

# TEST REPORT

**Application No.:** SHEM1901010667CR  
**FCC ID** 2ADTD-AEG2  
**Applicant:** Hangzhou Hikvision Digital Technology Co., Ltd.  
**Address of Applicant:** No.555 Qianmo Road, Binjiang District, Hangzhou 310052, China  
**Manufacturer:** Hangzhou Hikvision Digital Technology Co., Ltd.  
**Address of Manufacturer:** No.555 Qianmo Road, Binjiang District, Hangzhou 310052, China  
**Factory:** Hangzhou Hikvision Technology Co., Ltd.  
**Address of Factory:** No.700,Dongliu Road, Binjiang District, Hangzhou City, Zhejiang, 310052, China

**Equipment Under Test (EUT):**

**EUT Name:** Dashcam

**Model No.:** AE-DC5322-G2, AE-DC5322-G2 Plus, AE-DC5322-G2 Pro, AE-DC5322-G2S, AE-DC5322-G2A, AE-DC5322-G2B, AE-DC5322-G2C, AE-DC5322-G2+ ☒

☒ Please refer to section 2 of this report which indicates which model was actually tested and which were electrically identical.

**Trade mark:** HIKVISION

**Standard(s) :** 47 CFR Part 15, Subpart C 15.247

**Date of Receipt:** 2019-01-24

**Date of Test:** 2019-01-28 to 2019-03-13

**Date of Issue:** 2019-03-19

|                     |              |
|---------------------|--------------|
| <b>Test Result:</b> | <b>Pass*</b> |
|---------------------|--------------|

\* In the configuration tested, the EUT complied with the standards specified above.

*Parlam Zhan*

Parlam Zhan  
E&E Section Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.



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SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.  
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| Revision Record |             |            |        |
|-----------------|-------------|------------|--------|
| Version         | Description | Date       | Remark |
| 00              | Original    | 2019-03-19 | /      |
|                 |             |            |        |
|                 |             |            |        |

|                          |  |                                |  |  |
|--------------------------|--|--------------------------------|--|--|
| Authorized for issue by: |  |                                |  |  |
|                          |  | Vincent Zhu                    |  |  |
|                          |  | Vincent Zhu / Project Engineer |  |  |
|                          |  | Parlam zhan                    |  |  |
|                          |  | Parlam Zhan /Reviewer          |  |  |

## 2 Test Summary

| Radio Spectrum Technical Requirement |                                  |        |  |                      |
|--------------------------------------|----------------------------------|--------|--|----------------------|
| Item                                 | Standard                         | Method | Requirement                                  | Result               |
| Antenna Requirement                  | 47 CFR Part 15, Subpart C 15.247 | N/A    | 47 CFR Part 15, Subpart C 15.203 & 15.247(c) | Customer Declaration |

| Radio Spectrum Matter Part                            |                                  |  |   |        |
|---|----------------------------------|--|---|--------|
| Item  | Standard                         | Method                                 | Requirement                               | Result |
| Minimum 6dB Bandwidth                                 | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 11.8.1      | 47 CFR Part 15, Subpart C 15.247a(2)      | Pass   |
| Conducted Peak Output Power                           | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 11.9.1      | 47 CFR Part 15, Subpart C 15.247(b)(3)    | Pass   |
| Power Spectrum Density                                | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 11.10.2     | 47 CFR Part 15, Subpart C 15.247(e)       | Pass   |
| Conducted Band Edges Measurement                      | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 11.13.3.2   | 47 CFR Part 15, Subpart C 15.247(d)       | Pass   |
| Conducted Spurious Emissions                          | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 11.11       | 47 CFR Part 15, Subpart C 15.247(d)       | Pass   |
| Radiated Emissions which fall in the restricted bands | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 6.10.5      | 47 CFR Part 15, Subpart C 15.205 & 15.209 | Pass   |
| Radiated Spurious Emissions                           | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 6.4,6.5,6.6 | 47 CFR Part 15, Subpart C 15.205 & 15.209 | Pass   |

### Declaration of EUT Family Grouping:

Note: There are series models mentioned in this report, and they are the identical in electrical and electronic characters. Only the model AE-DC5322-G2 was tested since their differences were the model number and appearance.



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## 4 General Information

### 4.1 Details of E.U.T.

|                     |   |
|---------------------|---|
| Power supply:       | DC 12V by battery   |
| Test voltage:       | DC 12V  |
| Cable:              | DC Cable 3m for front camera<br>DC Cable 4m for behind camera |
| Antenna Gain        | -1 dBi  |
| Antenna Type        | PIFA Antenna  |
| Channel Spacing     | 2MHz  |
| Modulation Type     | GFSK  |
| Number of Channels  | 40  |
| Operation Frequency | 2402MHz to 2480MHz  |

### 4.2 Description of Support Units

| Description               | Manufacturer | Model No.      | Serial No. |
|---------------------------|--------------|----------------|------------|
| Laptop                    | Lenovo       | ThinkPad X100e | /          |
| SecureCRT                 | VanDyke      | V 6.2.0        | /          |
| Serial port adapter plate | /            | Test Plate 3   | /          |

### 4.3 Measurement Uncertainty

| No. | Item                            | Measurement Uncertainty  |
|-----|---------------------------------|--|
| 1   | Radio Frequency                 | $\pm 8.4 \times 10^{-8}$   |
| 2   | Timeout                         | $\pm 2s$   |
| 3   | Duty cycle                      | $\pm 0.37\%$   |
| 4   | Occupied Bandwidth              | $\pm 3\%$  |
| 5   | RF conducted power              | $\pm 0.6dB$  |
| 6   | RF power density                | $\pm 2.84dB$   |
| 7   | Conducted Spurious emissions    | $\pm 0.75dB$   |
| 8   | RF Radiated power               | $\pm 4.6dB$ (Below 1GHz)<br>$\pm 4.1dB$ (Above 1GHz)   |
| 9   | Radiated Spurious emission test | $\pm 4.2dB$ (Below 30MHz)<br>$\pm 4.4dB$ (30MHz-1GHz)<br>$\pm 4.8dB$ (1GHz-18GHz)<br>$\pm 5.2dB$ (Above 18GHz) |
| 10  | Temperature test                | $\pm 1^{\circ}C$   |
| 11  | Humidity test                   | $\pm 3\%$  |
| 12  | Supply voltages                 | $\pm 1.5\%$  |
| 13  | Time                            | $\pm 3\%$  |

Note: The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

#### 4.4 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd. Shanghai Branch

588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China

Tel: +86 21 6191 5666

Fax: +86 21 6191 5678

No tests were sub-contracted.

#### 4.5 Test Facility

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

- **CNAS (No. CNAS L0599)**

CNAS has accredited SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

- **NVLAP (Certificate No. 201034-0)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP). Certificate No. 201034-0.

- **FCC –Designation Number: CN5033**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

Designation Number: CN5033. Test Firm Registration Number: 479755.

- **Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

IC Registration No.: 8617A-1. CAB identifier: CN0020.

- **VCCI (Member No.: 3061)**

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.

#### 4.6 Deviation from Standards

None

#### 4.7 Abnormalities from Standard Conditions

None

## 5 Equipment List

| Equipment                 | Manufacturer | Model No         | Inventory No | Cal Date   | Cal Due Date |
|---------------------------|--------------|------------------|--------------|------------|--------------|
| <b>Conducted Test</b>     |              |                  |              |            |              |
| Spectrum Analyzer         | R&S          | FSP-30           | SHEM002-1    | 2018-12-20 | 2019-12-19   |
| Spectrum Analyzer         | Agilent      | N9020A           | SHEM181-1    | 2018-08-13 | 2019-08-12   |
| Signal Generator          | R&S          | SMR20            | SHEM006-1    | 2018-08-13 | 2019-08-12   |
| Signal Generator          | Agilent      | N5182A           | SHEM182-1    | 2018-08-13 | 2019-08-12   |
| Communication Tester      | R&S          | CMW270           | SHEM183-1    | 2018-08-13 | 2019-08-12   |
| Switcher                  | Tonscend     | JS0806           | SHEM184-1    | 2018-08-13 | 2019-08-12   |
| Power Sensor              | Keysight     | U2021XA * 4      | SHEM184-1    | 2018-08-13 | 2019-08-12   |
| Splitter                  | Anritsu      | MA1612A          | SHEM185-1    | /          | /            |
| Coupler                   | e-meca       | 803-S-1          | SHEM186-1    | /          | /            |
| High-low Temp Cabinet     | Suzhou Zhihe | TL-40            | SHEM087-1    | 2017-09-25 | 2020-09-24   |
| AC Power Stabilizer       | WOCEN        | 6100             | SHEM045-1    | 2018-12-26 | 2019-12-25   |
| DC Power Supply           | MCN          | MCH-303A         | SHEM210-1    | 2018-12-26 | 2019-12-25   |
| Conducted test Cable      | /            | RF01~RF04        | /            | 2018-12-26 | 2019-12-25   |
| <b>Radiated Test</b>      |              |                  |              |            |              |
| EMI test Receiver         | R&S          | ESU40            | SHEM051-1    | 2018-12-20 | 2019-12-19   |
| Spectrum Analyzer         | R&S          | FSP-30           | SHEM002-1    | 2018-12-20 | 2019-12-19   |
| Loop Antenna (9kHz-30MHz) | Schwarzbeck  | FMZB1519         | SHEM135-1    | 2017-04-10 | 2020-04-09   |
| Antenna (25MHz-2GHz)      | Schwarzbeck  | VULB9168         | SHEM048-1    | 2017-02-28 | 2020-02-27   |
| Antenna (25MHz-3GHz)      | Schwarzbeck  | HL562            | SHEM010-1    | 2017-02-28 | 2020-02-27   |
| Horn Antenna (1-8GHz)     | Schwarzbeck  | HF906            | SHEM009-1    | 2017-10-24 | 2020-10-23   |
| Horn Antenna (1-18GHz)    | Schwarzbeck  | BBHA9120D        | SHEM050-1    | 2017-01-14 | 2020-01-13   |
| Horn Antenna (14-40GHz)   | Schwarzbeck  | BBHA 9170        | SHEM049-1    | 2017-12-03 | 2020-12-02   |
| Pre-amplifier (9kHz-2GHz) | CLAVIIO      | BDLNA-0001       | SHEM164-1    | 2018-08-13 | 2019-08-12   |
| Pre-amplifier (1-18GHz)   | CLAVIIO      | BDLNA-0118       | SHEM050-2    | 2018-08-13 | 2019-08-12   |
| High-amplifier (14-40GHz) | Schwarzbeck  | 10001            | SHEM049-2    | 2018-12-20 | 2019-12-19   |
| Signal Generator          | R&S          | SMR40            | SHEM058-1    | 2018-08-13 | 2019-08-12   |
| Band Filter               | LORCH        | 9BRX-875/X150    | SHEM156-1    | /          | /            |
| Band Filter               | LORCH        | 13BRX-1950/X500  | SHEM083-2    | /          | /            |
| Band Filter               | LORCH        | 5BRX-2400/X200   | SHEM155-1    | /          | /            |
| Band Filter               | LORCH        | 5BRX-5500/X1000  | SHEM157-2    | /          | /            |
| High pass Filter          | Wainwright   | WHK3.0/18G       | SHEM157-1    | /          | /            |
| High pass Filter          | Wainwright   | WHKS1700         | SHEM157-3    | /          | /            |
| Semi/Fully Anechoic       | ST           | 11*6*6M          | SHEM078-2    | 2017-07-22 | 2020-07-21   |
| RE test Cable             | /            | RE01, RE02, RE06 | /            | 2018-12-26 | 2019-12-25   |



## 6 Radio Spectrum Technical Requirement

### 6.1 Antenna Requirement

#### 6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(c)

#### 6.1.2 Conclusion

Standard Requirement:

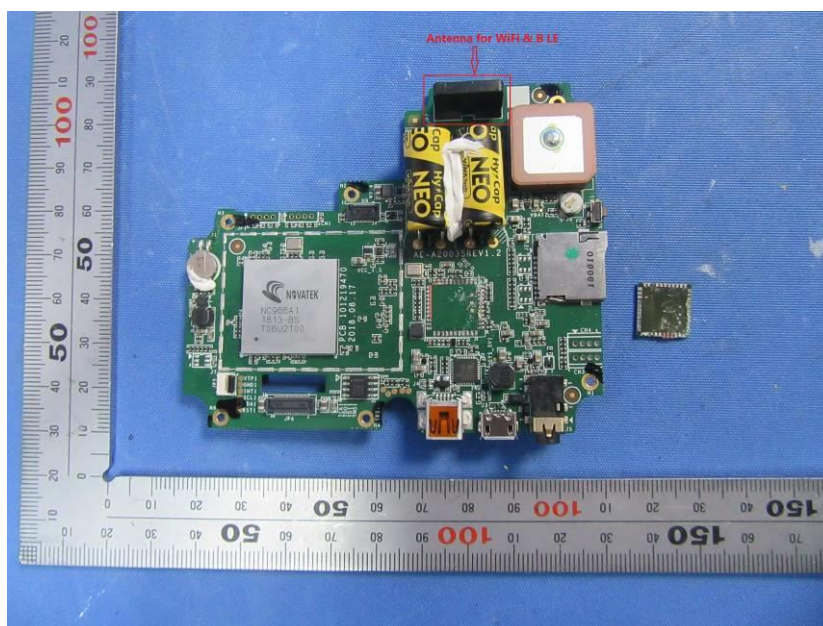
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is PIFA antenna and no consideration of replacement. The best case gain of the antenna is -1dBi.





