

**Shenzhen Global Test Service Co.,Ltd.**

No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

**FCC PART 15 SUBPART C TEST REPORT****FCC PART 15.247****Report Reference No.....: GTS20191209006-2-23****FCC ID.....: 2AL6KBL-M8821CS1**

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Date of issue.....: Dec.21, 2019

**Representative Laboratory Name.: Shenzhen Global Test Service Co.,Ltd.**

Address .....: No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

**Applicant's name.....: Shenzhen Bilian Electronic Co.,Ltd.**

Address .....: Building B1, Zhongxing Industrial Zone, Juling, Jutang Community, Guanlan street, LongHua district, Shenzhen, China

**Test specification .....**Standard .....: **FCC Part 15.247**

TRF Originator .....: Shenzhen Global Test Service Co.,Ltd.

Master TRF.....: Dated 2014-12

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**Test item description .....: IEEE 802.11 a/b/g/n/ac(1T1R)WLAN with Bluetooth Module**

Trade Mark .....: N/A

Manufacturer .....: Shenzhen Bilian Electronic Co.,Ltd.

Model/Type reference.....: BL-M8821CS1

Listed Models .....: N/A

Modulation Type .....: GFSK

Operation Frequency.....: From 2402MHz to 2480MHz

Hardware Version .....: 1.0

Software Version .....: V1.0

Rating .....: DC 3.3V

Result.....: **PASS**

**TEST REPORT**

|                          |                            |               |
|--------------------------|----------------------------|---------------|
| <b>Test Report No. :</b> | <b>GTS20191209006-2-23</b> | Dec.21, 2019  |
|                          |                            | Date of issue |

Equipment under Test : IEEE 802.11 a/b/g/n/ac(1T1R)WLAN with Bluetooth Module

Model /Type : BL-M8821CS1

Listed Models : N/A

**Applicant** : **Shenzhen Bilian Electronic Co.,Ltd.**

Address : Building B1, Zhongxing Industrial Zone, Juling, Jutang Community,  
Guanlan street, LongHua district, Shenzhen, China

**Manufacturer** : **Shenzhen Bilian Electronic Co.,Ltd.**

Address : Building B1, Zhongxing Industrial Zone, Juling, Jutang Community,  
Guanlan street, LongHua district, Shenzhen, China

|                     |             |
|---------------------|-------------|
| <b>Test Result:</b> | <b>PASS</b> |
|---------------------|-------------|

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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## **1. TEST STANDARDS**

The tests were performed according to following standards:

[FCC Rules Part 15.247](#): Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

[ANSI C63.10-2013](#): American National Standard for Testing Unlicensed Wireless Devices

[KDB558074 D01 DTS Meas Guidance v05r02](#): Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.

## 2. SUMMARY

### 2.1. General Remarks

|                                |   |              |
|--------------------------------|---|--------------|
| Date of receipt of test sample | : | Dec.13, 2019 |
|                                | : |              |
| Testing commenced on           | : | Dec.13, 2019 |
|                                | : |              |
| Testing concluded on           | : | Dec.21, 2019 |

### 2.2. Product Description

|                      |                                                                                                                                         |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Product Name         | IEEE 802.11 a/b/g/n/ac(1T1R)WLAN with Bluetooth Module                                                                                  |
| Trade Mark           | N/A                                                                                                                                     |
| Model/Type reference | BL-M8821CS1                                                                                                                             |
| List Models          | N/A                                                                                                                                     |
| Model Declaration    | N/A                                                                                                                                     |
| Power supply:        | DC 3.3V                                                                                                                                 |
| Bluetooth            |                                                                                                                                         |
| Operation frequency  | 2402-2480MHz                                                                                                                            |
| Channel Number       | 79 channels for Bluetooth (DSS)<br>40 channels for Bluetooth (DTS)                                                                      |
| Channel Spacing      | 1MHz for Bluetooth (DSS)<br>2MHz for Bluetooth (DTS)                                                                                    |
| Modulation Type      | GFSK, $\pi/4$ -DQPSK, 8DPSK for Bluetooth (DSS)<br>GFSK for Bluetooth (DTS)                                                             |
| WIFI(2.4G Band)      |                                                                                                                                         |
| Frequency Range      | 2412MHz ~ 2462MHz                                                                                                                       |
| Channel Spacing      | 5MHz                                                                                                                                    |
| Channel Number       | 11 Channel for 20MHz bandwidth(2412~2462MHz)<br>7 channels for 40MHz bandwidth(2422~2452MHz)                                            |
| Modulation Type      | 802.11b: DSSS; 802.11g/n: OFDM                                                                                                          |
| WIFI(5.2G Band)      |                                                                                                                                         |
| Frequency Range      | 5180MHz ~ 5240MHz                                                                                                                       |
| Channel Number       | 4 channels for 20MHz bandwidth(5180-5240MHz)<br>2 channels for 40MHz bandwidth(5190~5230MHz)<br>1 channels for 80MHz bandwidth(5210MHz) |
| Modulation Type      | 802.11a/n/ac: OFDM                                                                                                                      |
| WIFI (5.8G Band)     |                                                                                                                                         |
| Frequency Range      | 5745MHz ~ 5825MHz                                                                                                                       |
| Channel Number       | 5 channels for 20MHz bandwidth(5745-5825MHz)<br>2 channels for 40MHz bandwidth(5755~5795MHz)<br>1 channels for 80MHz bandwidth(5775MHz) |
| Modulation Type      | 802.11a/n/ac: OFDM                                                                                                                      |
| Antenna Description  | External Antenna , 2.0dBi for 2.4G, 2.0dBi for 5G                                                                                       |

### 2.3. Equipment Under Test

#### Power supply system utilised

|                      |   |                                                                   |                                   |
|----------------------|---|-------------------------------------------------------------------|-----------------------------------|
| Power supply voltage | : | <input type="radio"/> 230V / 50 Hz                                | <input type="radio"/> 120V / 60Hz |
|                      |   | <input type="radio"/> 12 V DC                                     | <input type="radio"/> 24 V DC     |
|                      |   | <input checked="" type="radio"/> Other (specified in blank below) |                                   |

DC 3.3V

### 2.4. Short description of the Equipment under Test (EUT)

This is a IEEE 802.11 a/b/g/n/ac(1T1R)WLAN with Bluetooth Module.

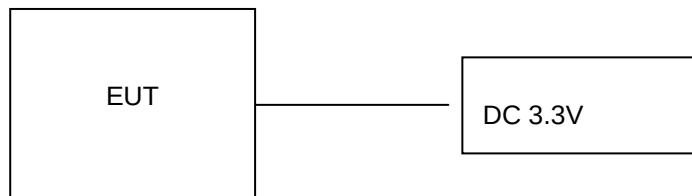
### 2.5. EUT operation mode

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 40 channels provided to the EUT.

