

## TEST REPORT

**Application No.:** SZEM1908017944CR  
**Applicant:** GE Lighting  
**Address of Applicant:** 1975 Noble Road, Cleveland, Ohio, 44112, United States  
**Manufacturer:** GE Lighting  
**Address of Manufacturer:** 1975 Noble Road, Cleveland, Ohio, 44112, United States  
**Factory:** TCL Technoly Electronics (Huizhou) Co., Ltd.  
**Address of Factory:** Section 37, Zhongkai High-tech Development Zone, Huizhou City, Guang Dong Province, P.R. China

**Equipment Under Test (EUT):**

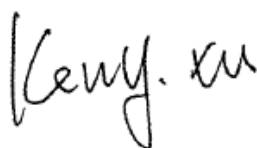
**EUT Name:** CbyGE no neutral smart switch  
**Model No.:** CSWONBLTWF1NN, CSWONBLPWF1NN (Models may be provided with suffixes of any additional symbols/letters/numbers sequence meaning body color, packaging) ♣

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

**Trade mark:** GE  
**FCC ID:** PUU-CSWONBLXWF1NN  
**Standard(s) :** 47 CFR Part 15, Subpart C 15.247  
**Date of Receipt:** 2019-08-28  
**Date of Test:** 2019-08-30 to 2019-10-15  
**Date of Issue:** 2019-10-17

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

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



Keny Xu  
EMC Laboratory Manager



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| Revision Record |         |            |          |          |
|-----------------|---------|------------|----------|----------|
| Version         | Chapter | Date       | Modifier | Remark   |
| 01              |         | 2019-10-17 |          | Original |
|                 |         |            |          |          |
|                 |         |            |          |          |

|                                 |  |                                                                                     |  |
|---------------------------------|--|-------------------------------------------------------------------------------------|--|
| <b>Authorized for issue by:</b> |  |                                                                                     |  |
|                                 |  |    |  |
|                                 |  | <hr/> <b>Calvin Weng /Project Engineer</b>                                          |  |
|                                 |  |  |  |
|                                 |  | <hr/> <b>Eric Fu /Reviewer</b>                                                      |  |

## 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(b)(4) | Pass   |

| Radio Spectrum Matter Part                            |                                  |                                        |                                           |        |
|-------------------------------------------------------|----------------------------------|----------------------------------------|-------------------------------------------|--------|
| Item                                                  | Standard                         | Method                                 | Requirement                               | Result |
| Conducted Emissions at AC Power Line (150kHz-30MHz)   | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 6.2         | 47 CFR Part 15, Subpart C 15.207          | Pass   |
| 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:

Model No.: CSWONBLTWF1NN, CSWONBLPWF1NN (Models may be provided with suffixes of any additional symbols/letters/numbers sequence meaning body color, packaging)

Only the model CSWONBLTWF1NN was tested, since the electrical circuit design, layout, components used, internal wiring and functions were identical for the above models, with only difference on the appearance and Control key

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## 4 General Information

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

|                      |                    |
|----------------------|--------------------|
| Power supply:        | AC120V, 60Hz       |
| Operation Frequency: | 2402MHz to 2480MHz |
| Bluetooth Version:   | 4.2                |
| Modulation Type:     | GFSK               |
| Channel Spacing:     | 2MHz               |
| Number of Channels:  | 40                 |
| Antenna Type:        | PCB Antenna        |
| Antenna Gain:        | 2.55dBi            |

### 4.2 Description of Support Units

| Description | Manufacturer | Model No. | Serial No. |
|-------------|--------------|-----------|------------|
| LED bulb    | GE           | LED15DA21 | N/A        |

### 4.3 Measurement Uncertainty

| No. | Item                            | Measurement Uncertainty                                            |
|-----|---------------------------------|--------------------------------------------------------------------|
| 1   | Radio Frequency                 | $\pm 7.25 \times 10^{-8}$                                          |
| 2   | Duty cycle                      | $\pm 0.37\%$                                                       |
| 3   | Occupied Bandwidth              | $\pm 3\%$                                                          |
| 4   | Conduction emission             | $\pm 3.0\text{dB}$ (150kHz to 30MHz)                               |
| 5   | RF conducted power              | $\pm 0.75\text{dB}$                                                |
| 6   | RF power density                | $\pm 2.84\text{dB}$                                                |
| 7   | Conducted Spurious emissions    | $\pm 0.75\text{dB}$                                                |
| 8   | RF Radiated power               | $\pm 4.5\text{dB}$ (Below 1GHz)<br>$\pm 4.8\text{dB}$ (Above 1GHz) |
| 9   | Radiated Spurious emission test | $\pm 4.5\text{dB}$ (Below 1GHz)<br>$\pm 4.8\text{dB}$ (Above 1GHz) |
| 10  | Temperature test                | $\pm 1^\circ\text{C}$                                              |
| 11  | Humidity test                   | $\pm 3\%$                                                          |
| 12  | Supply voltages                 | $\pm 1.5\%$                                                        |
| 13  | Time                            | $\pm 3\%$                                                          |

#### 4.4 Test Location

All tests were performed at:

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

No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China. 518057.

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No tests were sub-contracted.

#### 4.5 Test Facility

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

- **CNAS (No. CNAS L2929)**

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab 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.

- **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

- **VCCI**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

- **FCC –Designation Number: CN1178**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

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

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

CAB identifier: CN0006.

IC#: 4620C.