## 7 Radio Spectrum Matter Test Results

### 7.1 Minimum 6dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247a(2)  
Test Method: ANSI C63.10 (2013) Section 11.8.1  
Limit:  $\geq 500$  kHz

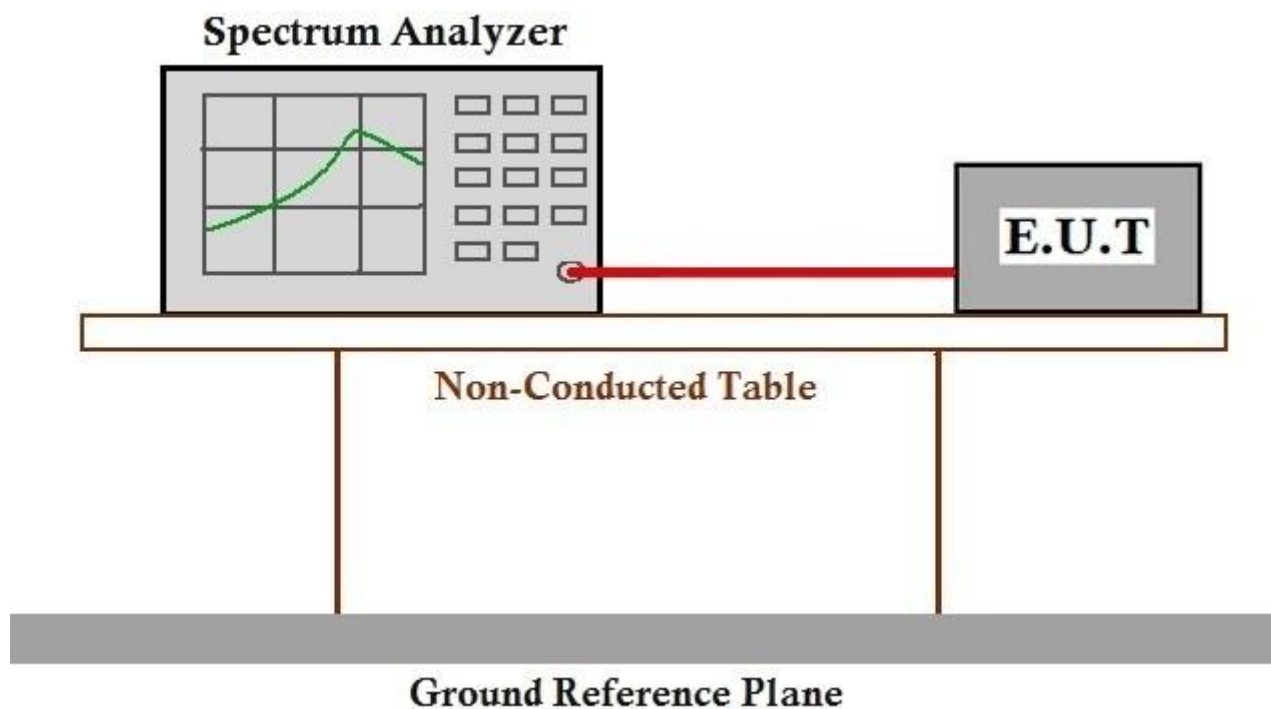
#### 7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX mode\_Keep the EUT in continuously transmitting mode with GFSK modulation

#### 7.1.2 Test Setup Diagram



#### 7.1.3 Measurement Procedure and Data

The detailed test data see: Appendix A SHEM190101066701

## 7.2 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(3)  
Test Method: ANSI C63.10 (2013) Section 11.9.1  
Limit:

| Frequency range(MHz) | Output power of the intentional radiator(watt)         |
|----------------------|--|
| 902-928              | 1 for $\geq 50$ hopping channels                       |
|                      | 0.25 for $25 \leq$ hopping channels $< 50$             |
|                      | 1 for digital modulation                               |
| 2400-2483.5          | 1 for $\geq 75$ non-overlapping hopping channels       |
|                      | 0.125 for all other frequency hopping systems          |
|                      | 1 for digital modulation                               |
| 5725-5850            | 1 for frequency hopping systems and digital modulation |

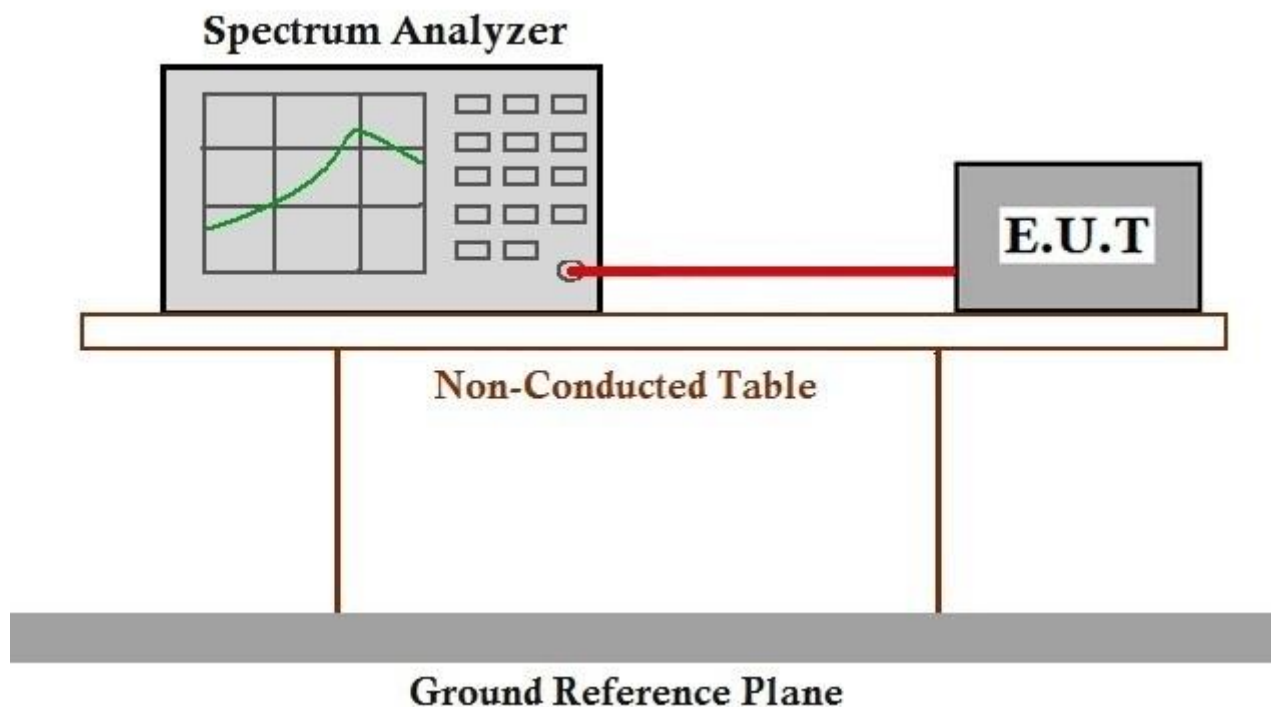
### 7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX mode\_Keep the EUT in continuously transmitting mode with GFSK modulation

### 7.2.2 Test Setup Diagram



### 7.2.3 Measurement Procedure and Data

The detailed test data see: Appendix A SHEM190101066701

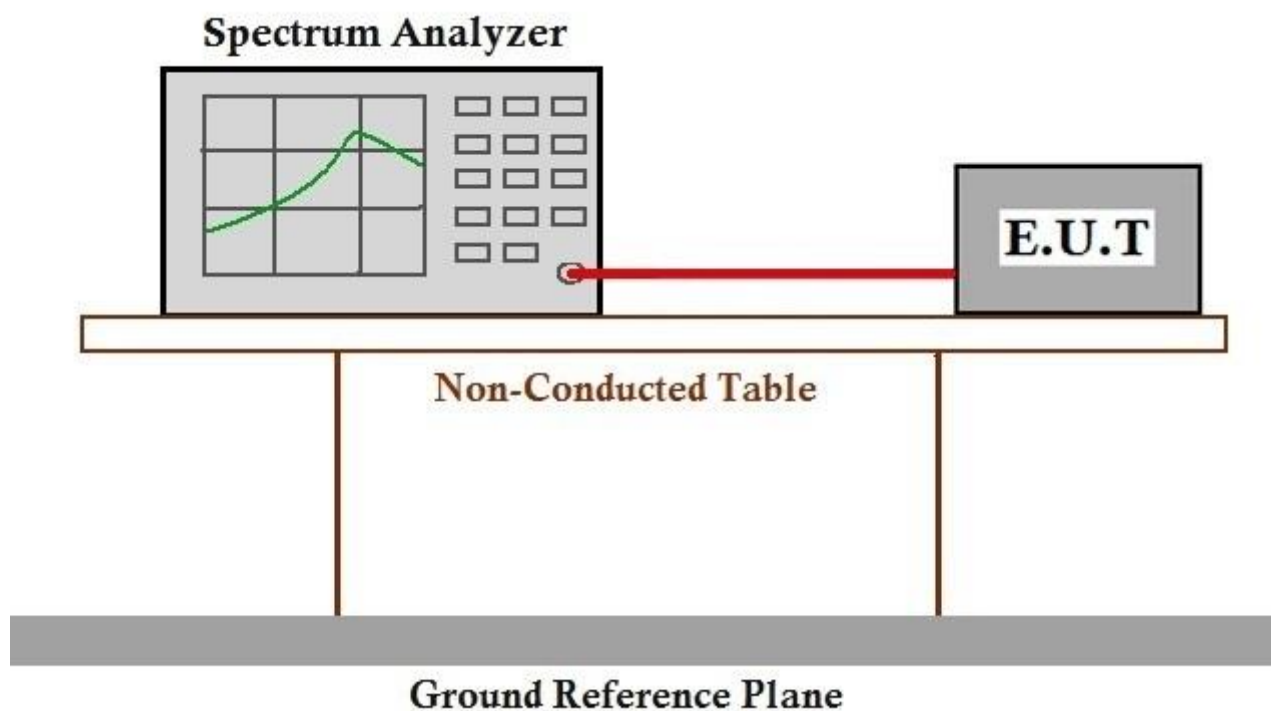
### 7.3 Power Spectrum Density

Test Requirement 47 CFR Part 15, Subpart C 15.247(e)  
Test Method: ANSI C63.10 (2013) Section 11.10.2  
Limit:  $\leq 8\text{dBm}$  in any 3 kHz band during any time interval of continuous transmission

#### 7.3.1 E.U.T. Operation

Operating Environment:  
Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar  
Test mode a:TX mode\_Keep the EUT in continuously transmitting mode with GFSK modulation

