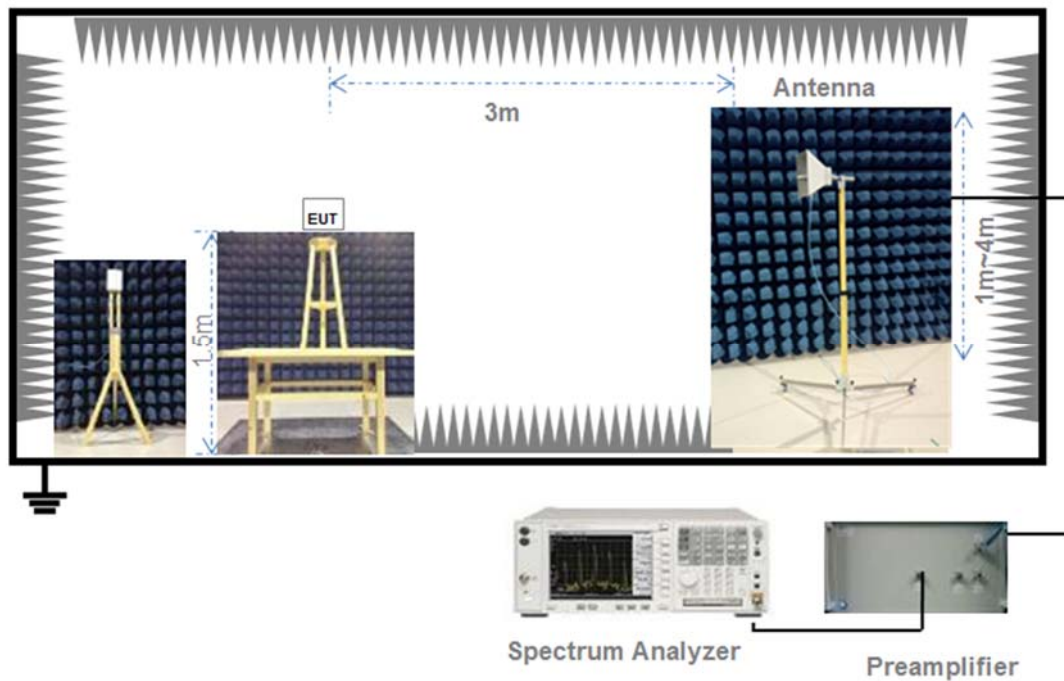
(Diagram 3)

#### 4.3.4 For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

#### 4.3.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

## 5 TEST ITEMS

### 5.1 Antenna Requirements

#### 5.1.1 Relevant Standards

FCC §15.203 & 15.247(b)

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.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. 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 FCC rule.

#### 5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

| Protected Method                        | Description                            |
|-----------------------------------------|----------------------------------------|
| The antenna is embedded in the product. | An embedded-in antenna design is used. |

| Reference Documents | Item                                     |
|---------------------|------------------------------------------|
| Photo               | Please refer to the EUT Photo documents. |

#### 5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

## 5.2 20 dB and 99% Bandwidth

### 5.2.1 Limit

FCC §15.215(c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

### 5.2.2 Test Setups

See section 4.1.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

### 5.2.3 Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW  $\geq$  1% of the 20 dB bandwidth

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

### 5.2.4 Test Result

Please refer to ANNEX A.1.



## 5.3 AC Conducted Emission

### 5.3.1 Limit

FCC §15.207

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 $\mu$ H/50 $\Omega$  line impedance stabilization network (LISN).

| Frequency range (MHz) | Conducted Limit (dB $\mu$ V) |           |
|-----------------------|------------------------------|-----------|
|                       | Quasi-peak                   | Average   |
| 0.15 - 0.50           | 66 to 56*                    | 56 to 46* |
| 0.50 - 5              | 56                           | 46        |
| 5 - 30                | 60                           | 50        |

### 5.3.2 Test Setups

See section 4.1.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

### 5.3.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed.

Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

### 5.3.4 Test Result

Please refer to ANNEX A.2.

## 5.4 field strength of Fundamental emissions

### 5.4.1 Limit

FCC&15.249(a)

Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| Frequency (MHz) | Field Strength of Fundamental (mV/m) | Field Strength of Harmonics ( $\mu$ V/m) |
|-----------------|--------------------------------------|------------------------------------------|
| 902-928         | 50                                   | 500                                      |
| 2400-2483.5     | 50                                   | 500                                      |
| 5725-5875       | 50                                   | 500                                      |
| 24000-24250     | 250                                  | 2500                                     |

As shown in § 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

### 5.4.2 Test Setups

See section 4.1.2-4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

### 5.4.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented. The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

### 5.4.4 Test Result

Please refer to ANNEX A.3.