Channel 00/19/39 was selected to test.

| Channel | Frequency(MHz) | Channel | Frequency(MHz) |
|---------|----------------|---------|----------------|
| 0       | 2402           | 20      | 2442           |
| 1       | 2404           | 21      | 2444           |
| 2       | 2406           | 22      | 2446           |
| --      | --             | --      | --             |
| --      | --             | --      | --             |
| 18      | 2438           | 38      | 2478           |
| 19      | 2440           | 39      | 2480           |

### 2.6. Block Diagram of Test Setup



### 2.7. Special Accessories

| Manufacturer | Description | Model  | Serial Number | Certificate |
|--------------|-------------|--------|---------------|-------------|
| BLOOMS       | Computer    | C615   | --            | SDOC        |
| PHILIPS      | Displayer   | 203V5L | --            | SDOC        |

The Computer and Displayer is provided by the laboratory.

### 2.8. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2AL6KBL-M8821CS1** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

### 2.9. Modifications

No modifications were implemented to meet testing criteria.

### 3. TEST ENVIRONMENT

#### 3.1. Address of the test laboratory

**Shenzhen Global Test Service Co.,Ltd.**

No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

#### 3.2. Test Facility

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

CNAS (No. CNAS L8169)

Shenzhen Global Test Service Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2019 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA (Certificate No. 4758.01)

Shenzhen Global Test Service Co., Ltd. has been assessed by the American Association for Laboratory Accreditation (A2LA). Certificate No. 4758.01.

#### 3.3. Environmental conditions

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

|                       |              |
|-----------------------|--------------|
| Temperature:          | 15-35 ° C    |
|                       |              |
| Humidity:             | 30-60 %      |
|                       |              |
| Atmospheric pressure: | 950-1050mbar |

#### 3.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen Global Test Service Co.,Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen GTS laboratory is reported:

| Test                  | Range      | Measurement Uncertainty | Notes |
|-----------------------|------------|-------------------------|-------|
| Radiated Emission     | 30~1000MHz | 4.10 dB                 | (1)   |
| Radiated Emission     | 1~18GHz    | 4.32 dB                 | (1)   |
| Radiated Emission     | 18-40GHz   | 5.54 dB                 | (1)   |
| Conducted Disturbance | 0.15~30MHz | 3.12 dB                 | (1)   |

- (1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

### 3.5. Test Description

| Test Specification clause | Test case                               | Test Mode | Test Channel                                                                                                                            | Recorded In Report |                                                                                                                                         | Pass                                                                                                              | Fail                     | NA                       | NP                       | Remark   |
|---------------------------|-----------------------------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|----------|
| §15.247(b)(4)             | Antenna gain                            | GFSK      | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Middle<br><input checked="" type="checkbox"/> Highest | GFSK               | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Middle<br><input checked="" type="checkbox"/> Highest | <input checked="" type="checkbox"/>                                                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.247(e)                | Power spectral density                  | GFSK      | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Middle<br><input checked="" type="checkbox"/> Highest | GFSK               | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Middle<br><input checked="" type="checkbox"/> Highest | <input checked="" type="checkbox"/>                                                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.247(a)(2)             | Spectrum bandwidth – 6 dB bandwidth     | GFSK      | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Middle<br><input checked="" type="checkbox"/> Highest | GFSK               | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Middle<br><input checked="" type="checkbox"/> Highest | <input checked="" type="checkbox"/><br><input checked="" type="checkbox"/>                                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.247(b)(1)             | Maximum output power                    | GFSK      | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Middle<br><input checked="" type="checkbox"/> Highest | GFSK               | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Middle<br><input checked="" type="checkbox"/> Highest | <input checked="" type="checkbox"/><br><input checked="" type="checkbox"/><br><input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.247(d)                | Band edge compliance conducted          | GFSK      | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Highest                                               | GFSK               | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Highest                                               | <input checked="" type="checkbox"/><br><input checked="" type="checkbox"/>                                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.205                   | Band edge compliance radiated           | GFSK      | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Highest                                               | GFSK               | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Highest                                               | <input checked="" type="checkbox"/>                                                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.247(d)                | TX spurious emissions conducted         | GFSK      | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Middle<br><input checked="" type="checkbox"/> Highest | GFSK               | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Middle<br><input checked="" type="checkbox"/> Highest | <input checked="" type="checkbox"/><br><input checked="" type="checkbox"/>                                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.247(d)                | TX spurious emissions radiated          | GFSK      | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Middle<br><input checked="" type="checkbox"/> Highest | GFSK               | <input checked="" type="checkbox"/> Lowest<br><input checked="" type="checkbox"/> Middle<br><input checked="" type="checkbox"/> Highest | <input checked="" type="checkbox"/>                                                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.109                   | RX spurious emissions radiated          | -/-       | -/-                                                                                                                                     | -/-                | -/-                                                                                                                                     | <input checked="" type="checkbox"/>                                                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.209(a)                | TX spurious Emissions radiated < 30 MHz | GFSK      | -/-                                                                                                                                     | GFSK               | -/-                                                                                                                                     | <input checked="" type="checkbox"/>                                                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.107(a)<br>§15.207     | Conducted Emissions < 30 MHz            | GFSK      | -/-                                                                                                                                     | GFSK               | -/-                                                                                                                                     | <input checked="" type="checkbox"/>                                                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |

Remark:

1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed

### 3.6. Equipments Used during the Test

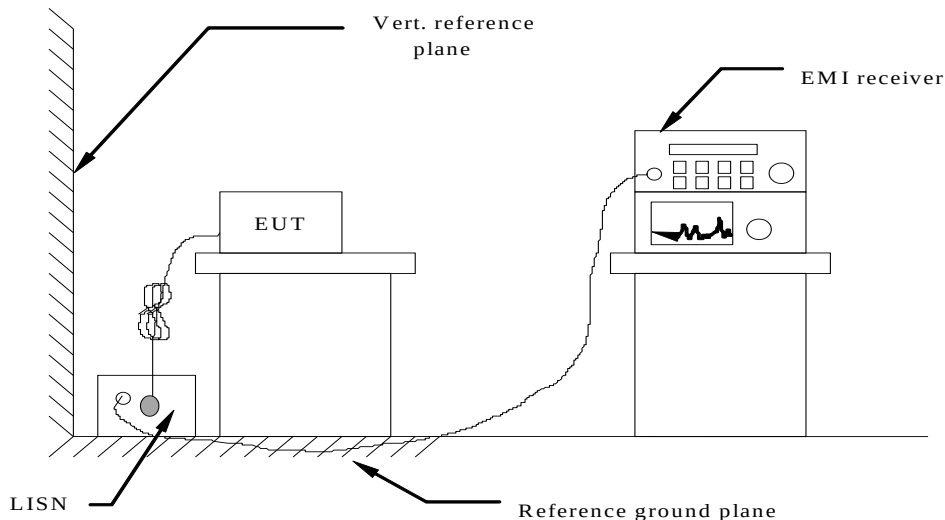
| Test Equipment             | Manufacturer                      | Model No.             | Serial No.      | Calibration Date | Calibration Due Date |
|----------------------------|-----------------------------------|-----------------------|-----------------|------------------|----------------------|
| LISN                       | R&S                               | ENV216                | 3560.6550.08    | 2019/09/20       | 2020/09/19           |
| LISN                       | R&S                               | ESH2-Z5               | 893606/008      | 2019/09/20       | 2020/09/19           |
| EMI Test Receiver          | R&S                               | ESPI3                 | 101841-cd       | 2019/09/20       | 2020/09/19           |
| EMI Test Receiver          | R&S                               | ESCI7                 | 101102          | 2019/09/20       | 2020/09/19           |
| Spectrum Analyzer          | Agilent                           | N9020A                | MY48010425      | 2019/09/20       | 2020/09/19           |
| Spectrum Analyzer          | R&S                               | FSV40                 | 100019          | 2019/09/20       | 2020/09/19           |
| Vector Signal generator    | Agilent                           | N5181A                | MY49060502      | 2019/09/20       | 2020/09/19           |
| Signal generator           | Agilent                           | E4421B                | 3610AO1069      | 2019/09/20       | 2020/09/19           |
| Climate Chamber            | ESPEC                             | EL-10KA               | A20120523       | 2019/09/20       | 2020/09/19           |
| Controller                 | EM Electronics                    | Controller EM 1000    | N/A             | N/A              | N/A                  |
| Horn Antenna               | Schwarzbeck                       | BBHA 9120D            | 01622           | 2019/09/23       | 2020/09/22           |
| Active Loop Antenna        | Beijing Da Ze Technology Co.,Ltd. | ZN30900C              | 15006           | 2019/10/12       | 2020/10/11           |
| Bilog Antenna              | Schwarzbeck                       | VULB9163              | 000976          | 2019/05/26       | 2020/05/25           |
| Broadband Horn Antenna     | SCHWARZBECK                       | BBHA 9170             | 791             | 2019/09/20       | 2020/09/19           |
| Amplifier                  | Schwarzbeck                       | BBV 9743              | #202            | 2019/09/20       | 2020/09/19           |
| Amplifier                  | Schwarzbeck                       | BBV9179               | 9719-025        | 2019/09/20       | 2020/09/19           |
| Amplifier                  | EMCI                              | EMC051845B            | 980355          | 2019/09/20       | 2020/09/19           |
| Temperature/Humidity Meter | Gangxing                          | CTH-608               | 02              | 2019/09/20       | 2020/09/19           |
| High-Pass Filter           | K&L                               | 9SH10-2700/X12750-O/O | KL142031        | 2019/09/20       | 2020/09/19           |
| High-Pass Filter           | K&L                               | 41H10-1375/U12750-O/O | KL142032        | 2019/09/20       | 2020/09/19           |
| RF Cable(below 1GHz)       | HUBER+SUHNER                      | RG214                 | RE01            | 2019/09/20       | 2020/09/19           |
| RF Cable(above 1GHz)       | HUBER+SUHNER                      | RG214                 | RE02            | 2019/09/20       | 2020/09/19           |
| Data acquisition card      | Agilent                           | U2531A                | TW53323507      | 2019/09/20       | 2020/09/19           |
| Power Sensor               | Agilent                           | U2021XA               | MY5365004       | 2019/09/20       | 2020/09/19           |
| Test Control Unit          | Tonscend                          | JS0806-1              | 178060067       | 2019/06/20       | 2020/06/19           |
| Automated filter bank      | Tonscend                          | JS0806-F              | 19F8060177      | 2019/06/20       | 2020/06/19           |
| EMI Test Software          | Tonscend                          | JS1120-1              | Ver 2.6.8.0518  | /                | /                    |
| EMI Test Software          | Tonscend                          | JS1120-3              | Ver 2.5.77.0418 | /                | /                    |
| EMI Test Software          | Tonscend                          | JS32-CE               | Ver 2.5         | /                | /                    |
| EMI Test Software          | Tonscend                          | JS32-RE               | Ver 2.5.1.8     | /                | /                    |

Note: 1. The Cal.Interval was one year.

## 4. TEST CONDITIONS AND RESULTS

### 4.1. AC Power Conducted Emission

#### TEST CONFIGURATION



#### TEST PROCEDURE

- 1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
- 2 Support equipment, if needed, was placed as per ANSI C63.10-2013
- 3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
- 4 The EUT received DC 5V power, the PC received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
- 5 All support equipments received AC power from a second LISN, if any.
- 6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
- 8 During the above scans, the emissions were maximized by cable manipulation.

#### AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following :

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

\* Decreases with the logarithm of the frequency.

#### TEST RESULTS

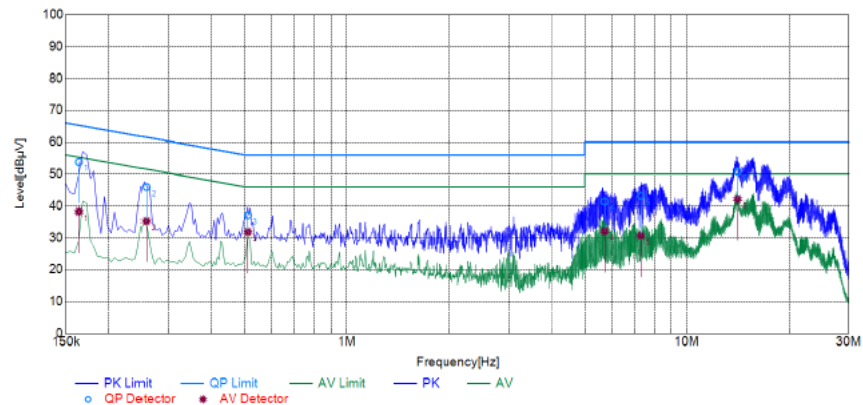
Power supply:

AC 120V/60Hz

Polarization

L

Test Graph



Final Data List

| NO. | Frequency<br>[MHz] | QP<br>Reading<br>[dBμV] | AVG.<br>Reading<br>[dBμV] | Factor<br>[dB] | QP<br>Result<br>[dBμV] | AVG.<br>Result<br>[dBμV] | QP<br>Limit<br>[dBμV] | AVG.<br>Limit<br>[dBμV] | QP<br>Margin<br>[dB] | AVG.<br>Margin<br>[dB] | Line | Remark |
|-----|--------------------|-------------------------|---------------------------|----------------|------------------------|--------------------------|-----------------------|-------------------------|----------------------|------------------------|------|--------|
| 1   | 0.1638             | 43.44                   | 27.93                     | 10.29          | 53.73                  | 38.22                    | 65.27                 | 55.27                   | 11.54                | 17.05                  | L1   | PASS   |
| 2   | 0.2569             | 35.84                   | 25.16                     | 10.12          | 45.96                  | 35.28                    | 61.53                 | 51.53                   | 15.57                | 16.25                  | L1   | PASS   |
| 3   | 0.5111             | 26.89                   | 21.56                     | 10.25          | 37.14                  | 31.81                    | 56.00                 | 46.00                   | 18.86                | 14.19                  | L1   | PASS   |
| 4   | 5.7310             | 30.88                   | 21.60                     | 10.45          | 41.33                  | 32.05                    | 60.00                 | 50.00                   | 18.67                | 17.95                  | L1   | PASS   |
| 5   | 7.3198             | 32.61                   | 20.11                     | 10.53          | 43.14                  | 30.64                    | 60.00                 | 50.00                   | 16.86                | 19.36                  | L1   | PASS   |
| 6   | 14.1233            | 39.89                   | 31.21                     | 10.88          | 50.77                  | 42.09                    | 60.00                 | 50.00                   | 9.23                 | 7.91                   | L1   | PASS   |

Note: 1. Result (dBμV) = Reading (dBμV) + Factor (dB).