#### 7.3.2 Test Setup Diagram



#### 7.3.3 Measurement Procedure and Data

The detailed test data see: Appendix A SHEM190101066701

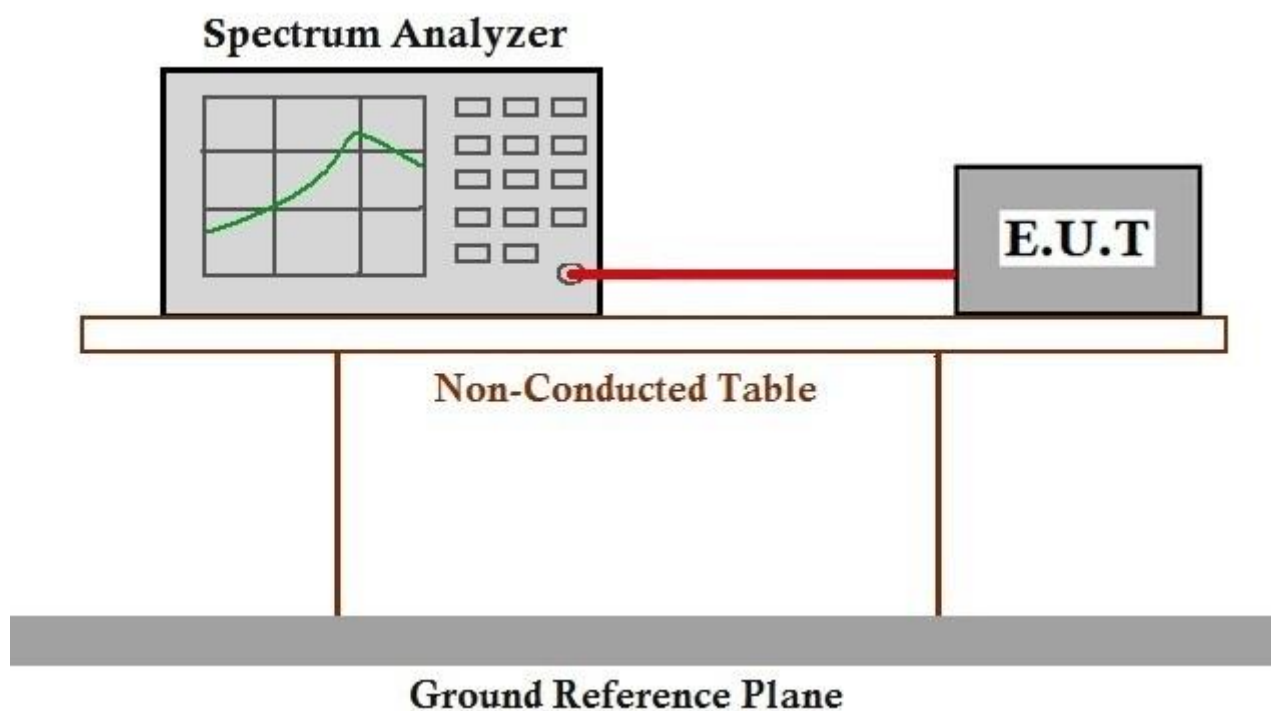
## 7.4 Conducted Band Edges Measurement

|                  |   |
|------------------|---|
| Test Requirement | 47 CFR Part 15, Subpart C 15.247(d)   |
| Test Method:     | ANSI C63.10 (2013) Section 11.13.3.2  |
| Limit:           | 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)) |

### 7.4.1 E.U.T. Operation

|                        |   |           |         |                       |           |
|------------------------|---|-----------|---------|-----------------------|-----------|
| Operating Environment: |   |           |         |                       |           |
| Temperature:           | 20 °C   | Humidity: | 50 % RH | Atmospheric Pressure: | 1010 mbar |
| Test mode              | a:TX mode_Keep the EUT in continuously transmitting mode with GFSK modulation |           |         |                       |           |

### 7.4.2 Test Setup Diagram



### 7.4.3 Measurement Procedure and Data

The detailed test data see: Appendix A SHEM190101066701

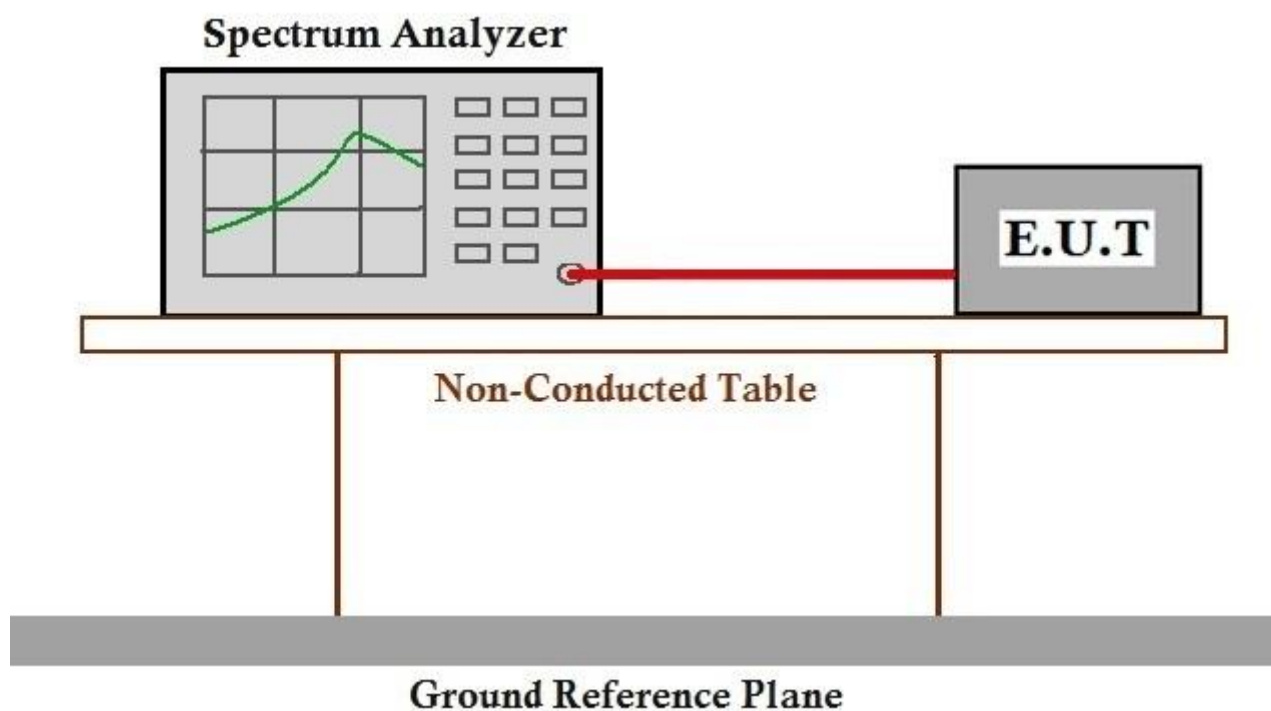
## 7.5 Conducted Spurious Emissions

|                  |   |
|------------------|---|
| Test Requirement | 47 CFR Part 15, Subpart C 15.247(d)   |
| Test Method:     | ANSI C63.10 (2013) Section 11.11  |
| Limit:           | 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)) |

### 7.5.1 E.U.T. Operation

|                        |   |           |         |                       |           |
|------------------------|---|-----------|---------|-----------------------|-----------|
| Operating Environment: |   |           |         |                       |           |
| Temperature:           | 20 °C   | Humidity: | 50 % RH | Atmospheric Pressure: | 1010 mbar |
| Test mode              | a:TX mode_Keep the EUT in continuously transmitting mode with GFSK modulation |           |         |                       |           |

### 7.5.2 Test Setup Diagram



### 7.5.3 Measurement Procedure and Data

The detailed test data see: Appendix A SHEM190101066701

## 7.6 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.10.5

Limit:

| Frequency(MHz) | Field strength(microvolts/meter) | Measurement distance(meters) |
|----------------|----------------------------------|------------------------------|
| 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                            |

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, 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.

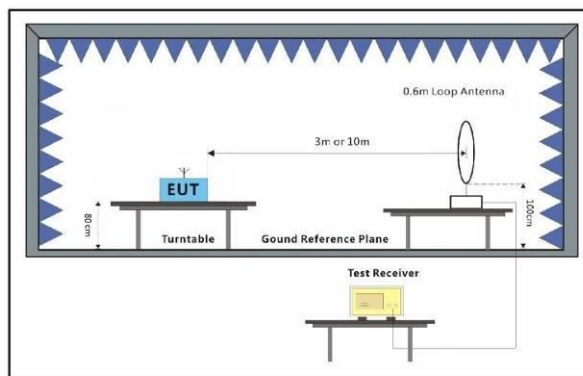
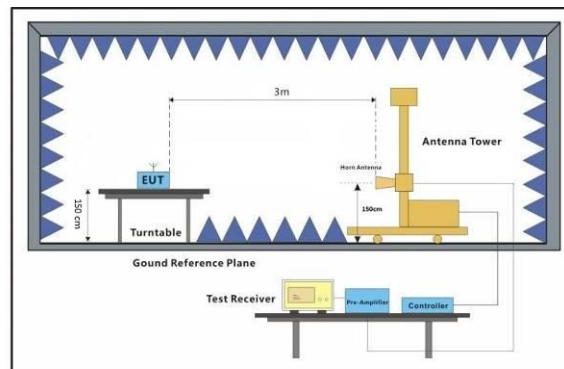
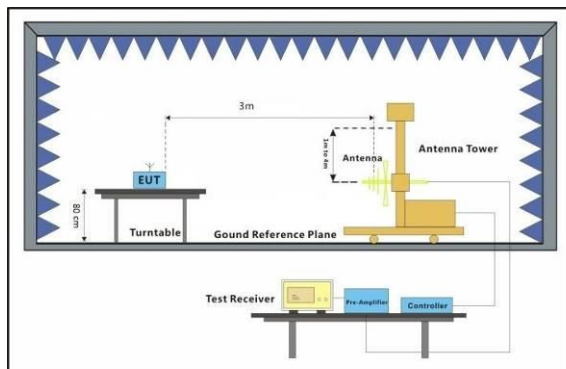
### 7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX mode\_Keep the EUT in continuously transmitting mode with GFSK modulation

### 7.6.2 Test Setup Diagram





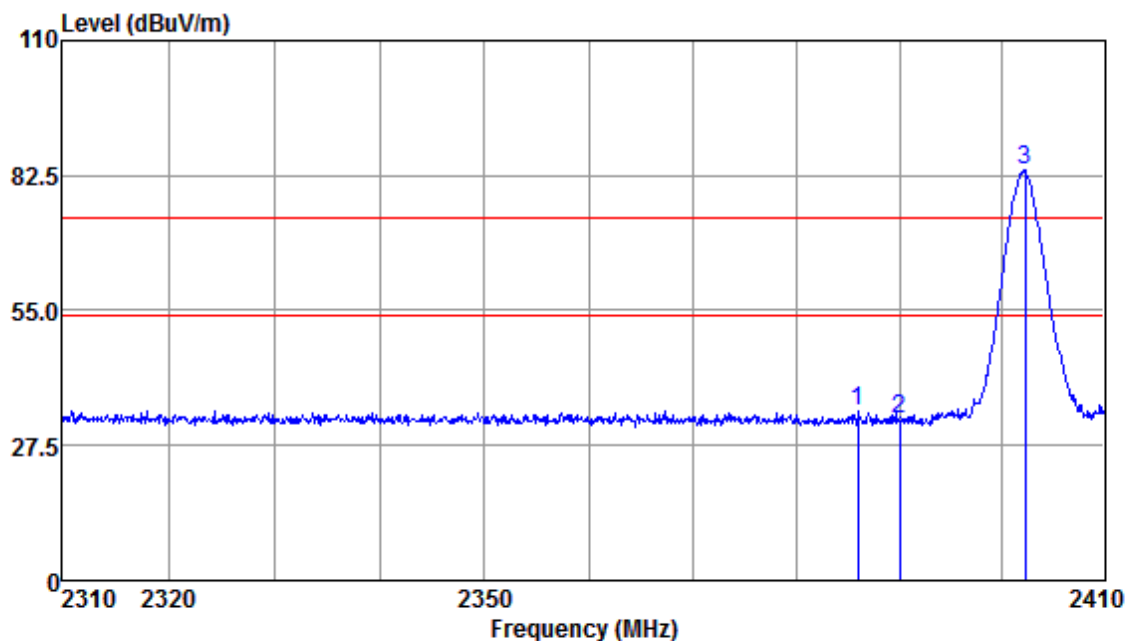
### 7.6.3 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark 1:  $\text{Level} = \text{Read Level} + \text{Cable Loss} + \text{Antenna Factor} - \text{Preamplifier Factor}$