## 5.5 Radiated Spurious Emission and Bandedge Measurement

### 5.5.1 Limit

FCC §15.249(a)

Except as provided in paragraph (a) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| Frequency (MHz) | Field Strength of Fundamental (mV/m) | Field Strength of Harmonics (μV/m) |
|-----------------|--------------------------------------|------------------------------------|
| 902-928         | 50                                   | 500                                |
| 2400-2483.5     | 50                                   | 500                                |
| 5725-5875       | 50                                   | 500                                |
| 24000-24250     | 250                                  | 2500                               |

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.

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength (μV/m) | Measurement Distance (m) |
|-----------------|-----------------------|--------------------------|
| 0.009 - 0.490   | 2400/F(kHz)           | 300                      |
| 0.490 - 1.705   | 24000/F(kHz)          | 30                       |
| 1.705 - 30.0    | 30                    | 30                       |
| 30 - 88         | 100                   | 3                        |
| 88 - 216        | 150                   | 3                        |
| 216 - 960       | 200                   | 3                        |
| Above 960       | 500                   | 3                        |

Note:

- For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

### 5.5.2 Test Setups

See section 4.1.2-4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

### 5.5.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented. The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was

recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

#### 5.5.4 Test Result

Please refer to ANNEX A.4.

## ANNEX A TEST RESULT

### A.1 20dB bandwidth and 99% bandwidth

#### Test Data

| Z-WAVE  |                       |                     |         |
|---------|-----------------------|---------------------|---------|
| Channel | 20 dB Bandwidth (MHz) | 99% Bandwidth (MHz) | Verdict |
| 916MHz  | 0.162354              | 0.150507            | Pass    |

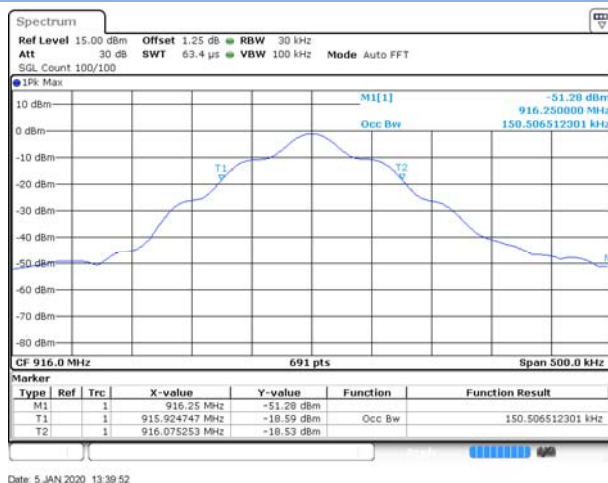
#### Test plots (20 dB Bandwidth)