2. Factor (dB) = Cable loss (dB) + LISN Factor (dB).

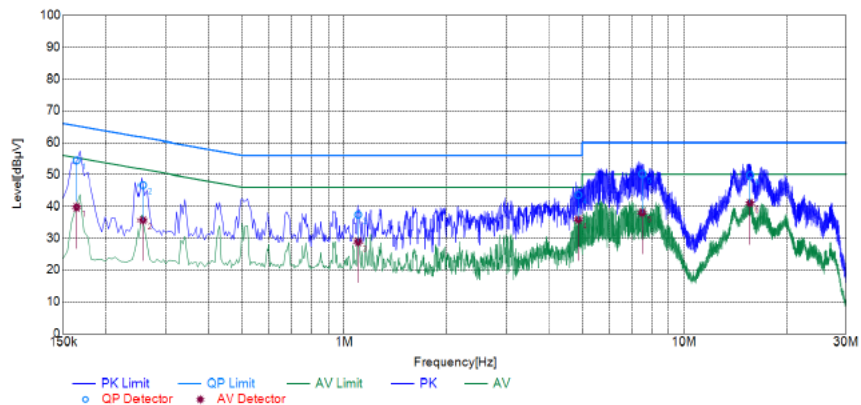
Power supply:

AC 120V/60Hz

Polarization

N

Test Graph



Final Data List

| NO. | Frequency<br>[MHz] | QP<br>Reading<br>[dBμV] | AVG.<br>Reading<br>[dBμV] | Factor<br>[dB] | QP<br>Result<br>[dBμV] | AVG.<br>Result<br>[dBμV] | QP<br>Limit<br>[dBμV] | AVG.<br>Limit<br>[dBμV] | QP<br>Margin<br>[dB] | AVG.<br>Margin<br>[dB] | Line | Remark |
|-----|--------------------|-------------------------|---------------------------|----------------|------------------------|--------------------------|-----------------------|-------------------------|----------------------|------------------------|------|--------|
| 1   | 0.1643             | 44.12                   | 29.40                     | 10.28          | 54.40                  | 39.68                    | 65.25                 | 55.25                   | 10.85                | 15.57                  | N    | PASS   |
| 2   | 0.2554             | 36.58                   | 25.57                     | 10.12          | 46.70                  | 35.69                    | 61.58                 | 51.58                   | 14.88                | 15.89                  | N    | PASS   |
| 3   | 1.0972             | 27.23                   | 18.68                     | 10.21          | 37.44                  | 28.89                    | 56.00                 | 46.00                   | 18.56                | 17.11                  | N    | PASS   |
| 4   | 4.8729             | 33.19                   | 25.50                     | 10.35          | 43.54                  | 35.85                    | 56.00                 | 46.00                   | 12.46                | 10.15                  | N    | PASS   |
| 5   | 7.5185             | 39.64                   | 27.47                     | 10.55          | 50.19                  | 38.02                    | 60.00                 | 50.00                   | 9.81                 | 11.98                  | N    | PASS   |
| 6   | 15.6198            | 38.65                   | 29.85                     | 11.11          | 49.76                  | 40.96                    | 60.00                 | 50.00                   | 10.24                | 9.04                   | N    | PASS   |

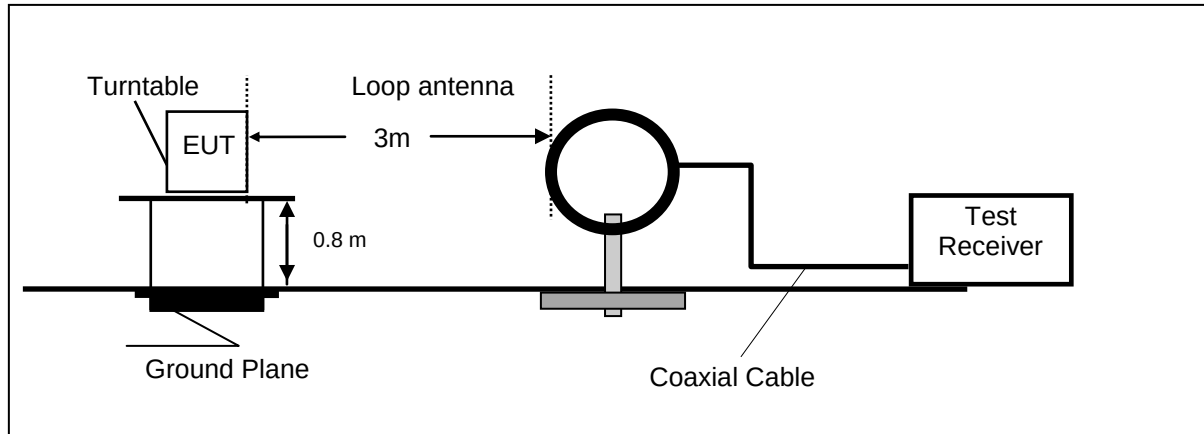
Note: 1. Result (dBμV) = Reading (dBμV) + Factor (dB).