#### 4.6 Deviation from Standards

None

#### 4.7 Abnormalities from Standard Conditions

None

## 5 Equipment List

| <b>Conducted Emissions at AC Power Line (150kHz-30MHz)</b> |                     |                 |                     |                 |                     |
|------------------------------------------------------------|---------------------|-----------------|---------------------|-----------------|---------------------|
| <b>Equipment</b>                                           | <b>Manufacturer</b> | <b>Model No</b> | <b>Inventory No</b> | <b>Cal Date</b> | <b>Cal Due Date</b> |
| Shielding Room                                             | ZhongYu Electron    | GB-88           | SEM001-06           | 2019-06-13      | 2022-06-12          |
| Measurement Software                                       | AUDIX               | e3 V8.2014-6-27 | N/A                 | N/A             | N/A                 |
| Coaxial Cable                                              | SGS                 | N/A             | SEM024-01           | 2019-07-11      | 2020-07-10          |
| LISN                                                       | Rohde & Schwarz     | ENV216          | SEM007-01           | 2018-09-25      | 2019-09-24          |
| LISN                                                       | Rohde & Schwarz     | ENV216          | SEM007-01           | 2019-09-24      | 2020-09-23          |
| LISN                                                       | ETS-LINDGREN        | 3816/2          | SEM007-02           | 2019-04-01      | 2020-03-31          |
| EMI Test Receiver                                          | Rohde & Schwarz     | ESCI            | SEM004-02           | 2019-04-01      | 2020-03-31          |

| <b>Minimum 6dB Bandwidth</b>         |                      |                      |                     |                 |                     |
|--------------------------------------|----------------------|----------------------|---------------------|-----------------|---------------------|
| <b>Equipment</b>                     | <b>Manufacturer</b>  | <b>Model No</b>      | <b>Inventory No</b> | <b>Cal Date</b> | <b>Cal Due Date</b> |
| Shielding Room                       | SAEMC                | MSR733               | SEM001-09           | 2019-06-13      | 2022-06-12          |
| DC Power Supply                      | Zhao Xin             | KXN-6020D            | SEM011-08           | 2018-09-25      | 2019-09-24          |
| DC Power Supply                      | Zhao Xin             | KXN-6020D            | SEM011-08           | 2019-09-24      | 2020-09-23          |
| Spectrum Analyzer                    | Rohde & Schwarz      | FSP                  | SEM004-06           | 2018-09-25      | 2019-09-24          |
| Spectrum Analyzer                    | Rohde & Schwarz      | FSP                  | SEM004-06           | 2019-09-24      | 2020-09-23          |
| Measurement Software                 | JS Tonscend          | JS1120-2 BT/WIFI V2. | N/A                 | N/A             | N/A                 |
| Coaxial Cable                        | SGS                  | N/A                  | SEM031-02           | 2019-07-11      | 2020-07-10          |
| Attenuator                           | Weinschel Associates | WA41                 | SEM021-09           | N/A             | N/A                 |
| Signal Generator                     | KEYSIGHT             | N5173B               | SEM006-05           | 2018-09-25      | 2019-09-24          |
| Signal Generator                     | KEYSIGHT             | N5173B               | SEM006-05           | 2019-09-24      | 2020-09-23          |
| Power Meter                          | Rohde & Schwarz      | NRVS                 | SEM014-02           | 2018-09-25      | 2019-09-24          |
| Power Meter                          | Rohde & Schwarz      | NRVS                 | SEM014-02           | 2019-09-24      | 2020-09-23          |
| Electric and Magnetic Field Analyzer | Narda                | NBM-550/EHP-50F      | EMC2143             | 2018-02-07      | 2020-02-06          |
| Electric Field Probe(100KHz-3GHz)    | WANDEL & GOLTERMANN  | EMR-20               | EMC0907             | 2019-05-21      | 2020-05-20          |
| EMF Tester                           | Narda                | ELT-400              | SZE039-4            | 2019-07-08      | 2020-07-07          |

| <b>Conducted Peak Output Power</b> |                     |                 |                     |                 |                     |
|------------------------------------|---------------------|-----------------|---------------------|-----------------|---------------------|
| <b>Equipment</b>                   | <b>Manufacturer</b> | <b>Model No</b> | <b>Inventory No</b> | <b>Cal Date</b> | <b>Cal Due Date</b> |
| Shielding Room                     | SAEMC               | MSR733          | SEM001-09           | 2019-06-13      | 2022-06-12          |
| DC Power Supply                    | Zhao Xin            | KXN-6020D       | SEM011-08           | 2019-09-24      | 2020-09-23          |
| Spectrum Analyzer                  | Rohde & Schwarz     | FSP             | SEM004-06           | 2018-09-25      | 2019-09-24          |
| Spectrum Analyzer                  | Rohde & Schwarz     | FSP             | SEM004-06           | 2019-09-24      | 2020-09-23          |





|                                         |                        |                         |           |            |            |
|-----------------------------------------|------------------------|-------------------------|-----------|------------|------------|
| Measurement Software                    | JS Tonscend            | JS1120-2<br>BT/WIFI V2. | N/A       | N/A        | N/A        |
| Coaxial Cable                           | SGS                    | N/A                     | SEM031-02 | 2019-07-11 | 2020-07-10 |
| Attenuator                              | Weinschel Associates   | WA41                    | SEM021-09 | N/A        | N/A        |
| Signal Generator                        | KEYSIGHT               | N5173B                  | SEM006-05 | 2018-09-25 | 2019-09-24 |
| Signal Generator                        | KEYSIGHT               | N5173B                  | SEM006-05 | 2019-09-24 | 2020-09-23 |
| Power Meter                             | Rohde & Schwarz        | NRVS                    | SEM014-02 | 2018-09-25 | 2019-09-24 |
| Power Meter                             | Rohde & Schwarz        | NRVS                    | SEM014-02 | 2019-09-24 | 2020-09-23 |
| Electric and Magnetic<br>Field Analyzer | Narda                  | NBM-<br>550/EHP-50F     | EMC2143   | 2018-02-07 | 2020-02-06 |
| Electric Field<br>Probe(100KHz-3GHz)    | WANDEL &<br>GOLTERMANN | EMR-20                  | EMC0907   | 2019-05-21 | 2020-05-20 |
| EMF Tester                              | Narda                  | ELT-400                 | SZE039-4  | 2019-07-08 | 2020-07-07 |