##### 916MHz CHANNEL



#### Test plots (99% Bandwidth)

##### 916MHz CHANNEL





## A.2 AC Conducted Emission

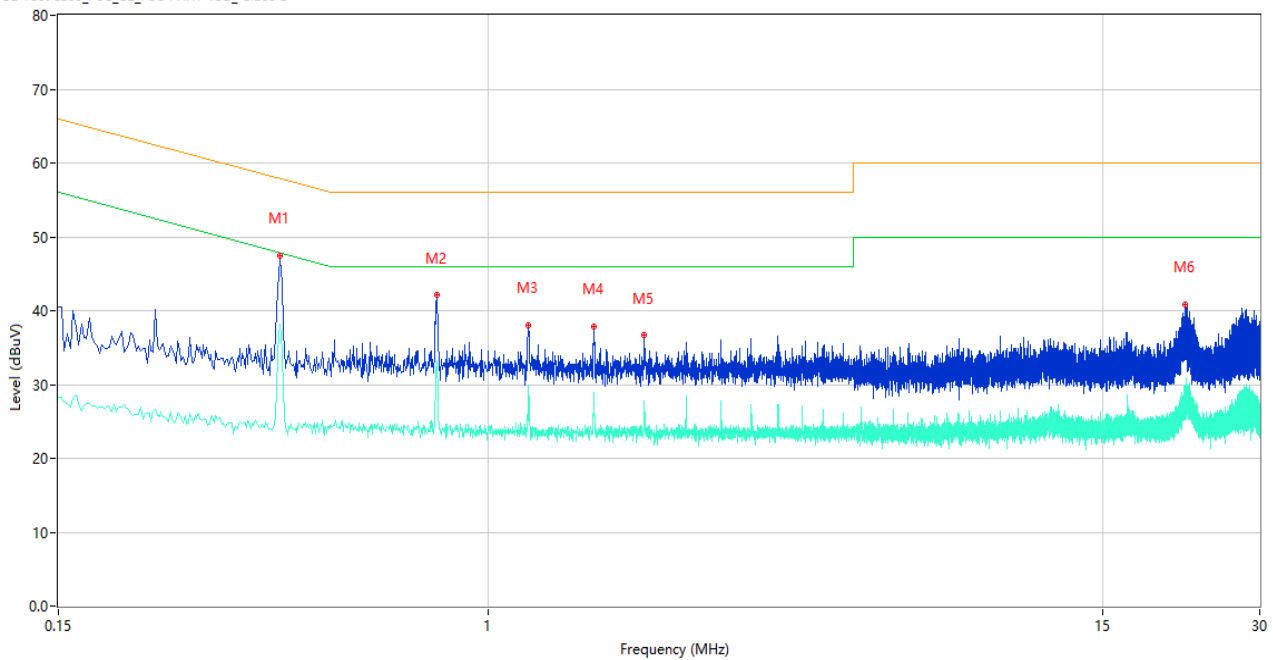
Note<sup>1</sup>: The EUT is working in the Normal link mode. All modes have been tested and normal link mode is worst.

Note<sup>2</sup>: Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 60 Hz and 240 VAC, 50 Hz) for which the device is capable of operation. So, The configuration 120 VAC, 60 Hz and 240 VAC, 50 Hz were tested respectively, but only the worst configuration (120 VAC, 60 Hz ) shown here.

### Test Data and Plots

#### PHASE L

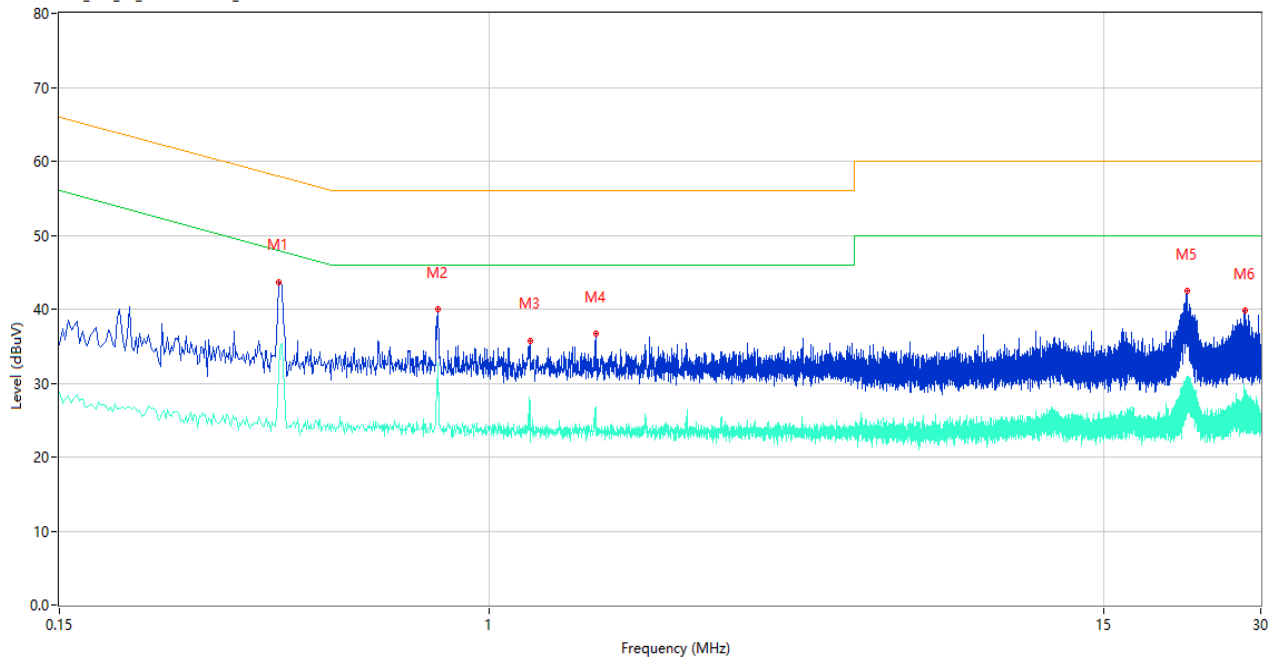
CE Test case\_FCC\_CE\_FCC PART 15B\_ Class B