2. Factor (dB) = Cable loss (dB) + LISN Factor (dB).

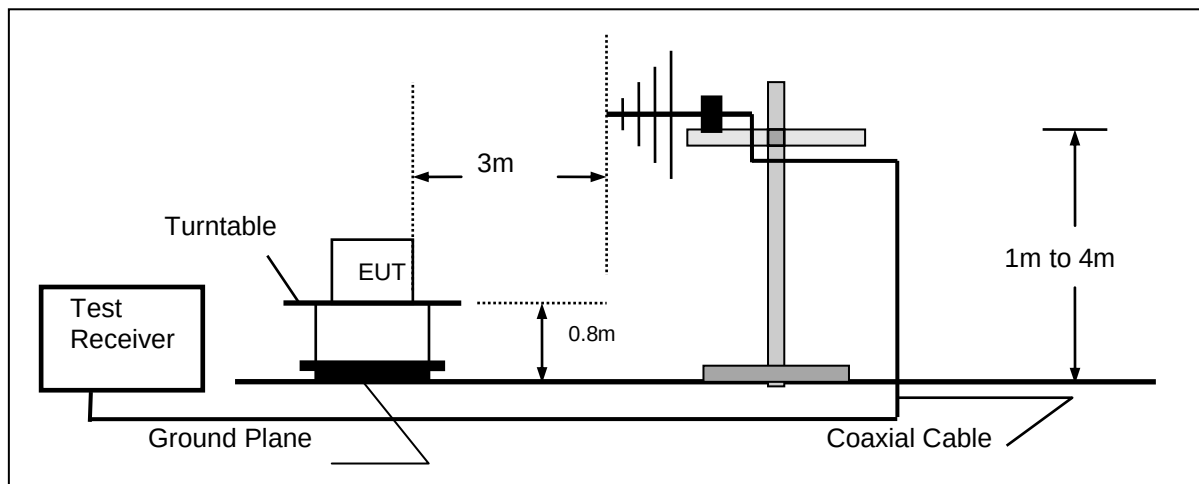
## 4.2. Radiated Emission

### TEST CONFIGURATION

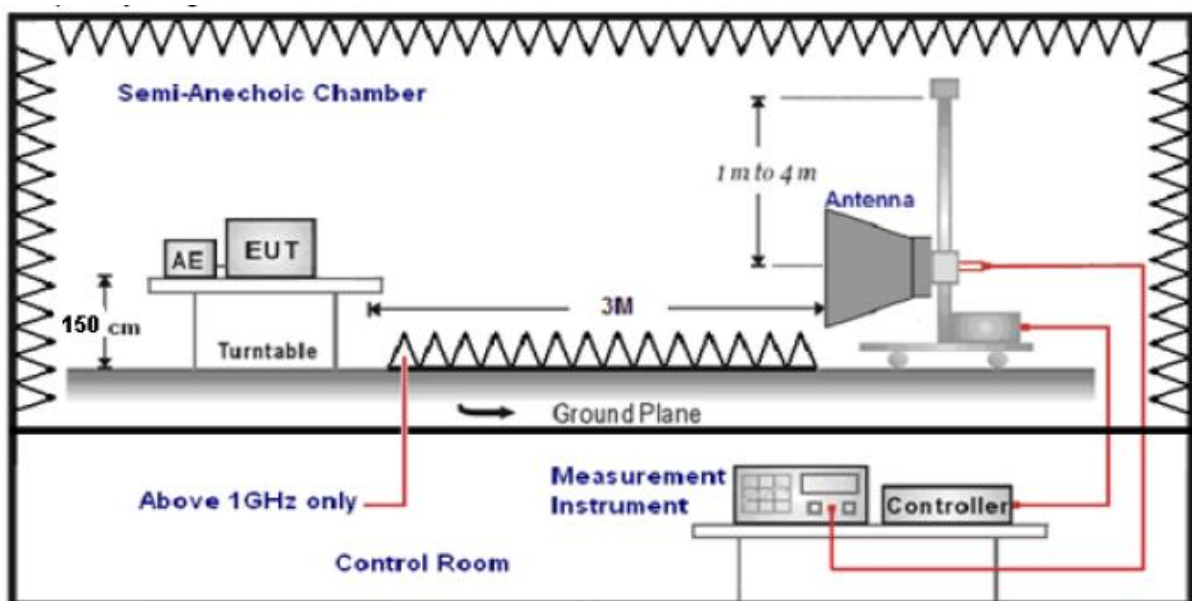
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



**TEST PROCEDURE**

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 30MHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

| Test Frequency range | Test Antenna Type          | Test Distance |
|----------------------|----------------------------|---------------|
| 9KHz-30MHz           | Active Loop Antenna        | 3             |
| 30MHz-1GHz           | Ultra-Broadband Antenna    | 3             |
| 1GHz-18GHz           | Double Ridged Horn Antenna | 3             |
| 18GHz-25GHz          | Horn Antenna               | 1             |

7. Setting test receiver/spectrum as following table states:

| Test Frequency range | Test Receiver/Spectrum Setting                                                                            | Detector |
|----------------------|-----------------------------------------------------------------------------------------------------------|----------|
| 9KHz-150KHz          | RBW=200Hz/VBW=3KHz,Sweep time=Auto                                                                        | QP       |
| 150KHz-30MHz         | RBW=9KHz/VBW=100KHz,Sweep time=Auto                                                                       | QP       |
| 30MHz-1GHz           | RBW=120KHz/VBW=1000KHz,Sweep time=Auto                                                                    | QP       |
| 1GHz-40GHz           | Peak Value: RBW=1MHz/VBW=3MHz,<br>Sweep time=Auto<br>Average Value: RBW=1MHz/VBW=10Hz,<br>Sweep time=Auto | Peak     |

**Field Strength Calculation**

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

|                           |                                            |
|---------------------------|--------------------------------------------|
| Where FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| RA = Reading Amplitude    | AG = Amplifier Gain                        |
| AF = Antenna Factor       |                                            |