## Power Spectrum Density

| Equipment                               | Manufacturer           | Model No                | Inventory No | Cal Date   | Cal Due Date |
|-----------------------------------------|------------------------|-------------------------|--------------|------------|--------------|
| Shielding Room                          | SAEMC                  | MSR733                  | SEM001-09    | 2019-06-13 | 2022-06-12   |
| DC Power Supply                         | Zhao Xin               | KXN-6020D               | SEM011-08    | 2018-09-25 | 2019-09-24   |
| DC Power Supply                         | Zhao Xin               | KXN-6020D               | SEM011-08    | 2019-09-24 | 2020-09-23   |
| Spectrum Analyzer                       | Rohde & Schwarz        | FSP                     | SEM004-06    | 2018-09-25 | 2019-09-24   |
| Spectrum Analyzer                       | Rohde & Schwarz        | FSP                     | SEM004-06    | 2019-09-24 | 2020-09-23   |
| Measurement Software                    | JS Tonscend            | JS1120-2<br>BT/WIFI V2. | N/A          | N/A        | N/A          |
| Coaxial Cable                           | SGS                    | N/A                     | SEM031-02    | 2019-07-11 | 2020-07-10   |
| Attenuator                              | Weinschel Associates   | WA41                    | SEM021-09    | N/A        | N/A          |
| Signal Generator                        | KEYSIGHT               | N5173B                  | SEM006-05    | 2018-09-25 | 2019-09-24   |
| Signal Generator                        | KEYSIGHT               | N5173B                  | SEM006-05    | 2019-09-24 | 2020-09-23   |
| Power Meter                             | Rohde & Schwarz        | NRVS                    | SEM014-02    | 2018-09-25 | 2019-09-24   |
| Power Meter                             | Rohde & Schwarz        | NRVS                    | SEM014-02    | 2019-09-24 | 2020-09-23   |
| Electric and Magnetic<br>Field Analyzer | Narda                  | NBM-<br>550/EHP-50F     | EMC2143      | 2018-02-07 | 2020-02-06   |
| Electric Field<br>Probe(100KHz-3GHz)    | WANDEL &<br>GOLTERMANN | EMR-20                  | EMC0907      | 2019-05-21 | 2020-05-20   |
| EMF Tester                              | Narda                  | ELT-400                 | SZE039-4     | 2019-07-08 | 2020-07-07   |

## Conducted Band Edges Measurement

| Equipment         | Manufacturer    | Model No  | Inventory No | Cal Date   | Cal Due Date |
|-------------------|-----------------|-----------|--------------|------------|--------------|
| Shielding Room    | SAEMC           | MSR733    | SEM001-09    | 2019-06-13 | 2022-06-12   |
| DC Power Supply   | Zhao Xin        | KXN-6020D | SEM011-08    | 2018-09-25 | 2019-09-24   |
| DC Power Supply   | Zhao Xin        | KXN-6020D | SEM011-08    | 2019-09-24 | 2020-09-23   |
| Spectrum Analyzer | Rohde & Schwarz | FSP       | SEM004-06    | 2018-09-25 | 2019-09-24   |
| Spectrum Analyzer | Rohde & Schwarz | FSP       | SEM004-06    | 2019-09-24 | 2020-09-23   |



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|                                         |                        |                         |           |            |            |
|-----------------------------------------|------------------------|-------------------------|-----------|------------|------------|
| Measurement Software                    | JS Tonscend            | JS1120-2<br>BT/WIFI V2. | N/A       | N/A        | N/A        |
| Coaxial Cable                           | SGS                    | N/A                     | SEM031-02 | 2019-07-11 | 2020-07-10 |
| Attenuator                              | Weinschel Associates   | WA41                    | SEM021-09 | N/A        | N/A        |
| Signal Generator                        | KEYSIGHT               | N5173B                  | SEM006-05 | 2018-09-25 | 2019-09-24 |
| Signal Generator                        | KEYSIGHT               | N5173B                  | SEM006-05 | 2019-09-24 | 2020-09-23 |
| Power Meter                             | Rohde & Schwarz        | NRVS                    | SEM014-02 | 2018-09-25 | 2019-09-24 |
| Power Meter                             | Rohde & Schwarz        | NRVS                    | SEM014-02 | 2019-09-24 | 2020-09-23 |
| Electric and Magnetic<br>Field Analyzer | Narda                  | NBM-<br>550/EHP-50F     | EMC2143   | 2018-02-07 | 2020-02-06 |
| Electric Field<br>Probe(100KHz-3GHz)    | WANDEL &<br>GOLTERMANN | EMR-20                  | EMC0907   | 2019-05-21 | 2020-05-20 |
| EMF Tester                              | Narda                  | ELT-400                 | SZE039-4  | 2019-07-08 | 2020-07-07 |