Remark 2: For frequencies above 1GHz, the field strength limits 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 the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

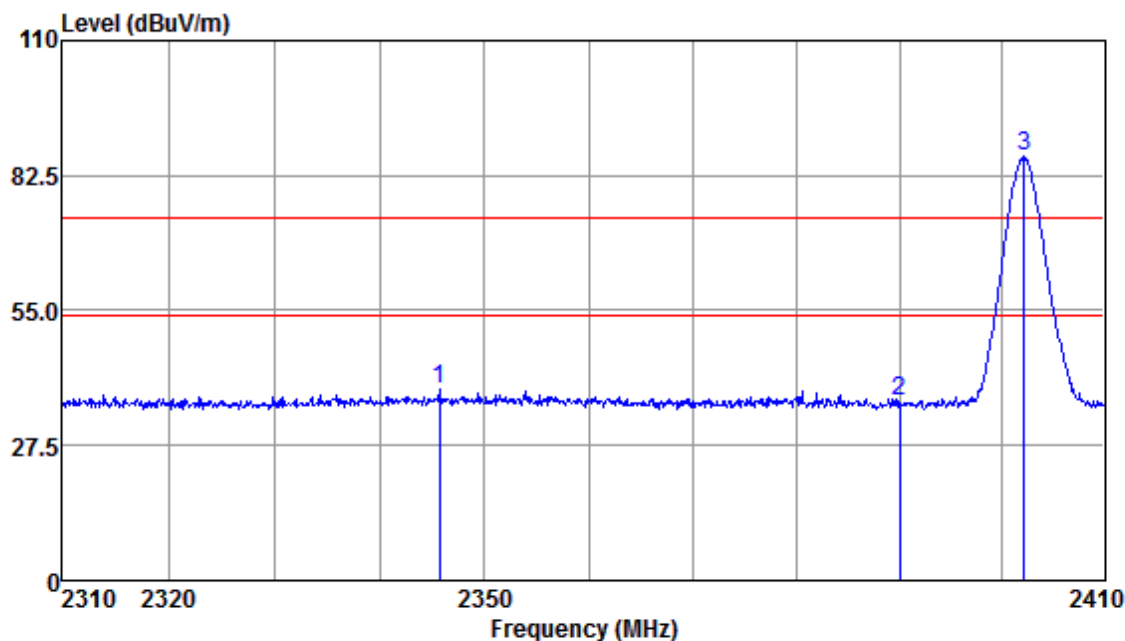


Antenna Polarity :HORIZONTAL

| Freq    | Read Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|---------|------------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz     | dBuv       | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2385.92 | 39.47      | 26.03          | 6.47       | 37.36         | 34.61          | 74.00      | -39.39     | Peak   |
| 2390.00 | 37.81      | 26.03          | 6.47       | 37.36         | 32.95          | 74.00      | -41.05     | Peak   |
| 2402.25 | 88.29      | 26.05          | 6.50       | 37.35         | 83.49          | 74.00      | 9.49       | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

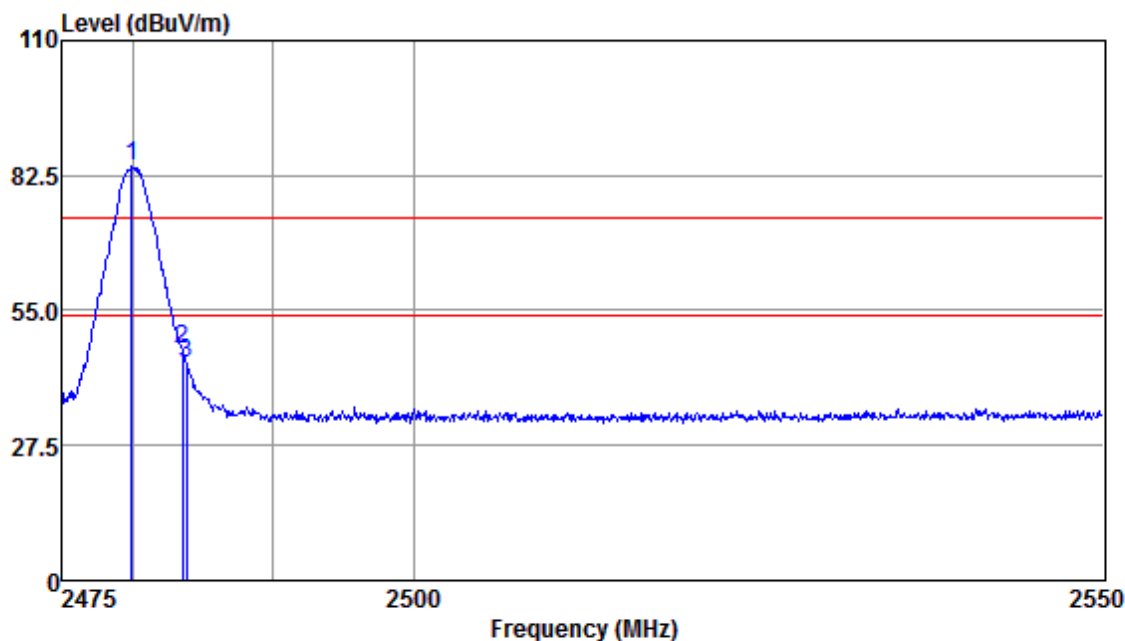


Antenna Polarity :VERTICAL

| Freq    | Read Level | Antenna Factor | Cable Loss | Preamplifier Factor | Emission Level | Limit Line | Over Limit | Remark |
|---------|------------|----------------|------------|---------------------|----------------|------------|------------|--------|
| MHz     | dBuV       | dB/m           | dB         | dB                  | dBuV/m         | dBuV/m     | dB         |        |
| 2345.71 | 44.03      | 25.97          | 6.40       | 37.37               | 39.03          | 74.00      | -34.97     | Peak   |
| 2390.00 | 41.45      | 26.03          | 6.47       | 37.36               | 36.59          | 74.00      | -37.41     | Peak   |
| 2402.15 | 91.09      | 26.05          | 6.50       | 37.35               | 86.29          | 74.00      | 12.29      | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamplifier Factor

Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

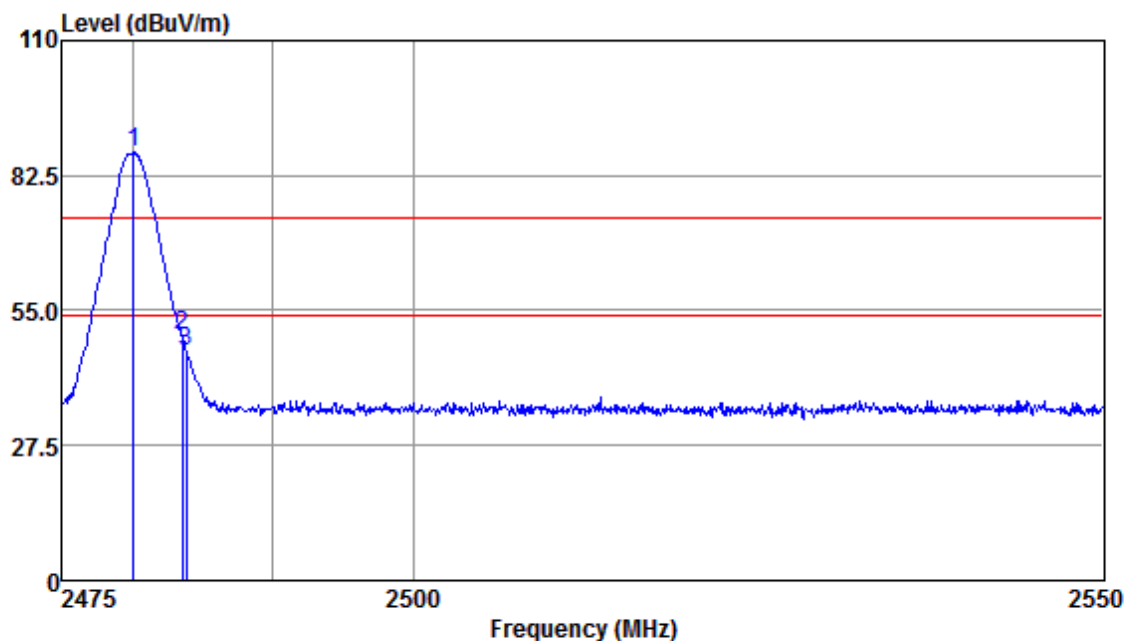


Antenna Polarity :HORIZONTAL

| Freq    | Read Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|---------|------------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz     | dBuv       | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2479.88 | 88.81      | 26.17          | 6.74       | 37.49         | 84.23          | 74.00      | 10.23      | Peak   |
| 2483.50 | 51.78      | 26.18          | 6.80       | 37.51         | 47.25          | 74.00      | -26.75     | Peak   |
| 2483.81 | 48.92      | 26.18          | 6.80       | 37.51         | 44.39          | 74.00      | -29.61     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:High



Antenna Polarity :VERTICAL

| Freq    | Read Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|---------|------------|----------------|------------|---------------|----------------|------------|------------|--------|
| -----   | -----      | -----          | -----      | -----         | -----          | -----      | -----      | -----  |
| MHz     | dBuv       | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2480.03 | 91.86      | 26.17          | 6.74       | 37.49         | 87.28          | 74.00      | 13.28      | Peak   |
| 2483.50 | 54.28      | 26.18          | 6.80       | 37.51         | 49.75          | 74.00      | -24.25     | Peak   |
| 2483.81 | 51.39      | 26.18          | 6.80       | 37.51         | 46.86          | 74.00      | -27.14     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

## 7.7 Radiated Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209  
Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6  
Limit:

| Frequency(MHz) | Field strength(microvolts/meter) | Measurement distance(meters) |
|----------------|----------------------------------|------------------------------|
| 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                            |

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, 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.

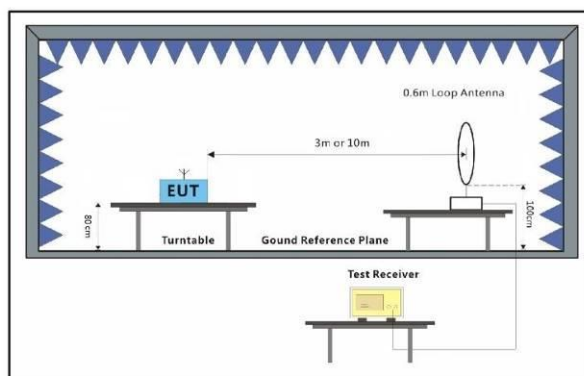
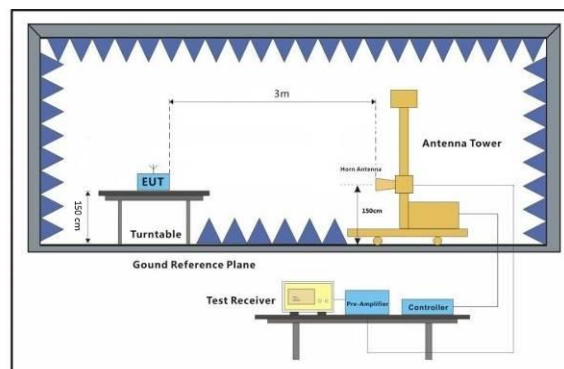
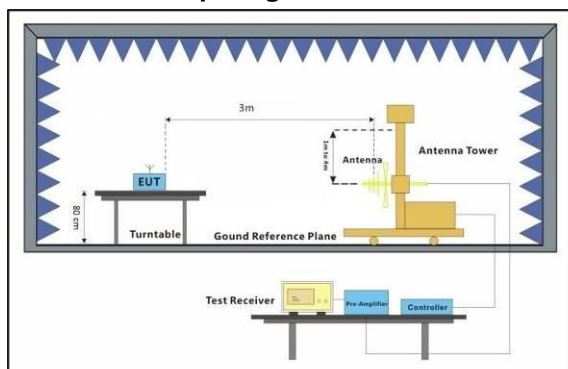
### 7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX mode\_Keep the EUT in continuously transmitting mode with GFSK modulation