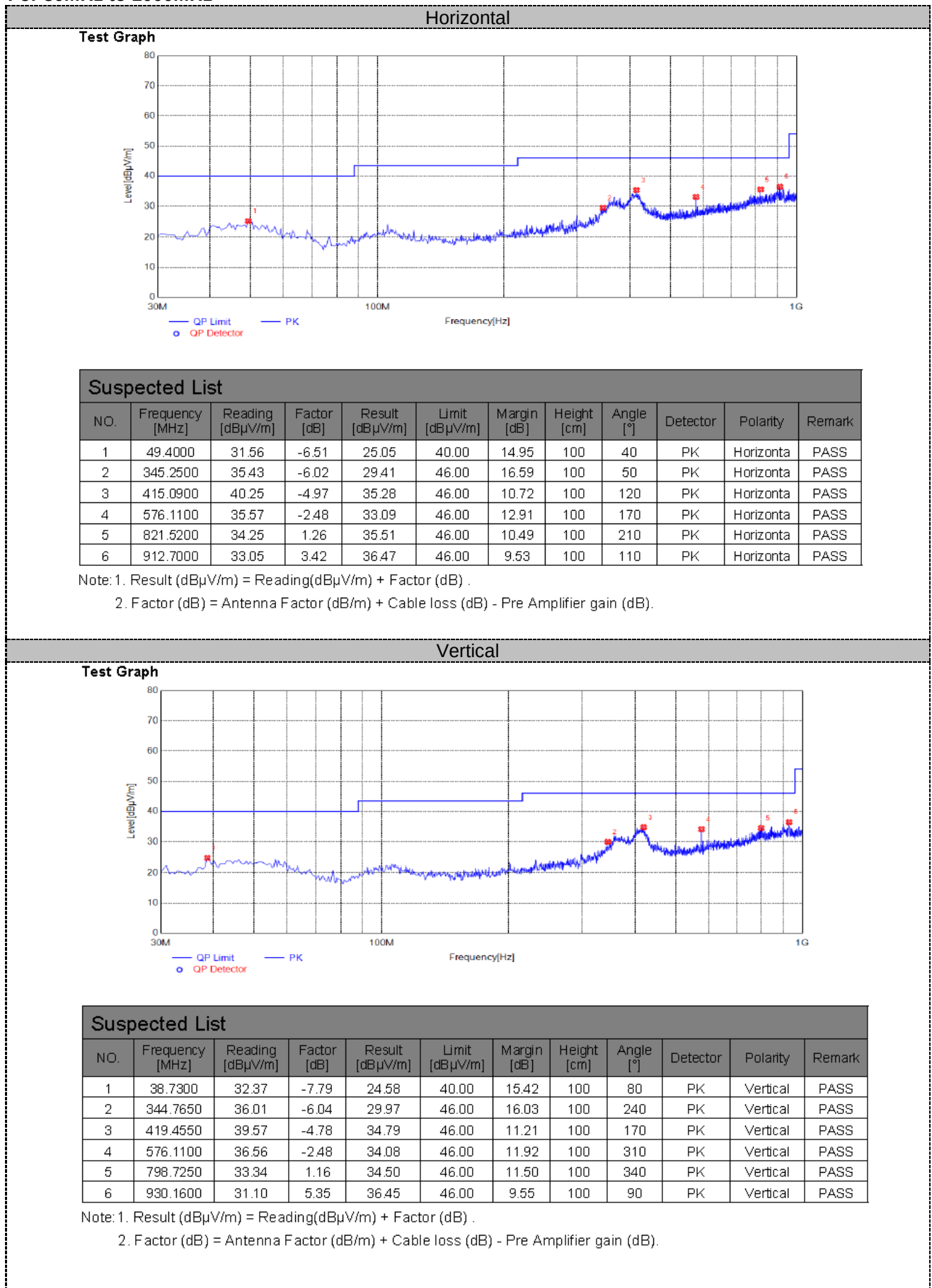
$$Transd=AF +CL-AG$$

**RADIATION LIMIT**

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

| Frequency (MHz) | Distance (Meters) | Radiated (dBµV/m)                   | Radiated (µV/m) |
|-----------------|-------------------|-------------------------------------|-----------------|
| 0.009-0.49      | 3                 | $20\log(2400/F(KHz))+40\log(300/3)$ | $2400/F(KHz)$   |
| 0.49-1.705      | 3                 | $20\log(24000/F(KHz))+40\log(30/3)$ | $24000/F(KHz)$  |
| 1.705-30        | 3                 | $20\log(30)+40\log(30/3)$           | 30              |
| 30-88           | 3                 | 40.0                                | 100             |
| 88-216          | 3                 | 43.5                                | 150             |
| 216-960         | 3                 | 46.0                                | 200             |
| Above 960       | 3                 | 54.0                                | 500             |

**TEST RESULTS****For 30MHz to 1000MHz**

## For 1GHz to 25GHz

BT LE

Channel 0 / 2402 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4804.00   | 50.87        | 32.44          | 30.25        | 7.95         | 61.01           | 74.00        | -12.99    | Peak    | Horizontal |
| 4804.00   | 36.34        | 32.44          | 30.25        | 7.95         | 46.48           | 54.00        | -7.52     | Average | Horizontal |
| 4804.00   | 52.90        | 32.44          | 30.25        | 7.95         | 63.04           | 74.00        | -10.96    | Peak    | Vertical   |
| 4804.00   | 35.90        | 32.44          | 30.25        | 7.95         | 46.04           | 54.00        | -7.96     | Average | Vertical   |

Channel 19 / 2440 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4880.00   | 49.11        | 32.52          | 30.31        | 8.12         | 59.44           | 74.00        | -14.56    | Peak    | Horizontal |
| 4880.00   | 37.61        | 32.52          | 30.31        | 8.12         | 47.94           | 54.00        | -6.06     | Average | Horizontal |
| 4880.00   | 51.48        | 32.52          | 30.31        | 8.12         | 61.81           | 74.00        | -12.19    | Peak    | Vertical   |
| 4880.00   | 36.23        | 32.52          | 30.31        | 8.12         | 46.56           | 54.00        | -7.44     | Average | Vertical   |

Channel 39 / 2480 MHz

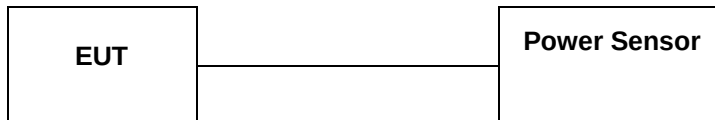
| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4960.00   | 51.46        | 32.68          | 30.27        | 7.88         | 61.75           | 74.00        | -12.25    | Peak    | Horizontal |
| 4960.00   | 36.53        | 32.68          | 30.27        | 7.88         | 46.82           | 54.00        | -7.18     | Average | Horizontal |
| 4960.00   | 49.51        | 32.68          | 30.27        | 7.88         | 59.80           | 74.00        | -14.20    | Peak    | Vertical   |
| 4960.00   | 32.15        | 32.68          | 30.27        | 7.88         | 42.44           | 54.00        | -11.56    | Average | Vertical   |

## Notes:

- 1). Measuring frequencies from 9 KHz~10<sup>th</sup> harmonic or 26.5GHz (which is less), No emission found between lowest internal used/generated frequency to 30MHz.
- 2). Radiated emissions measured in frequency range from 9 KHz~10<sup>th</sup> harmonic or 26.5GHz (which is less) were made with an instrument using Peak detector mode.
- 3). Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

### 4.3. Maximum Peak Output Power

#### TEST CONFIGURATION



#### TEST PROCEDURE

According to KDB558074 D01 DTS Measurement Guidance Section 9.1 Maximum peak conducted output power, 9.1.2.

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

#### LIMIT

The Maximum Peak Output Power Measurement is 30dBm.

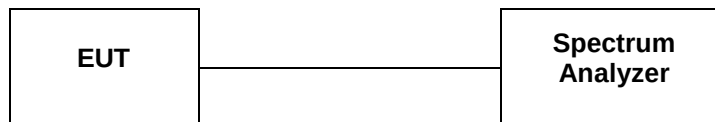
#### TEST RESULTS

| Modulation | Channel | Peak Output power (dBm) | Limit (dBm) | Result |
|------------|---------|-------------------------|-------------|--------|
| GFSK       | 0       | 3.56                    | 30          | Pass   |
|            | 19      | 3.03                    |             |        |
|            | 39      | 2.68                    |             |        |

Note: 1. The test results including the cable loss.

#### 4.4. Power Spectral Density

##### TEST CONFIGURATION



##### TEST PROCEDURE

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 3 kHz.
3. Set the VBW = 10 KHz.
4. Set the span to 1.5 times the DTS channel bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.
11. The resulting peak PSD level must be 8 dBm.