## Conducted Spurious Emissions

| Equipment                               | Manufacturer           | Model No                | Inventory No | Cal Date   | Cal Due Date |
|-----------------------------------------|------------------------|-------------------------|--------------|------------|--------------|
| Shielding Room                          | SAEMC                  | MSR733                  | SEM001-09    | 2019-06-13 | 2022-06-12   |
| DC Power Supply                         | Zhao Xin               | KXN-6020D               | SEM011-08    | 2018-09-25 | 2019-09-24   |
| DC Power Supply                         | Zhao Xin               | KXN-6020D               | SEM011-08    | 2019-09-24 | 2020-09-23   |
| Spectrum Analyzer                       | Rohde & Schwarz        | FSP                     | SEM004-06    | 2018-09-25 | 2019-09-24   |
| Spectrum Analyzer                       | Rohde & Schwarz        | FSP                     | SEM004-06    | 2019-09-24 | 2020-09-23   |
| Measurement Software                    | JS Tonscend            | JS1120-2<br>BT/WIFI V2. | N/A          | N/A        | N/A          |
| Coaxial Cable                           | SGS                    | N/A                     | SEM031-02    | 2019-07-11 | 2020-07-10   |
| Attenuator                              | Weinschel Associates   | WA41                    | SEM021-09    | N/A        | N/A          |
| Signal Generator                        | KEYSIGHT               | N5173B                  | SEM006-05    | 2018-09-25 | 2019-09-24   |
| Signal Generator                        | KEYSIGHT               | N5173B                  | SEM006-05    | 2019-09-24 | 2020-09-23   |
| Power Meter                             | Rohde & Schwarz        | NRVS                    | SEM014-02    | 2018-09-25 | 2019-09-24   |
| Power Meter                             | Rohde & Schwarz        | NRVS                    | SEM014-02    | 2019-09-24 | 2020-09-23   |
| Electric and Magnetic<br>Field Analyzer | Narda                  | NBM-<br>550/EHP-50F     | EMC2143      | 2018-02-07 | 2020-02-06   |
| Electric Field<br>Probe(100KHz-3GHz)    | WANDEL &<br>GOLTERMANN | EMR-20                  | EMC0907      | 2019-05-21 | 2020-05-20   |
| EMF Tester                              | Narda                  | ELT-400                 | SZE039-4     | 2019-07-08 | 2020-07-07   |

## Radiated Emissions which fall in the restricted bands

| Equipment                   | Manufacturer | Model No            | Inventory No | Cal Date   | Cal Due Date |
|-----------------------------|--------------|---------------------|--------------|------------|--------------|
| 3m Semi-Anechoic<br>Chamber | AUDIX        | N/A                 | SEM001-02    | 2018-03-13 | 2021-03-12   |
| Measurement Software        | AUDIX        | e3 V8.2014-6-<br>27 | N/A          | N/A        | N/A          |
| Coaxial Cable               | SGS          | N/A                 | SEM026-01    | 2019-07-11 | 2020-07-10   |



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|                            |                                    |             |           |            |            |
|----------------------------|------------------------------------|-------------|-----------|------------|------------|
| EXA Spectrum Analyzer      | Agilent Technologies Inc           | N9010A      | SEM004-12 | 2019-04-12 | 2020-04-11 |
| Horn Antenna (1-18GHz)     | Rohde & Schwarz                    | HF907       | SEM003-07 | 2018-04-13 | 2021-04-12 |
| Horn Antenna(15GHz-40GHz)  | Schwarzbeck                        | BBHA 9170   | SEM003-15 | 2017-10-17 | 2020-10-16 |
| Pre-Amplifier(0.1-26.5GHz) | Compliance Directions Systems Inc. | PAP-0126    | SEM004-11 | 2018-09-25 | 2019-09-24 |
| Pre-Amplifier(0.1-26.5GHz) | Compliance Directions Systems Inc. | PAP-0126    | SEM004-11 | 2019-09-24 | 2020-09-23 |
| Pre-amplifier(18-26GHz)    | Rohde & Schwarz                    | CH14-H052   | SEM005-17 | 2019-04-01 | 2020-03-31 |
| Pre-amplifier(26GHz-40GHz) | Compliance Directions Systems Inc. | PAP-2640-50 | SEM005-08 | 2019-04-01 | 2020-03-31 |
| DC Power Supply            | Zhao Xin                           | KXN-6020D   | SEM011-08 | 2018-09-25 | 2019-09-24 |
| DC Power Supply            | Zhao Xin                           | KXN-6020D   | SEM011-08 | 2019-09-24 | 2020-09-23 |
| Active Loop Antenna        | ETS-Lindgren                       | 6502        | SEM003-08 | 2017-08-22 | 2020-08-21 |

| RE in Chamber                  |                          |                 |               |            |               |
|--------------------------------|--------------------------|-----------------|---------------|------------|---------------|
| Test Equipment                 | Manufacturer             | Model No.       | Inventory No. | Cal. Date  | Cal. Due date |
| 3m Semi-Anechoic Chamber       | ETS-LINDGREN             | N/A             | SEM001-01     | 2017-08-05 | 2020-08-04    |
| MXE EMI Receiver (20Hz-8.4GHz) | Agilent Technologies     | N9038A          | SEM004-05     | 2018-09-25 | 2019-09-24    |
| MXE EMI Receiver (20Hz-8.4GHz) | Agilent Technologies     | N9038A          | SEM004-05     | 2019-09-24 | 2020-09-23    |
| BiConiLog Antenna (26-3000MHz) | ETS-LINDGREN             | 3142C           | SEM003-01     | 2017-06-27 | 2020-06-26    |
| Pre-amplifier (0.1-1300MHz)    | Agilent Technologies     | 8447D           | SEM005-01     | 2019-04-01 | 2020-03-31    |
| Measurement Software           | AUDIX                    | e3 V8.2014-6-27 | N/A           | N/A        | N/A           |
| Coaxial Cable                  | SGS                      | N/A             | SEM025-01     | 2019-07-11 | 2020-07-10    |
| 3m Semi-Anechoic Chamber       | AUDIX                    | N/A             | SEM001-02     | 2018-03-13 | 2021-03-12    |
| Measurement Software           | AUDIX                    | e3 V8.2014-6-27 | N/A           | N/A        | N/A           |
| Coaxial Cable                  | SGS                      | N/A             | SEM026-01     | 2019-07-11 | 2020-07-10    |
| EXA Spectrum Analyzer          | Agilent Technologies Inc | N9010A          | SEM004-12     | 2019-04-12 | 2020-04-11    |
| Horn Antenna (1-18GHz)         | Rohde & Schwarz          | HF907           | SEM003-07     | 2018-04-13 | 2021-04-12    |