| No. | Frequency (MHz) | Results (dBuV) | Factor (dB) | Limit (dBuV) | Over Limit (dB) | Detector | Line | Verdict |
|-----|-----------------|----------------|-------------|--------------|-----------------|----------|------|---------|
| 1   | 0.398           | 47.50          | 10.31       | 57.90        | -10.40          | Peak     | L    | Pass    |
| 1** | 0.398           | 38.19          | 10.31       | 47.90        | -9.71           | AV       | L    | Pass    |
| 2   | 0.798           | 42.07          | 10.27       | 56.00        | -13.93          | Peak     | L    | Pass    |
| 2** | 0.798           | 32.54          | 10.27       | 46.00        | -13.46          | AV       | L    | Pass    |
| 3   | 1.192           | 38.07          | 10.24       | 56.00        | -17.93          | Peak     | L    | Pass    |
| 3** | 1.192           | 29.98          | 10.24       | 46.00        | -16.02          | AV       | L    | Pass    |
| 4   | 1.588           | 37.91          | 10.25       | 56.00        | -18.09          | Peak     | L    | Pass    |
| 4** | 1.588           | 28.63          | 10.25       | 46.00        | -17.37          | AV       | L    | Pass    |
| 5   | 1.990           | 36.70          | 10.27       | 56.00        | -19.30          | Peak     | L    | Pass    |
| 5** | 1.990           | 26.06          | 10.27       | 46.00        | -19.94          | AV       | L    | Pass    |
| 6   | 21.564          | 40.90          | 10.59       | 60.00        | -19.10          | Peak     | L    | Pass    |
| 6** | 21.564          | 26.71          | 10.59       | 50.00        | -23.29          | AV       | L    | Pass    |

# PHASE N

CE Test case\_FCC\_CE\_FCC PART 15B\_Class B



| No. | Frequency (MHz) | Results (dBuV) | Factor (dB) | Limit (dBuV) | Over Limit (dB) | Detector | Line | Verdict |
|-----|-----------------|----------------|-------------|--------------|-----------------|----------|------|---------|
| 1   | 0.394           | 43.70          | 10.30       | 57.98        | -14.28          | Peak     | N    | Pass    |
| 1** | 0.394           | 31.62          | 10.30       | 47.98        | -16.36          | AV       | N    | Pass    |
| 2   | 0.796           | 40.02          | 10.27       | 56.00        | -15.98          | Peak     | N    | Pass    |
| 2** | 0.796           | 32.75          | 10.27       | 46.00        | -13.25          | AV       | N    | Pass    |
| 3   | 1.196           | 35.78          | 10.25       | 56.00        | -20.22          | Peak     | N    | Pass    |
| 3** | 1.196           | 27.64          | 10.25       | 46.00        | -18.36          | AV       | N    | Pass    |
| 4   | 1.596           | 36.67          | 10.25       | 56.00        | -19.33          | Peak     | N    | Pass    |
| 4** | 1.596           | 26.71          | 10.25       | 46.00        | -19.29          | AV       | N    | Pass    |
| 5   | 21.688          | 42.47          | 10.59       | 60.00        | -17.53          | Peak     | N    | Pass    |
| 5** | 21.688          | 28.05          | 10.59       | 50.00        | -21.95          | AV       | N    | Pass    |
| 6   | 27.974          | 39.86          | 10.71       | 60.00        | -20.14          | Peak     | N    | Pass    |
| 6** | 27.974          | 29.05          | 10.71       | 50.00        | -20.95          | AV       | N    | Pass    |

### A.3 Field Strength of Fundamental Emissions

Note<sup>1</sup>: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

Note<sup>2</sup>: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.

Note<sup>3</sup>: According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note<sup>4</sup>: The Level (dBuV/m) has been corrected by factor.

Note<sup>5</sup>: The adjacent to the restricted frequency band (608-614MHz and 960-1240MHz) is far away the fundamental, it is noise only. Please refer to Section A.8 for test data.