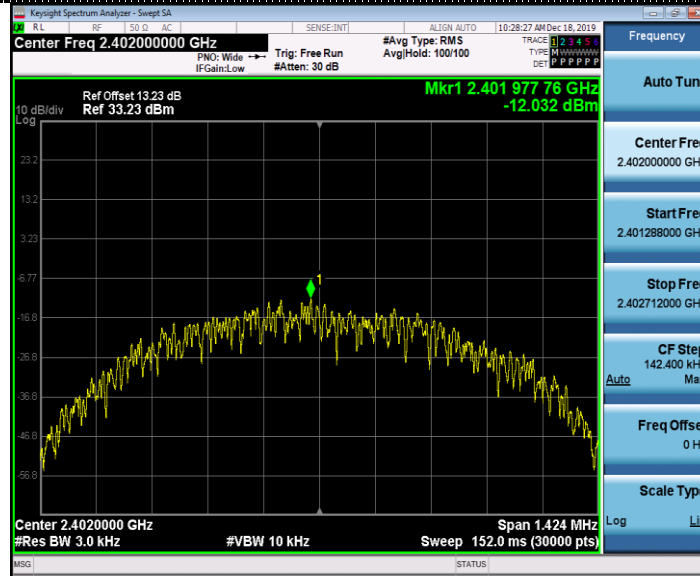
##### LIMIT

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

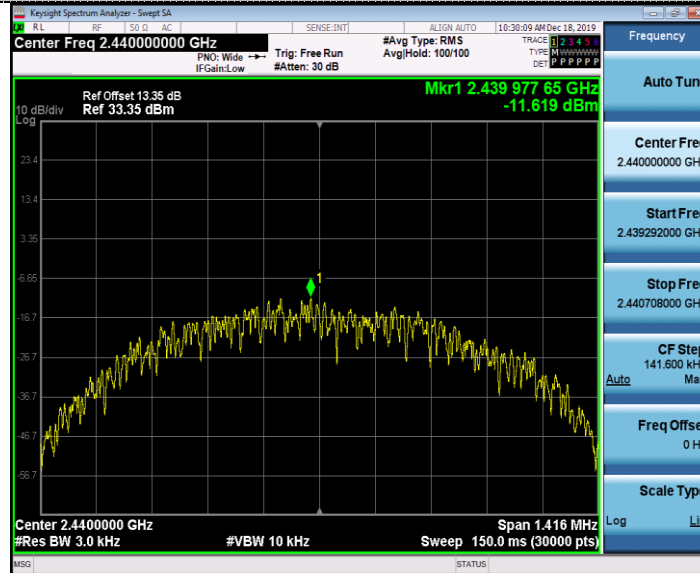
##### TEST RESULTS

| Modulation | Channel | Power Spectral Density(dBm/3KHz) | Limit (dBm/3KHz) | Result |
|------------|---------|----------------------------------|------------------|--------|
| GFSK       | 0       | -12.03                           | 8.00             | Pass   |
|            | 19      | -11.62                           |                  |        |
|            | 39      | -12.91                           |                  |        |

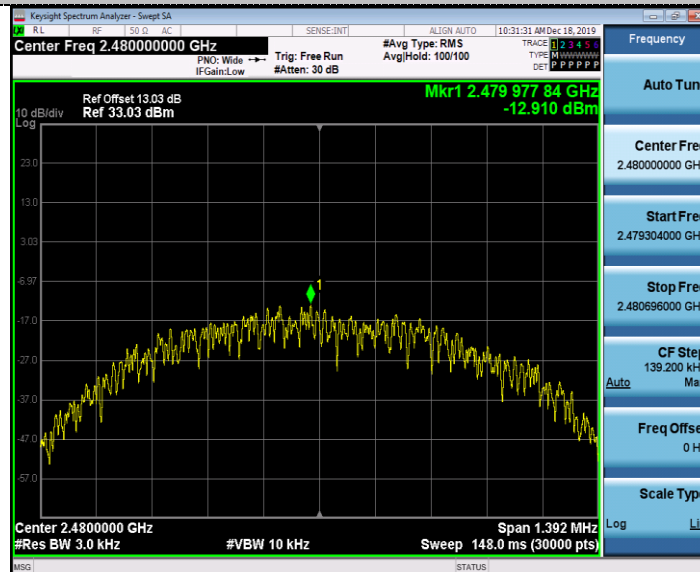
## CH00



## CH19

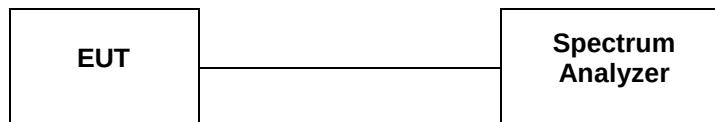


## CH39



#### 4.5. 6dB Bandwidth

##### TEST CONFIGURATION



##### TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=100 KHz and VBW=300KHz. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB. According to KDB558074 D01 V03 for one of the following procedures may be used to determine the modulated DTS device signal bandwidth.

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW)  $\geq 3$  RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

##### LIMIT

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

##### TEST RESULTS

| Modulation | Channel | 6dB Bandwidth (MHz) | Limit (KHz) | Result |
|------------|---------|---------------------|-------------|--------|
| GFSK       | 0       | 0.712               | $\geq 500$  | Pass   |
|            | 19      | 0.708               |             |        |
|            | 39      | 0.696               |             |        |

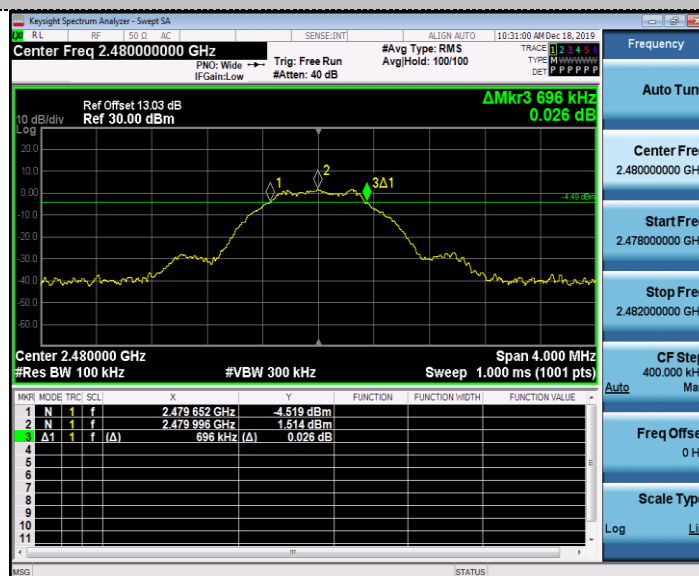
## CH00



## CH19



## CH39

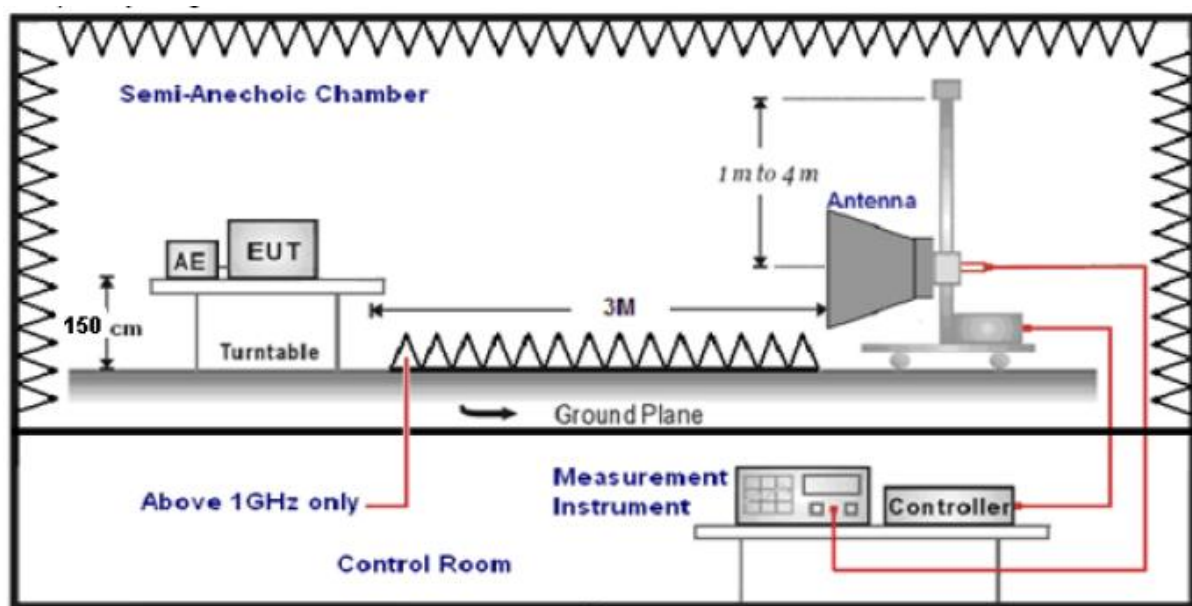


## 4.6. Band Edge Compliance of RF Emission

### TEST REQUIREMENT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### TEST CONFIGURATION



### TEST PROCEDURE

1. The EUT was placed on a turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed..
5. The distance between test antenna and EUT was 3 meter:
6. Setting test receiver/spectrum as following table states:

| Test Frequency range | Test Receiver/Spectrum Setting                                                                            | Detector |
|----------------------|-----------------------------------------------------------------------------------------------------------|----------|
| 1GHz-40GHz           | Peak Value: RBW=1MHz/VBW=3MHz,<br>Sweep time=Auto<br>Average Value: RBW=1MHz/VBW=10Hz,<br>Sweep time=Auto | Peak     |