|                                |                                          |             |           |            |            |
|--------------------------------|------------------------------------------|-------------|-----------|------------|------------|
| Horn Antenna<br>(15GHz-40GHz)  | Schwarzbeck                              | BBHA 9170   | SEM003-15 | 2017-10-17 | 2020-10-16 |
| Pre-Amplifier<br>(0.1-26.5GHz) | Compliance<br>Directions Systems<br>Inc. | PAP-0126    | SEM004-11 | 2018-11-12 | 2019-11-11 |
| Pre-amplifier<br>(18-26GHz)    | Rohde & Schwarz                          | CH14-H052   | SEM005-17 | 2019-04-01 | 2020-03-31 |
| Pre-amplifier<br>(26GHz-40GHz) | Compliance<br>Directions Systems<br>Inc. | PAP-2640-50 | SEM005-08 | 2019-04-01 | 2020-03-31 |
| DC Power Supply                | Zhao Xin                                 | RXN-305D    | SEM011-02 | 2018-09-25 | 2019-09-24 |
| DC Power Supply                | Zhao Xin                                 | RXN-305D    | SEM011-02 | 2019-09-24 | 2020-09-23 |
| Active Loop Antenna            | ETS-Lindgren                             | 6502        | SEM003-08 | 2017-08-22 | 2020-08-21 |

## General used equipment

| Equipment                          | Manufacturer                                    | Model No | Inventory No | Cal Date   | Cal Due Date |
|------------------------------------|-------------------------------------------------|----------|--------------|------------|--------------|
| Humidity/ Temperature<br>Indicator | Shanghai<br>Meteorological<br>Industry Factory  | ZJ1-2B   | SEM002-03    | 2018-09-27 | 2019-09-26   |
| Humidity/ Temperature<br>Indicator | Shanghai<br>Meteorological<br>Industry Factory  | ZJ1-2B   | SEM002-03    | 2019-09-26 | 2020-09-25   |
| Humidity/ Temperature<br>Indicator | Shanghai<br>Meteorological<br>Industry Factory  | ZJ1-2B   | SEM002-04    | 2018-09-27 | 2019-09-26   |
| Humidity/ Temperature<br>Indicator | Shanghai<br>Meteorological<br>Industry Factory  | ZJ1-2B   | SEM002-04    | 2019-09-26 | 2020-09-25   |
| Humidity/ Temperature<br>Indicator | Mingle                                          | N/A      | SEM002-08    | 2018-09-27 | 2019-09-26   |
| Humidity/ Temperature<br>Indicator | Mingle                                          | N/A      | SEM002-08    | 2019-09-26 | 2020-09-25   |
| Barometer                          | Changchun<br>Meteorological<br>Industry Factory | DYM3     | SEM002-01    | 2019-04-04 | 2020-04-03   |



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## 6 Radio Spectrum Technical Requirement

### 6.1 Antenna Requirement

#### 6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)

#### 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 integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 2.55dBi.

Antenna location: Refer to Appendix(Internal photos)



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## 7 Radio Spectrum Matter Test Results

### 7.1 Conducted Emissions at AC Power Line (150kHz-30MHz)

Test Requirement 47 CFR Part 15, Subpart C 15.207  
Test Method: ANSI C63.10 (2013) Section 6.2  
Limit:

| Frequency of emission(MHz) | Conducted limit(dBμV) |           |
|----------------------------|-----------------------|-----------|
|                            | 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.



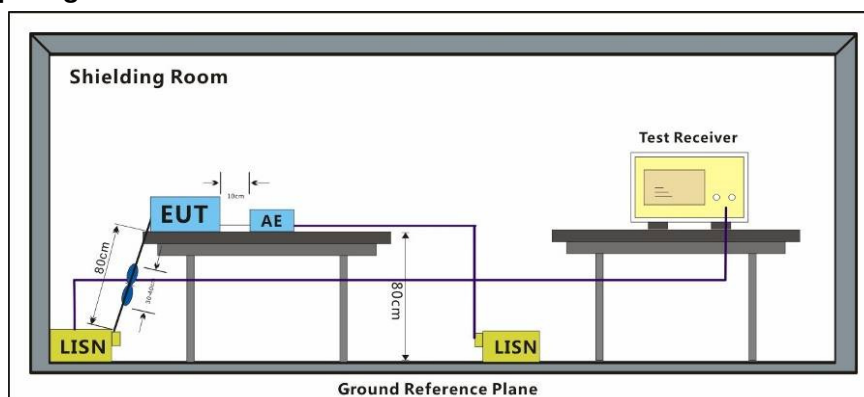
### 7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 21.2 °C Humidity: 53 % RH Atmospheric Pressure: 1005 mbar