### 7.7.2 Test Setup Diagram





### 7.7.3 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

#### Remark:

- 1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:  
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
- 3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 4) For frequencies above 1GHz, the field strength limits 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 the emissions whose peak level is lower than the average limit, only the peak measurement is shown



Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

| Frequency | RX_R  | Factor | Emission | Limit  | Over Limit | Detector |
|-----------|-------|--------|----------|--------|------------|----------|
| MHz       | dBuV  | dB     | dBuV/m   | dBuV/m | dB         |          |
| 4804      | 39.43 | 6.18   | 45.61    | 54     | -8.39      | peak     |
| 7206      | 35.08 | 10.63  | 45.71    | 54     | -8.29      | peak     |
| 9608      | 32.68 | 14.38  | 47.06    | 54     | -6.94      | peak     |

Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

| Frequency | RX_R  | Factor | Emission | Limit  | Over Limit | Detector |
|-----------|-------|--------|----------|--------|------------|----------|
| MHz       | dBuV  | dB     | dBuV/m   | dBuV/m | dB         |          |
| 4804      | 38.53 | 6.18   | 44.71    | 54     | -9.29      | peak     |
| 7206      | 37.29 | 10.63  | 47.92    | 54     | -6.08      | peak     |
| 9608      | 34.93 | 14.38  | 49.31    | 54     | -4.69      | peak     |

Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:middle

| Frequency | RX_R  | Factor | Emission | Limit  | Over Limit | Detector |
|-----------|-------|--------|----------|--------|------------|----------|
| MHz       | dBuV  | dB     | dBuV/m   | dBuV/m | dB         |          |
| 4880      | 38.25 | 6.97   | 45.22    | 54     | -8.78      | peak     |
| 7320      | 35.93 | 11.12  | 47.05    | 54     | -6.95      | peak     |
| 9760      | 33.07 | 14.35  | 47.42    | 54     | -6.58      | peak     |

Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:middle

| Frequency | RX_R  | Factor | Emission | Limit  | Over Limit | Detector |
|-----------|-------|--------|----------|--------|------------|----------|
| MHz       | dBuV  | dB     | dBuV/m   | dBuV/m | dB         |          |
| 4880      | 38.96 | 6.97   | 45.93    | 54     | -8.07      | peak     |
| 7320      | 37.01 | 11.12  | 48.13    | 54     | -5.87      | peak     |
| 9760      | 34.89 | 14.35  | 49.24    | 54     | -4.76      | peak     |

Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

| Frequency | RX_R  | Factor | Emission | Limit  | Over Limit | Detector |
|-----------|-------|--------|----------|--------|------------|----------|
| MHz       | dBuV  | dB     | dBuV/m   | dBuV/m | dB         |          |
| 4960      | 38.96 | 7.49   | 46.45    | 54     | -7.55      | peak     |
| 7440      | 38.37 | 11.65  | 50.02    | 54     | -3.98      | peak     |
| 9920      | 33.22 | 14.4   | 47.62    | 54     | -6.38      | peak     |

Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:High

| Frequency | RX_R  | Factor | Emission | Limit  | Over Limit | Detector |
|-----------|-------|--------|----------|--------|------------|----------|
| MHz       | dBuV  | dB     | dBuV/m   | dBuV/m | dB         |          |
| 4960      | 35.19 | 7.49   | 42.68    | 54     | -11.32     | peak     |
| 7440      | 37.13 | 11.65  | 48.78    | 54     | -5.22      | peak     |
| 9920      | 34.03 | 14.4   | 48.43    | 54     | -5.57      | peak     |



## **8 Test Setup Photographs**

Refer to the < Test Setup photos-FCC>.

## **9 EUT Constructional Details**

Refer to the < External Photos > & < Internal Photos >.

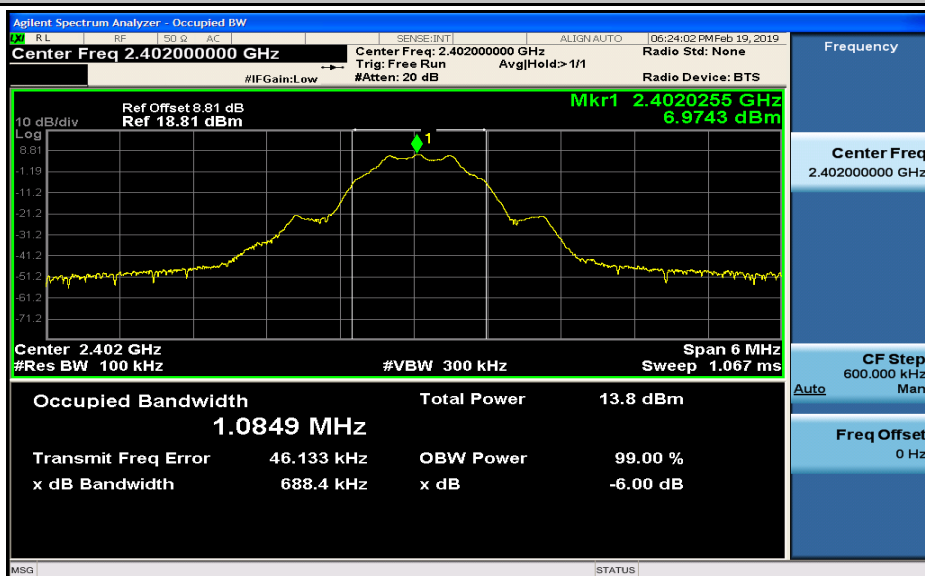


## Appendix A SHEM190101066701

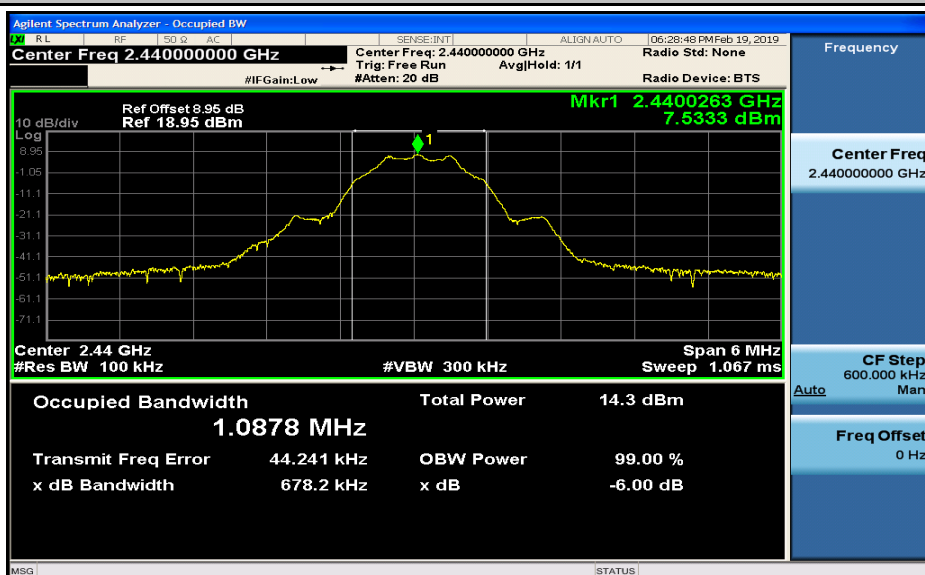
### 1.6dB Bandwidth

| Test Mode | Test Channel | EBW[MHz] | Limit | Verdict |
|-----------|--------------|----------|-------|---------|
| BLE       | 2402         | 0.69     | 0.5   | PASS    |
| BLE       | 2440         | 0.68     | 0.5   | PASS    |
| BLE       | 2480         | 0.69     | 0.5   | PASS    |