#### Test Data

| Frequency (MHz) | Field Strength (dBuV) | Limit (dBuV/m) | Verdict |
|-----------------|-----------------------|----------------|---------|
| 916             | 56.04                 | 500            | Pass    |

## A.4 Radiated Emission and Bandedge Measurement

Note 1: The symbol of “--” in the table which means not application.

Note 2: For the test data above 1 GHz, according the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

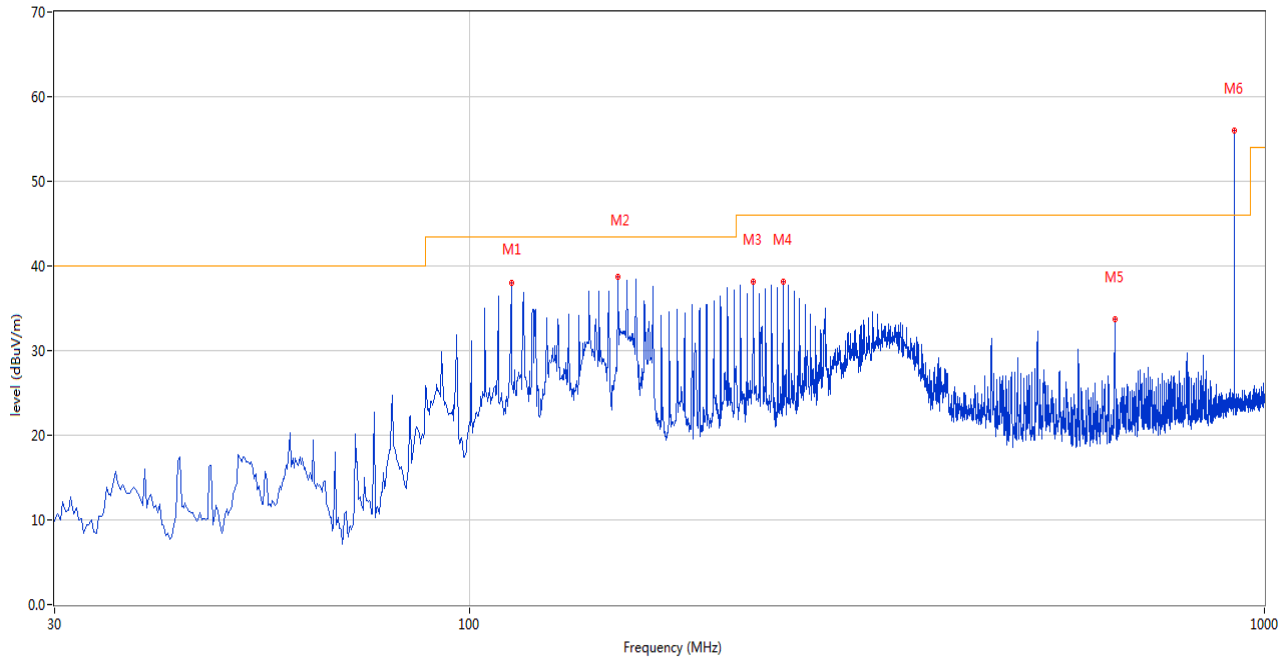
Note 3: The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

Note 4: The EUT is working in the Normal link mode below 1 GHz. All modes have been tested and normal link mode is worst.