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

### 7.1.2 Test Setup Diagram

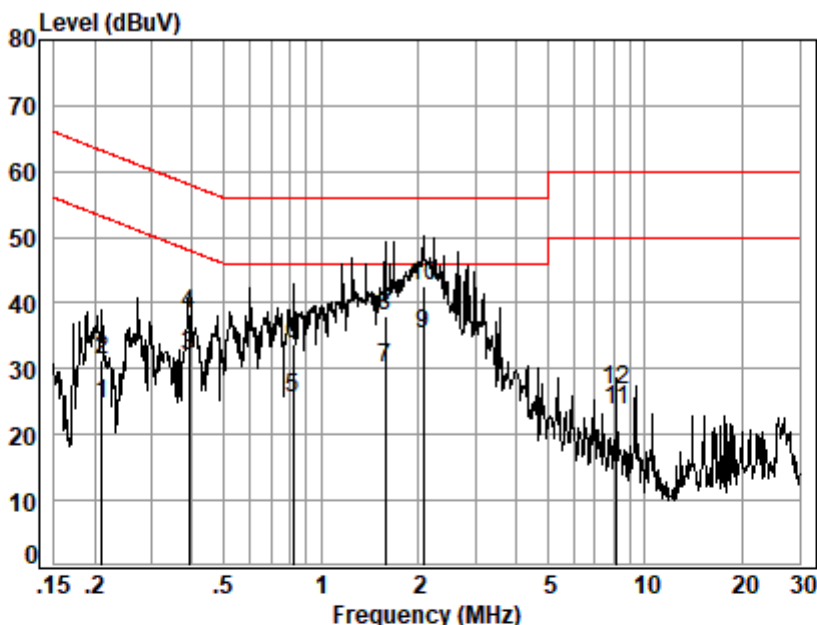


### 7.1.3 Measurement Procedure and Data

- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50ohm/50μH + 5ohm linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Remark: LISN=Read Level+ Cable Loss+ LISN Factor

Mode:a; Line:Live Line



Site : Shielding Room  
Condition: Line  
Job No. : 17944CR  
Test mode: a

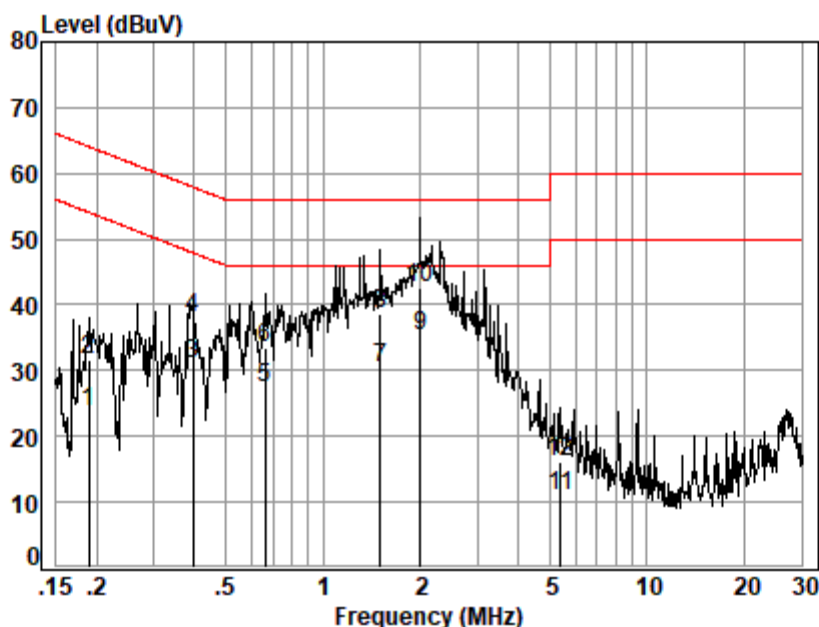
|    | Freq | Cable Loss | LISN Factor | Read Level | Level | Limit Line | Over Limit | Remark  |
|----|------|------------|-------------|------------|-------|------------|------------|---------|
|    | MHz  | dB         | dB          | dBuV       | dBuV  | dBuV       | dB         |         |
| 1  | 0.21 | 0.02       | 9.51        | 14.97      | 24.50 | 53.18      | -28.68     | Average |
| 2  | 0.21 | 0.02       | 9.51        | 21.85      | 31.38 | 63.18      | -31.80     | QP      |
| 3  | 0.39 | 0.05       | 9.58        | 22.46      | 32.09 | 48.03      | -15.94     | Average |
| 4  | 0.39 | 0.05       | 9.58        | 28.66      | 38.29 | 58.03      | -19.74     | QP      |
| 5  | 0.82 | 0.08       | 9.63        | 15.96      | 25.67 | 46.00      | -20.33     | Average |
| 6  | 0.82 | 0.08       | 9.63        | 23.97      | 33.68 | 56.00      | -22.32     | QP      |
| 7  | 1.58 | 0.14       | 9.64        | 20.25      | 30.03 | 46.00      | -15.97     | Average |
| 8  | 1.58 | 0.14       | 9.64        | 28.17      | 37.95 | 56.00      | -18.05     | QP      |
| 9  | 2.07 | 0.16       | 9.64        | 25.57      | 35.37 | 46.00      | -10.63     | Average |
| 10 | 2.07 | 0.16       | 9.64        | 32.77      | 42.57 | 56.00      | -13.43     | QP      |
| 11 | 8.15 | 0.17       | 9.75        | 13.66      | 23.58 | 50.00      | -26.42     | Average |
| 12 | 8.15 | 0.17       | 9.75        | 16.85      | 26.77 | 60.00      | -33.23     | QP      |