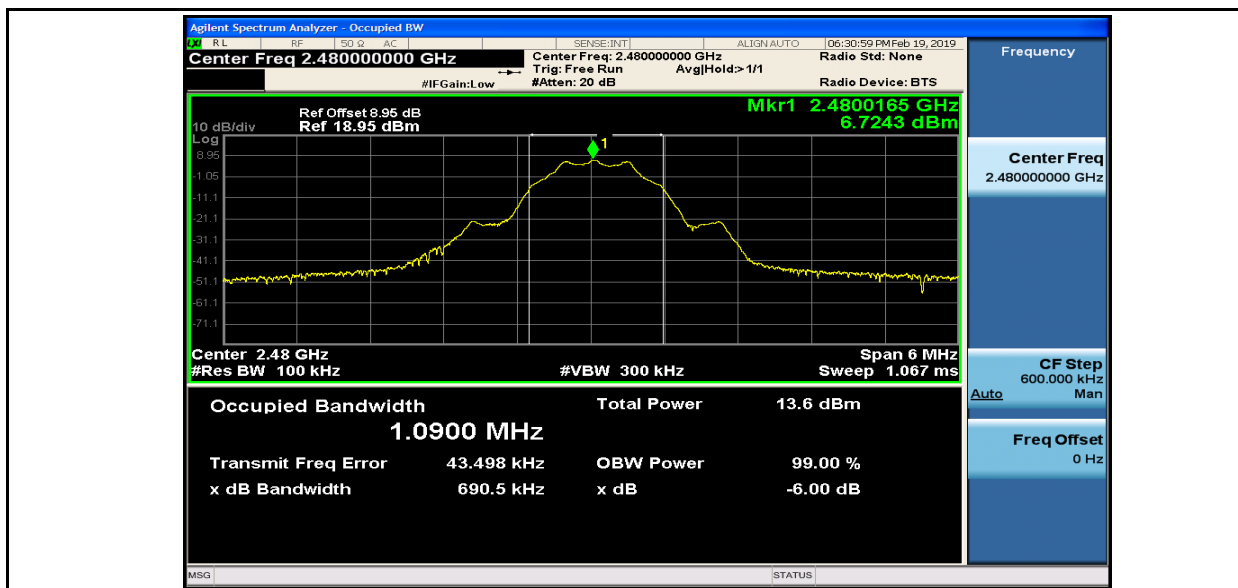
### 6dB Bandwidth\_BLE\_2402



### 6dB Bandwidth\_BLE\_2440



### 6dB Bandwidth\_BLE\_2480



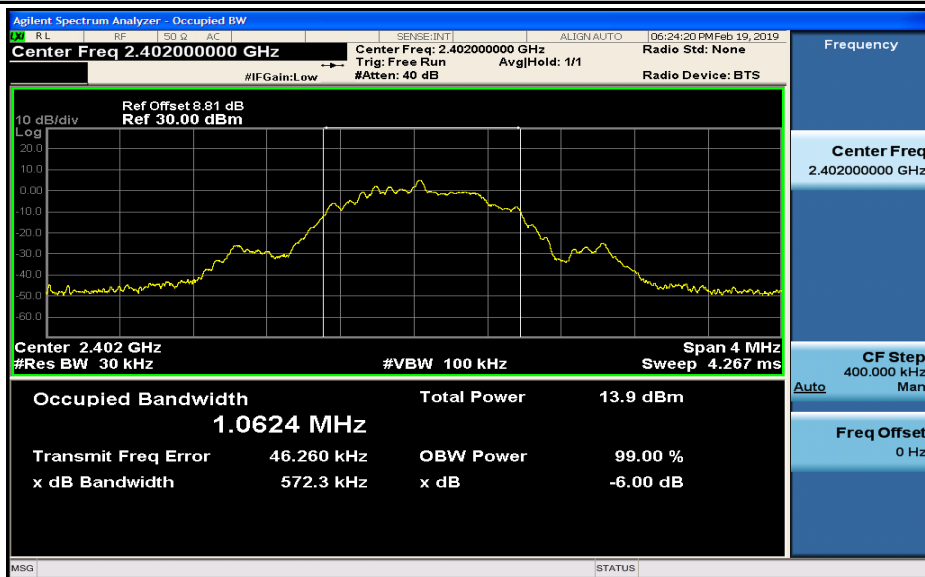




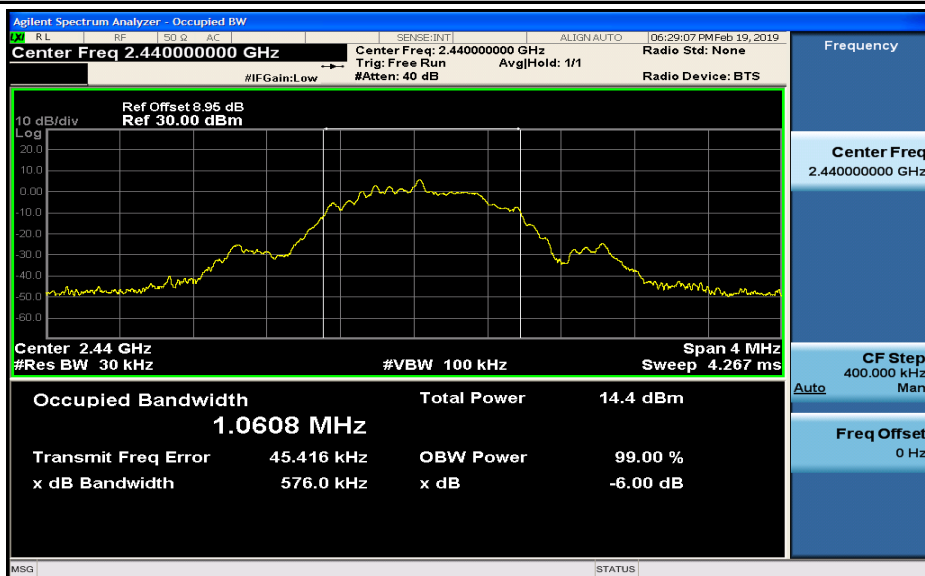
## 2.Occupied Bandwidth

| Test Mode | Test Channel | OBW[MHz] | Limit[MHz] | Verdict |
|-----------|--------------|----------|------------|---------|
| BLE       | 2402         | 1.06     | ---        | PASS    |
| BLE       | 2440         | 1.06     | ---        | PASS    |
| BLE       | 2480         | 1.06     | ---        | PASS    |

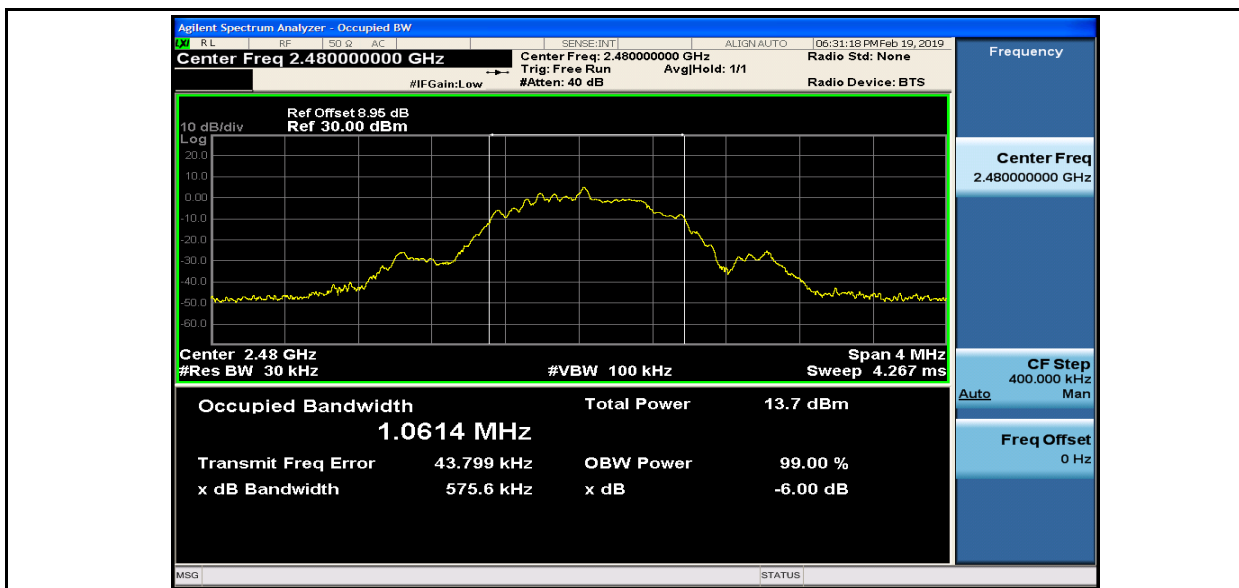
### Occupied Bandwidth\_BLE\_2402



### Occupied Bandwidth\_BLE\_2440



### Occupied Bandwidth\_BLE\_2480

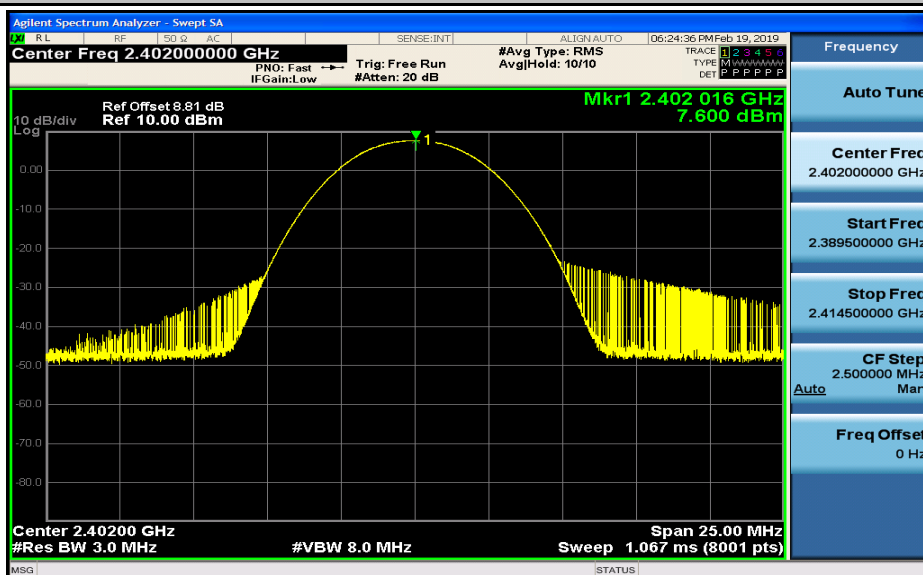




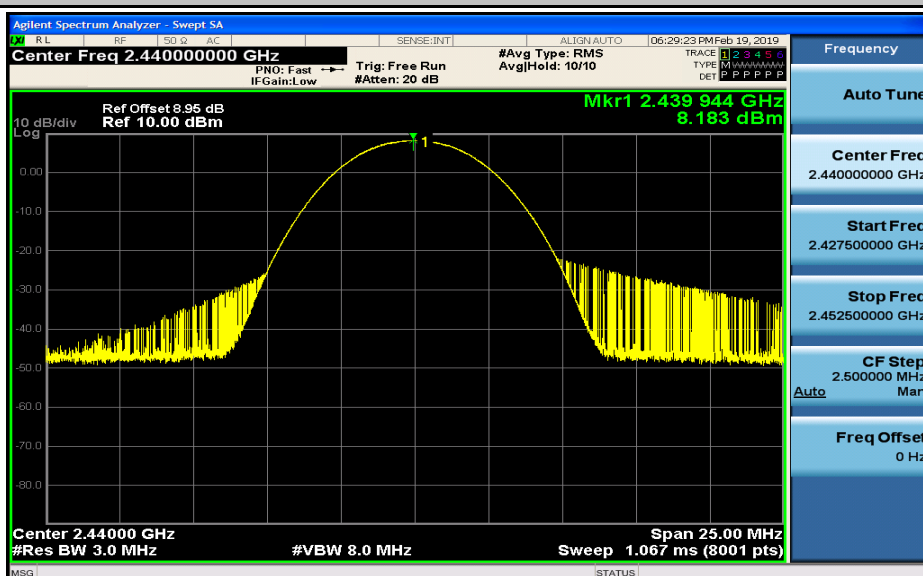
**3.Maximum peak conducted output power**

| Test Mode | Test Channel | Power[dBm] | Limit[dBm] | Verdict |
|-----------|--------------|------------|------------|---------|
| BLE       | 2402         | 7.6        | 30         | PASS    |
| BLE       | 2440         | 8.18       | 30         | PASS    |
| BLE       | 2480         | 7.58       | 30         | PASS    |

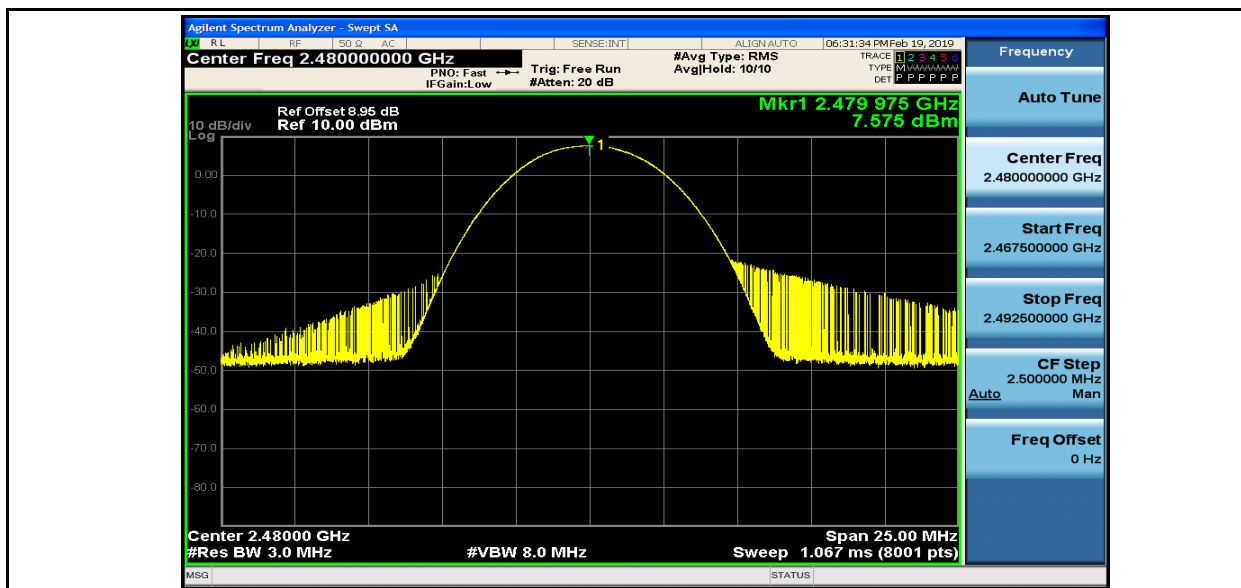
Maximum peak conducted output power\_BLE\_2402