### LIMIT

Below -20dB of the highest emission level in operating band.  
Radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)

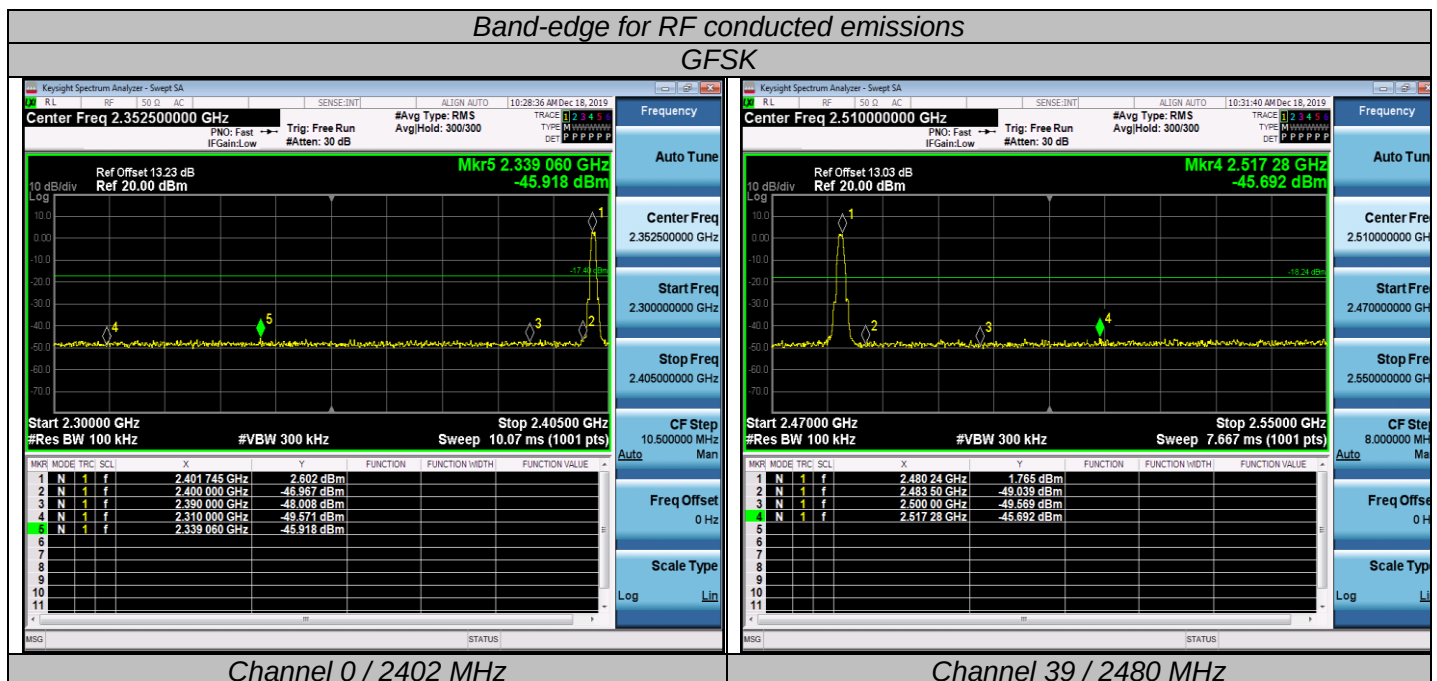
**TEST RESULTS****4.6.1 For Radiated Bandedge Measurement**

| Frequency(MHz): |                         |    | 2402           |             |                    | Polarity:            |                  |                       | HORIZONTAL        |               |                          |
|-----------------|-------------------------|----|----------------|-------------|--------------------|----------------------|------------------|-----------------------|-------------------|---------------|--------------------------|
| Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier | Correction Factor (dB/m) |
| 2390.00         | 45.50                   | PK | 74             | -28.50      | 1                  | 268                  | 50.81            | 27.49                 | 3.32              | 36.12         | -5.31                    |
| 2390.00         | 33.68                   | AV | 54             | -20.32      | 1                  | 268                  | 38.99            | 27.49                 | 3.32              | 36.12         | -5.31                    |
| Frequency(MHz): |                         |    | 2402           |             |                    | Polarity:            |                  |                       | VERTICAL          |               |                          |
| Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier | Correction Factor (dB/m) |
| 2390.00         | 46.43                   | PK | 74             | -27.57      | 1                  | 149                  | 51.74            | 27.49                 | 3.32              | 36.12         | -5.31                    |
| 2390.00         | 34.55                   | AV | 54             | -19.45      | 1                  | 149                  | 39.86            | 27.49                 | 3.32              | 36.12         | -5.31                    |
| Frequency(MHz): |                         |    | 2480           |             |                    | Polarity:            |                  |                       | HORIZONTAL        |               |                          |
| Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier | Correction Factor (dB/m) |
| 2483.50         | 48.28                   | PK | 74             | -25.72      | 1                  | 135                  | 54.00            | 27.45                 | 3.38              | 36.55         | -5.72                    |
| 2483.50         | 36.52                   | AV | 54             | -17.48      | 1                  | 135                  | 42.24            | 27.45                 | 3.38              | 36.55         | -5.72                    |
| Frequency(MHz): |                         |    | 2480           |             |                    | Polarity:            |                  |                       | VERTICAL          |               |                          |
| Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier | Correction Factor (dB/m) |
| 2483.50         | 49.15                   | PK | 74             | -24.85      | 1                  | 192                  | 54.87            | 27.45                 | 3.38              | 36.55         | -5.72                    |
| 2483.50         | 35.08                   | AV | 54             | -18.92      | 1                  | 192                  | 40.80            | 27.45                 | 3.38              | 36.55         | -5.72                    |

NOTE:

Emission level (dBuV/m) = Meter Reading+ antenna Factor+ cable loss- preamp factor

Margin value = Limits-Emission level

**4.6.2 For Conducted Bandedge Measurement**

## 4.7. Antenna Requirement

### Standard Applicable

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.

And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

### Test Result

The antenna used for this product is External Antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 2.0dBi.

Reference to the test report No. **GTS20191209006-2-22**

## **5. TEST SETUP PHOTOS OF THE EUT**

Reference to the Test Report NO. GTS20191209006-2-22

## **6. EXTERNAL AND INTERNAL PHOTOS OF THE EUT**

Reference to the Test Report NO. GTS20191209006-2-22

.....End of Report.....