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Mode:a; Line:Neutral Line



Site : Shielding Room  
Condition: Neutral  
Job No. : 17944CR  
Test mode: a

|    | Freq | Cable Loss | LISN Factor | Read Level | Level | Limit Line | Over Limit | Remark  |
|----|------|------------|-------------|------------|-------|------------|------------|---------|
|    | MHz  | dB         | dB          | dBuV       | dBuV  | dBuV       | dB         |         |
| 1  | 0.19 | 0.02       | 9.44        | 14.40      | 23.86 | 54.06      | -30.20     | Average |
| 2  | 0.19 | 0.02       | 9.44        | 22.12      | 31.58 | 64.06      | -32.48     | QP      |
| 3  | 0.40 | 0.05       | 9.54        | 21.56      | 31.15 | 47.95      | -16.80     | Average |
| 4  | 0.40 | 0.05       | 9.54        | 28.40      | 37.99 | 57.95      | -19.96     | QP      |
| 5  | 0.66 | 0.07       | 9.61        | 17.54      | 27.22 | 46.00      | -18.78     | Average |
| 6  | 0.66 | 0.07       | 9.61        | 23.73      | 33.41 | 56.00      | -22.59     | QP      |
| 7  | 1.50 | 0.13       | 9.69        | 20.64      | 30.46 | 46.00      | -15.54     | Average |
| 8  | 1.50 | 0.13       | 9.69        | 28.72      | 38.54 | 56.00      | -17.46     | QP      |
| 9  | 1.99 | 0.16       | 9.70        | 25.43      | 35.29 | 46.00      | -10.71     | Average |
| 10 | 1.99 | 0.16       | 9.70        | 32.61      | 42.47 | 56.00      | -13.53     | QP      |
| 11 | 5.42 | 0.17       | 9.77        | 1.14       | 11.08 | 50.00      | -38.92     | Average |
| 12 | 5.42 | 0.17       | 9.77        | 6.28       | 16.22 | 60.00      | -43.78     | QP      |

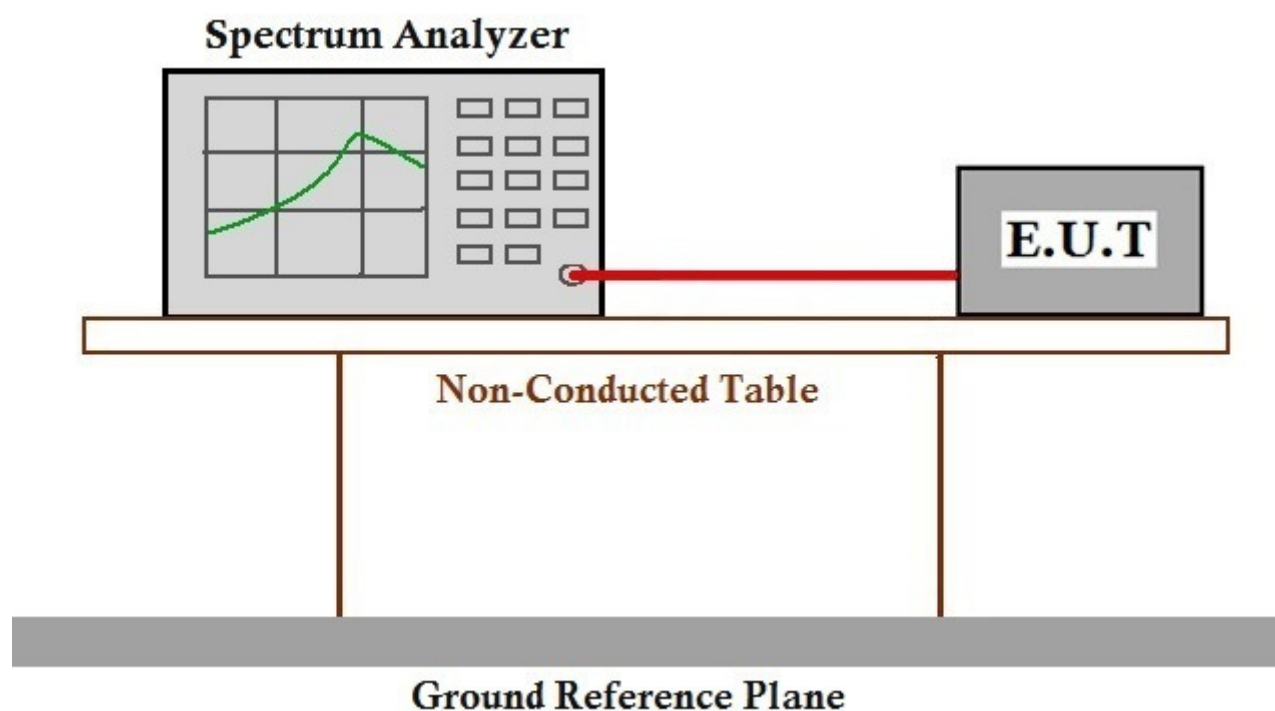
## 7.2 Minimum 6dB Bandwidth

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

### 7.2.1 E.U.T. Operation

Operating Environment:  
Temperature: 26.6 °C Humidity: 44.7 % RH Atmospheric Pressure: 1005 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 15.247