Maximum peak conducted output power\_BLE\_2440



Maximum peak conducted output power\_BLE\_2480



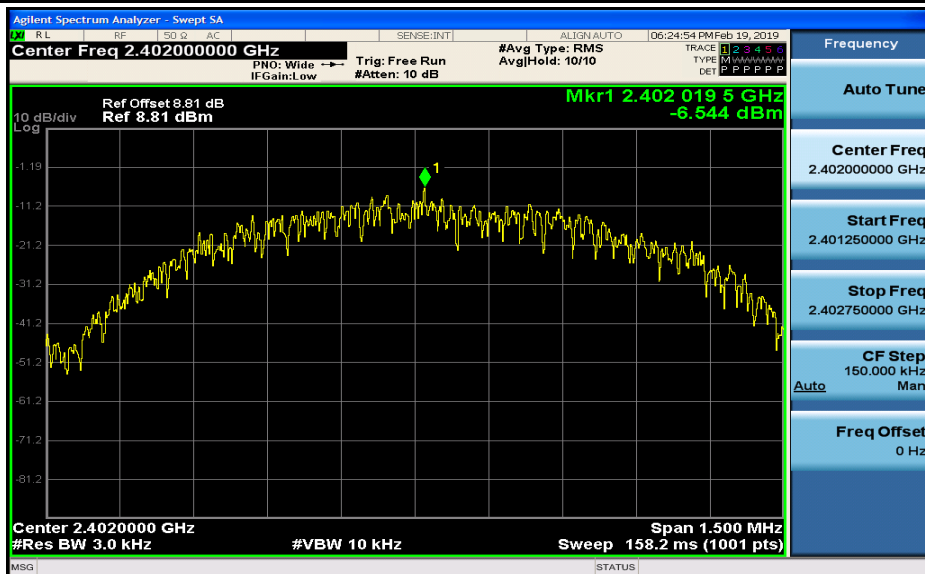




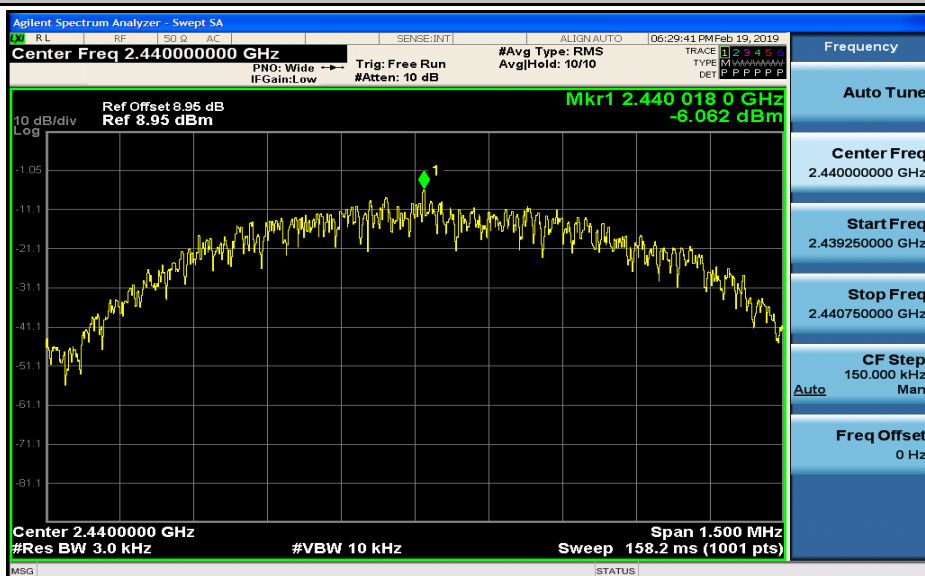
**4.Maximum Peak power spectral density**

| Test Mode | Test Channel | PSD[dBm/3kHz] | Limit[dBm/3kHz] | Verdict |
|-----------|--------------|---------------|-----------------|---------|
| BLE       | 2402         | -6.54         | 8.00            | PASS    |
| BLE       | 2440         | -6.06         | 8.00            | PASS    |
| BLE       | 2480         | -6.88         | 8.00            | PASS    |

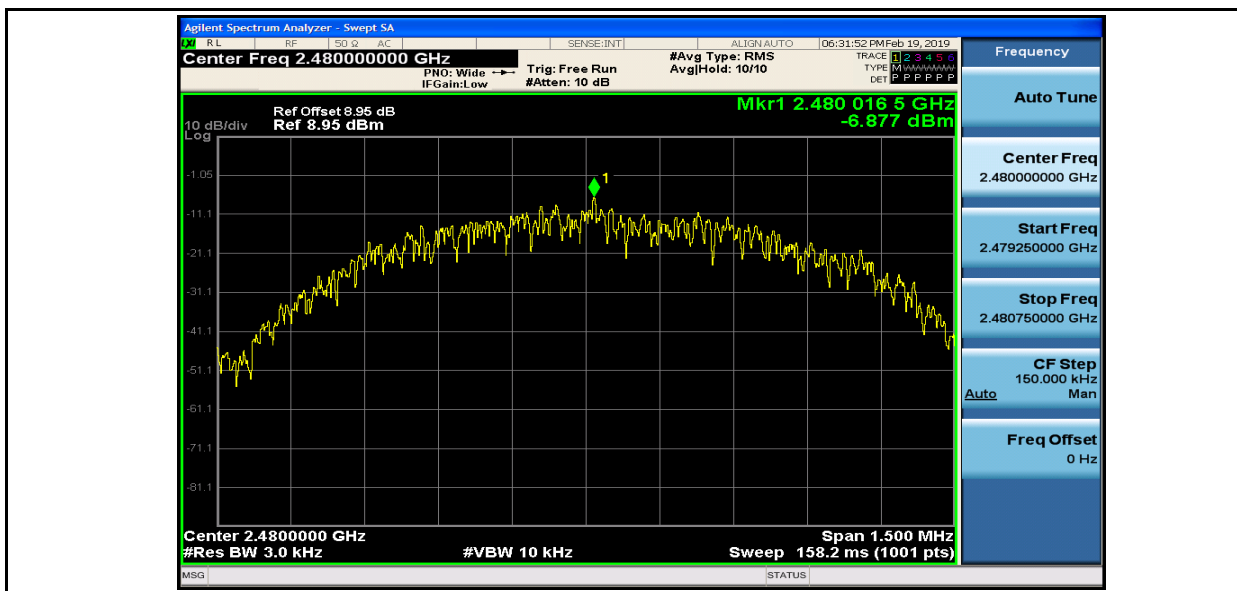
### Maximum Peak power spectral density\_BLE\_2402



### Maximum Peak power spectral density\_BLE\_2440



### Maximum Peak power spectral density\_BLE\_2480

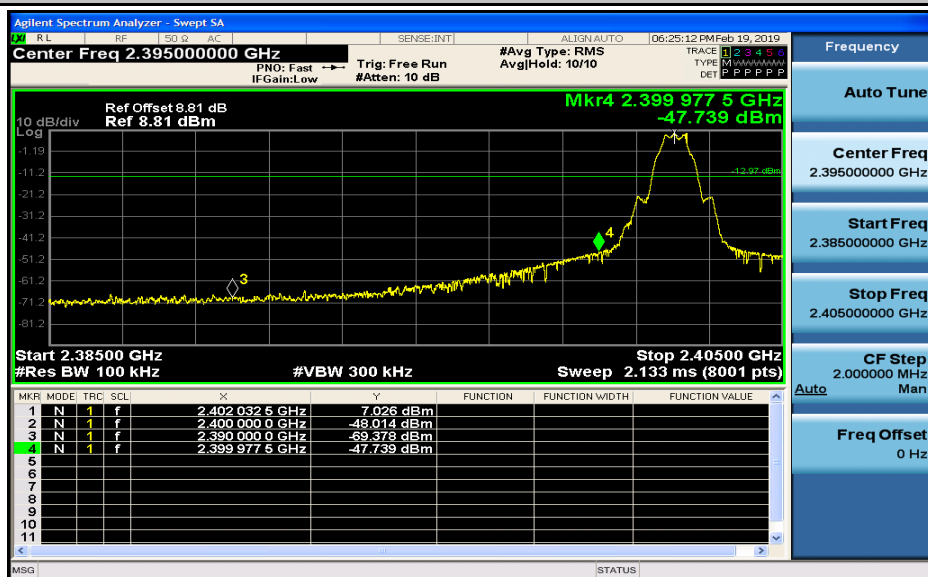




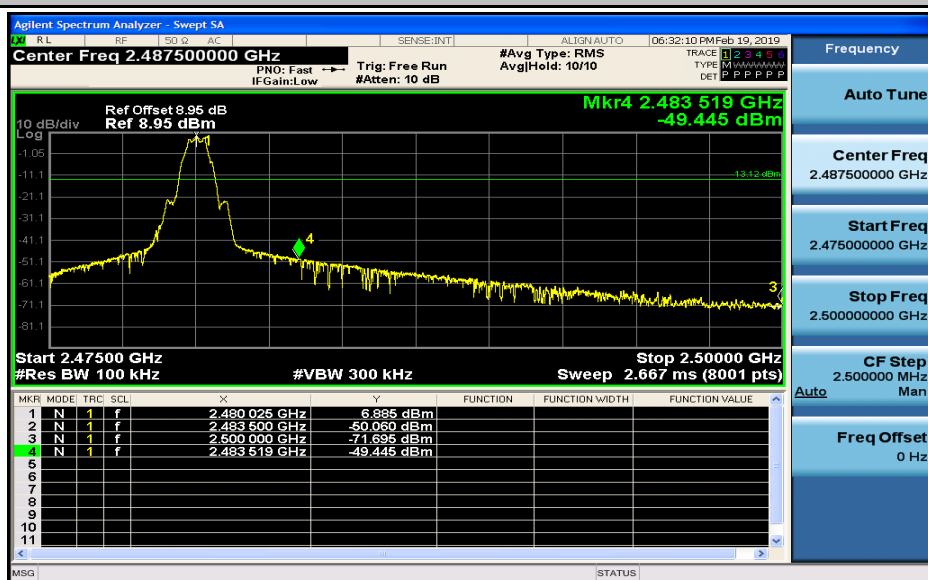
**5.Band-edge for RF Conducted Emissions**

| Test Mode | Test Channel | Carrier Power[dBm] | Max. Spurious Level [dBm] | Limit [dBm] | Verdict |
|-----------|--------------|--------------------|---------------------------|-------------|---------|
| BLE       | 2402         | 7.03               | -47.74                    | -12.97      | PASS    |
| BLE       | 2480         | 6.89               | -49.45                    | -13.12      | PASS    |