### Test Data and Plots

#### 30 MHz to 1 GHz, ANT H

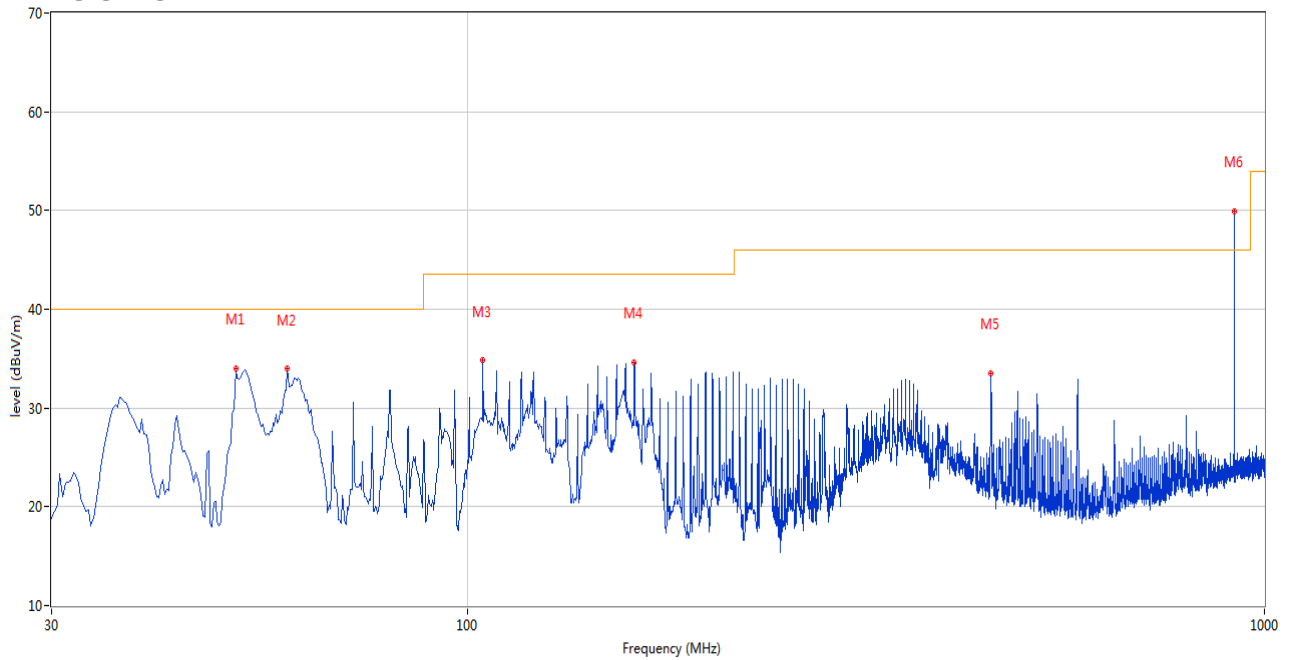
RE Test case\_FCC\_Part 15B\_FCC Part 15B Class B 30MHz-1GHz



| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna    | Verdict |
|-----|-----------------|------------------|-------------|----------------|-----------------|----------|----------------|-------------|------------|---------|
| 1   | 112.692         | 37.95            | -28.12      | 43.5           | -5.55           | Peak     | 226.00         | 200         | Horizontal | Pass    |
| 2   | 153.675         | 38.69            | -24.84      | 43.5           | -4.81           | Peak     | 219.00         | 200         | Horizontal | Pass    |
| 3   | 227.395         | 38.15            | -27.02      | 46.0           | -7.85           | Peak     | 192.00         | 100         | Horizontal | Pass    |
| 4   | 247.765         | 38.16            | -26.02      | 46.0           | -7.84           | Peak     | 165.00         | 100         | Horizontal | Pass    |
| 5   | 647.890         | 33.75            | -15.56      | 46.0           | -12.25          | Peak     | 150.00         | 100         | Horizontal | Pass    |
| 6   | 916.095         | 56.04            | -10.76      | 46.0           | 10.04           | Peak     | 280.00         | 100         | Horizontal | N/A     |

## 30 MHz to 1 GHz, ANT V

RE Test case\_FCC\_Part 15B\_FCC Part 15B Class B 30MHz-1GHz



| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna  | Verdict |
|-----|-----------------|------------------|-------------|----------------|-----------------|----------|----------------|-------------|----------|---------|
| 1   | 51.097          | 34.02            | -26.61      | 40.0           | -5.98           | Peak     | 13.00          | 100         | Vertical | Pass    |
| 2   | 59.343          | 33.94            | -27.50      | 40.0           | -6.06           | Peak     | 270.00         | 100         | Vertical | Pass    |
| 3   | 104.448         | 34.80            | -28.72      | 43.5           | -8.70           | Peak     | 76.00          | 100         | Vertical | Pass    |
| 4   | 161.678         | 34.57            | -24.87      | 43.5           | -8.93           | Peak     | 316.00         | 100         | Vertical | Pass    |
| 5   | 453.405         | 33.52            | -19.64      | 46.0           | -12.48          | Peak     | 328.00         | 100         | Vertical | Pass    |
| 6   | 916.095         | 49.92            | -10.76      | 46.0           | 3.92            | Peak     | 154.00         | 100         | Vertical | N/A     |