### Band-edge for RF Conducted Emissions\_BLE\_2402\_Hopping Off



### Band-edge for RF Conducted Emissions\_BLE\_2480\_Hopping Off

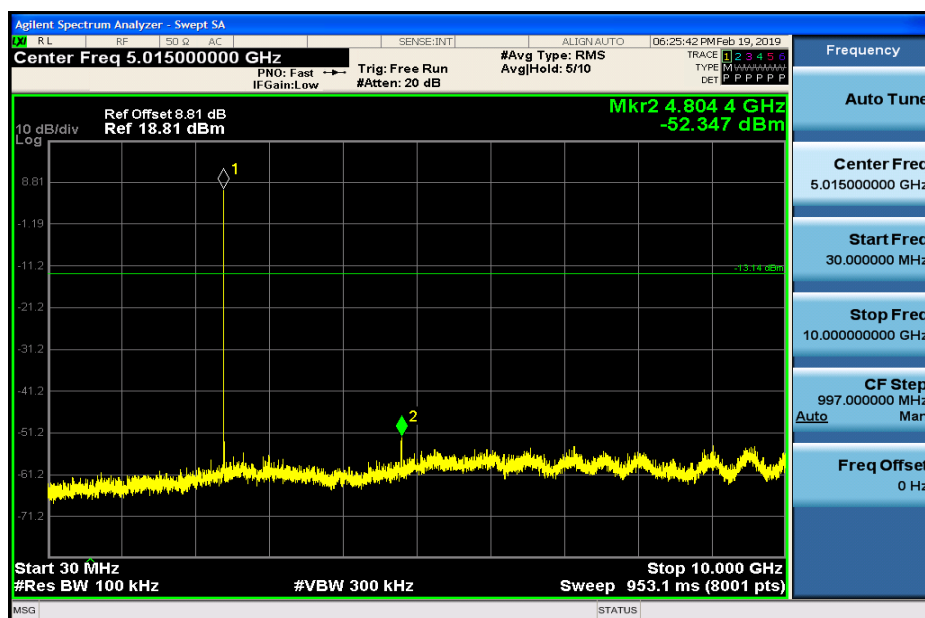




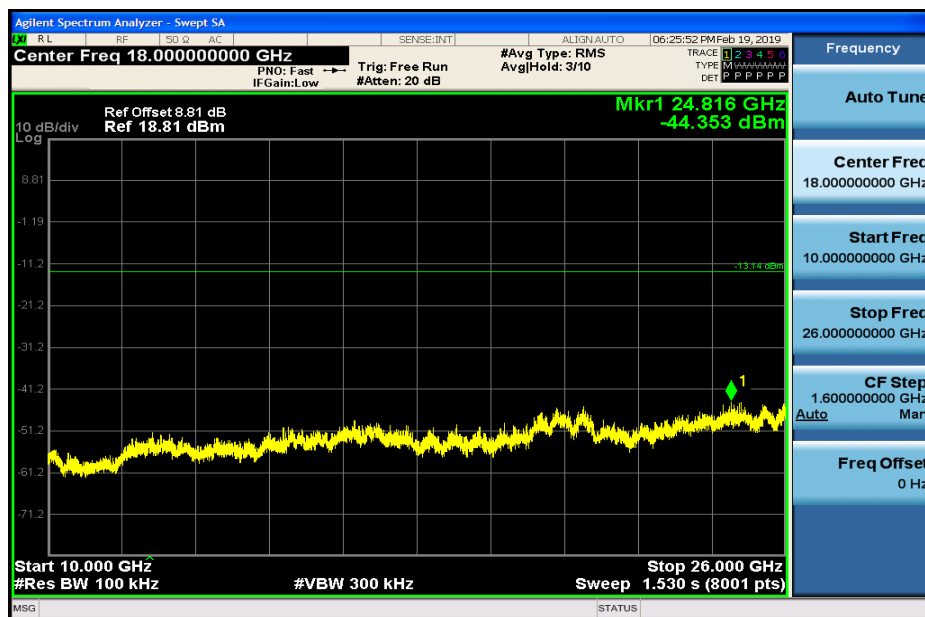
## 6.RF Conducted Spurious Emissions

| Test Mode | Test Channel | StartFre [MHz] | StopFre [MHz] | RBW [kHz] | VBW [kHz] | Pref[dBm] | Max. Level [dBm] | Limit [dBm] | Verdict |
|-----------|--------------|----------------|---------------|-----------|-----------|-----------|------------------|-------------|---------|
| BLE       | 2402         | 30             | 10000         | 100       | 300       | 6.87      | -52.35           | <-13.14     | PASS    |
| BLE       | 2402         | 10000          | 26000         | 100       | 300       | 6.865     | -44.353          | <-13.135    | PASS    |
| BLE       | 2440         | 30             | 10000         | 100       | 300       | 7.45      | -54.59           | <-12.55     | PASS    |
| BLE       | 2440         | 10000          | 26000         | 100       | 300       | 7.452     | -44.100          | <-12.548    | PASS    |
| BLE       | 2480         | 30             | 10000         | 100       | 300       | 6.82      | -51.08           | <-13.18     | PASS    |
| BLE       | 2480         | 10000          | 26000         | 100       | 300       | 6.821     | -44.048          | <-13.179    | PASS    |

RF Conducted Spurious Emissions\_BLE\_2402

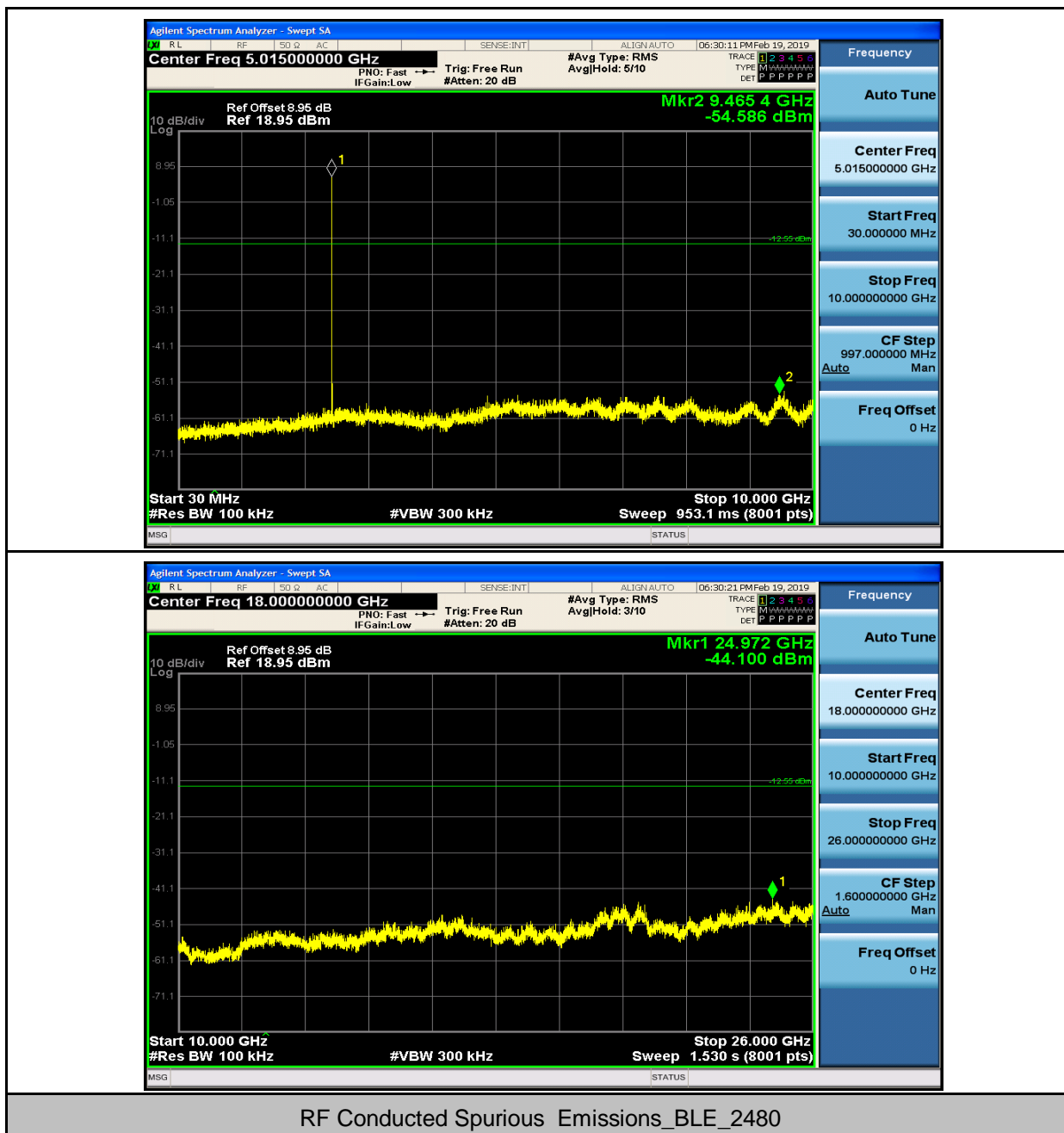


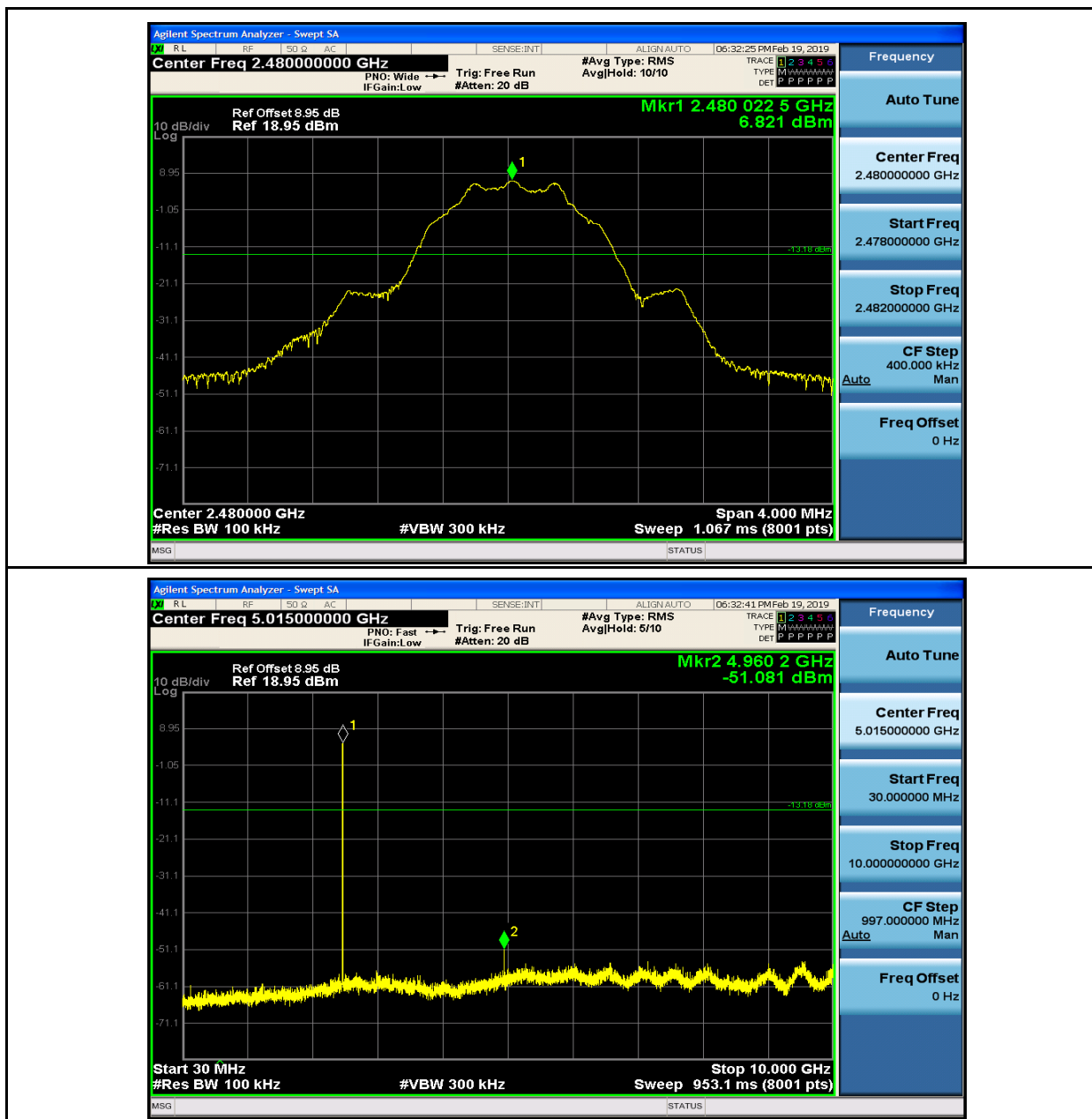


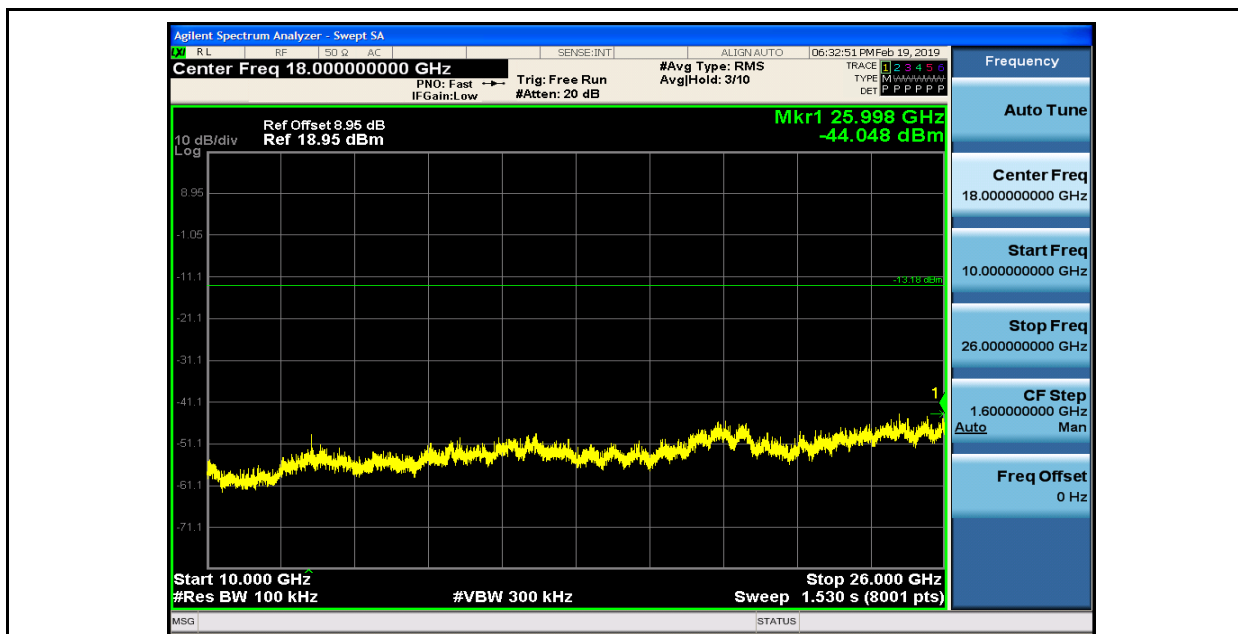


### RF Conducted Spurious Emissions\_BLE\_2440









- End of the Report -