## 1 GHz to 10 GHz, ANT H

| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna    | Verdict |
|-----|-----------------|------------------|-------------|----------------|-----------------|----------|----------------|-------------|------------|---------|
| 1   | 1526.000        | 37.93            | -15.20      | 74.0           | -36.07          | Peak     | 192.00         | 150         | Horizontal | Pass    |
| 1** | 1526.000        | 32.59            | -15.20      | 54.0           | -21.41          | AV       | 192.00         | 150         | Horizontal | Pass    |
| 2   | 2748.500        | 47.49            | -8.99       | 74.0           | -26.51          | Peak     | 207.00         | 150         | Horizontal | Pass    |
| 2** | 2748.500        | 45.47            | -8.99       | 54.0           | -8.53           | AV       | 207.00         | 150         | Horizontal | Pass    |
| 3   | 3406.000        | 45.08            | -6.80       | 74.0           | -28.92          | Peak     | 124.00         | 150         | Horizontal | Pass    |
| 3** | 3406.000        | 28.89            | -6.80       | 54.0           | -25.11          | AV       | 124.00         | 150         | Horizontal | Pass    |
| 4   | 4117.000        | 46.52            | -4.08       | 74.0           | -27.48          | Peak     | 60.00          | 150         | Horizontal | Pass    |
| 4** | 4117.000        | 30.13            | -4.08       | 54.0           | -23.87          | AV       | 60.00          | 150         | Horizontal | Pass    |
| 5   | 5311.000        | 50.05            | 0.07        | 74.0           | -23.95          | Peak     | 320.00         | 150         | Horizontal | Pass    |
| 5** | 5311.000        | 33.37            | 0.07        | 54.0           | -20.63          | AV       | 320.00         | 150         | Horizontal | Pass    |
| 6   | 6943.000        | 53.71            | 4.27        | 74.0           | -20.29          | Peak     | 258.00         | 150         | Horizontal | Pass    |
| 6** | 6943.000        | 36.72            | 4.27        | 54.0           | -17.28          | AV       | 258.00         | 150         | Horizontal | Pass    |

## 1 GHz to 10 GHz, ANT V

| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Over Limit (dB) | Detector | Table (Degree) | Height (cm) | Antenna  | Verdict |
|-----|-----------------|------------------|-------------|----------------|-----------------|----------|----------------|-------------|----------|---------|
| 1   | 1447.000        | 38.15            | -14.76      | 74.0           | -35.85          | Peak     | 49.00          | 150         | Vertical | Pass    |
| 1** | 1447.000        | 20.78            | -14.76      | 54.0           | -33.22          | AV       | 49.00          | 150         | Vertical | Pass    |
| 2   | 1951.500        | 40.46            | -13.43      | 74.0           | -33.54          | Peak     | 260.00         | 150         | Vertical | Pass    |
| 2** | 1951.500        | 22.51            | -13.43      | 54.0           | -31.49          | AV       | 260.00         | 150         | Vertical | Pass    |
| 3   | 2748.000        | 44.77            | -9.09       | 74.0           | -29.23          | Peak     | 1.00           | 150         | Vertical | Pass    |
| 3** | 2748.000        | 32.16            | -9.09       | 54.0           | -21.84          | AV       | 1.00           | 150         | Vertical | Pass    |
| 4   | 3451.000        | 45.94            | -6.57       | 74.0           | -28.06          | Peak     | 0.00           | 150         | Vertical | Pass    |
| 4** | 3451.000        | 28.12            | -6.57       | 54.0           | -25.88          | AV       | 0.00           | 150         | Vertical | Pass    |
| 5   | 5218.000        | 50.38            | -0.25       | 74.0           | -23.62          | Peak     | 28.00          | 150         | Vertical | Pass    |
| 5** | 5218.000        | 33.56            | -0.25       | 54.0           | -20.44          | AV       | 28.00          | 150         | Vertical | Pass    |
| 6   | 7606.000        | 55.55            | 18.34       | 74.0           | -18.45          | Peak     | 360.00         | 150         | Vertical | Pass    |
| 6** | 7606.000        | 38.65            | 18.34       | 54.0           | -15.35          | AV       | 360.00         | 150         | Vertical | Pass    |



## **ANNEX B TEST SETUP PHOTOS**

Please refer the document "BL-SZ19C0523-AR.PDF".

## **ANNEX C EUT EXTERNAL PHOTOS**

Please refer the document "BL- SZ19C0523-AW.PDF".

## **ANNEX D EUT INTERNAL PHOTOS**

Please refer the document "BL- SZ19C0523-AI.PDF".

--END OF REPORT--