### 7.3 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 |

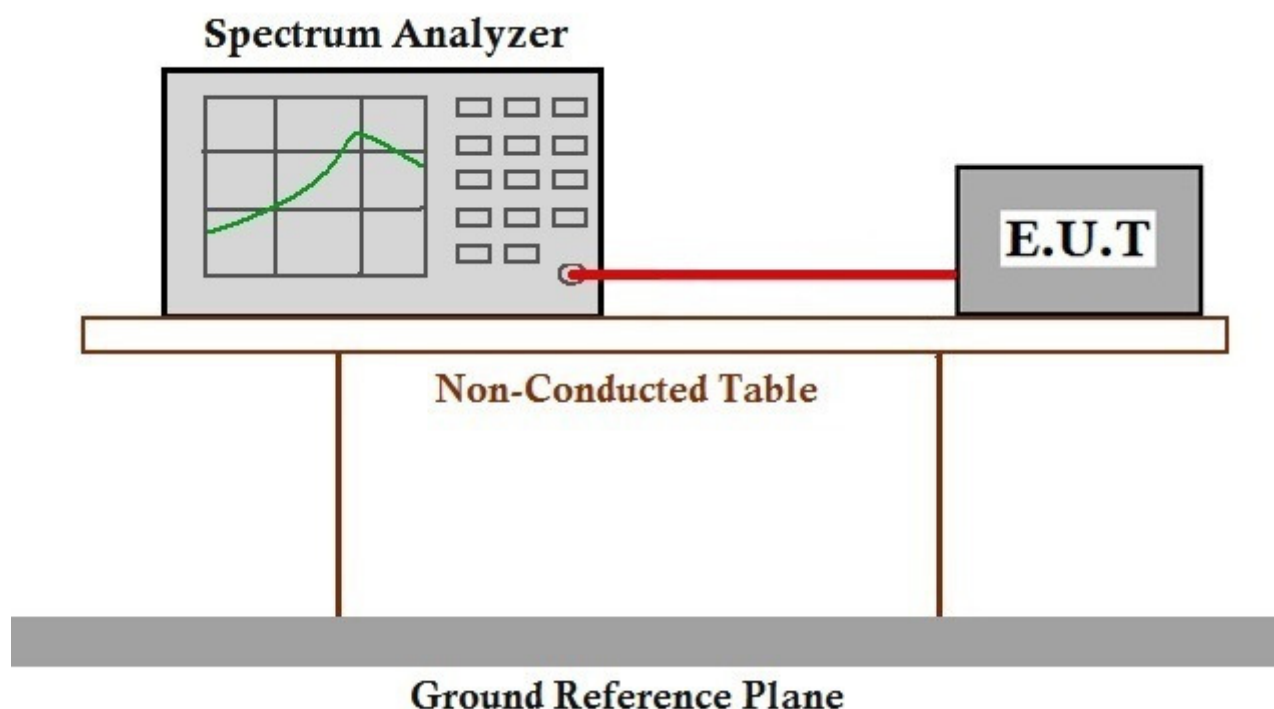
### 7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 26.6 °C Humidity: 44.7 % RH Atmospheric Pressure: 1005 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 15.247



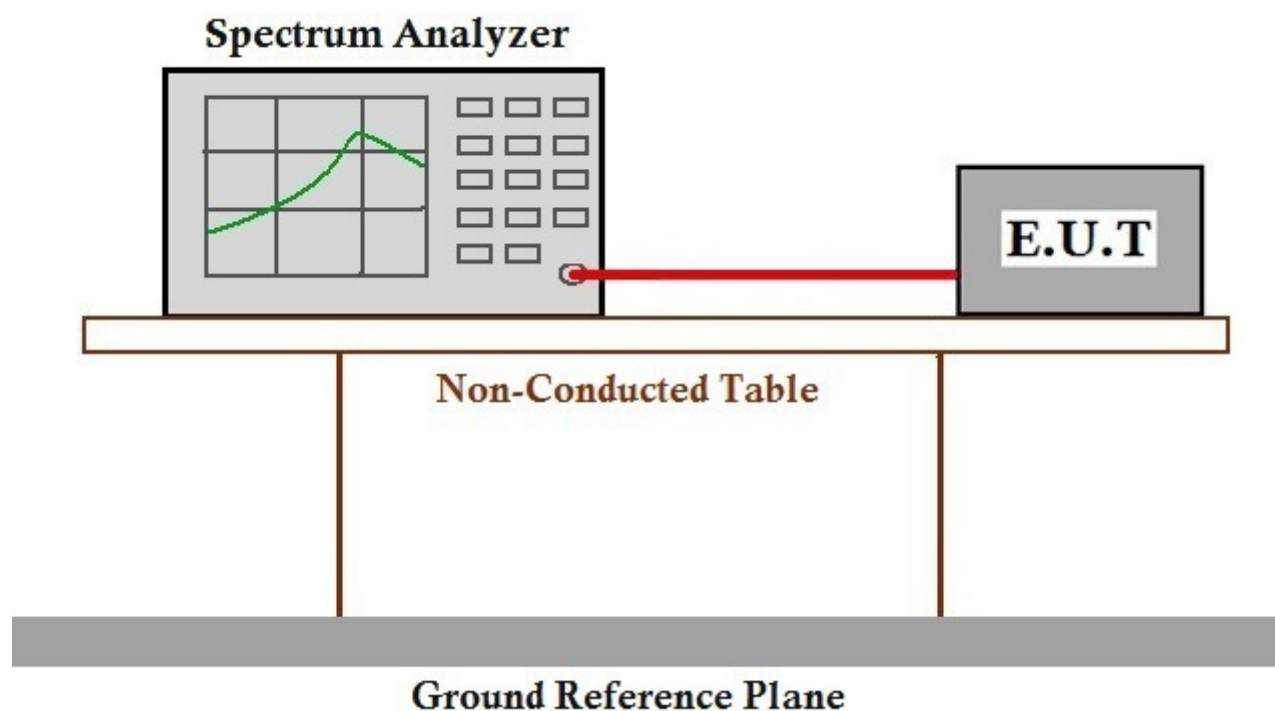
## 7.4 Power Spectrum Density

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

### 7.4.1 E.U.T. Operation

Operating Environment:  
Temperature: 26.6 °C Humidity: 44.7 % RH Atmospheric Pressure: 1005 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 15.247

## 7.5 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)) |

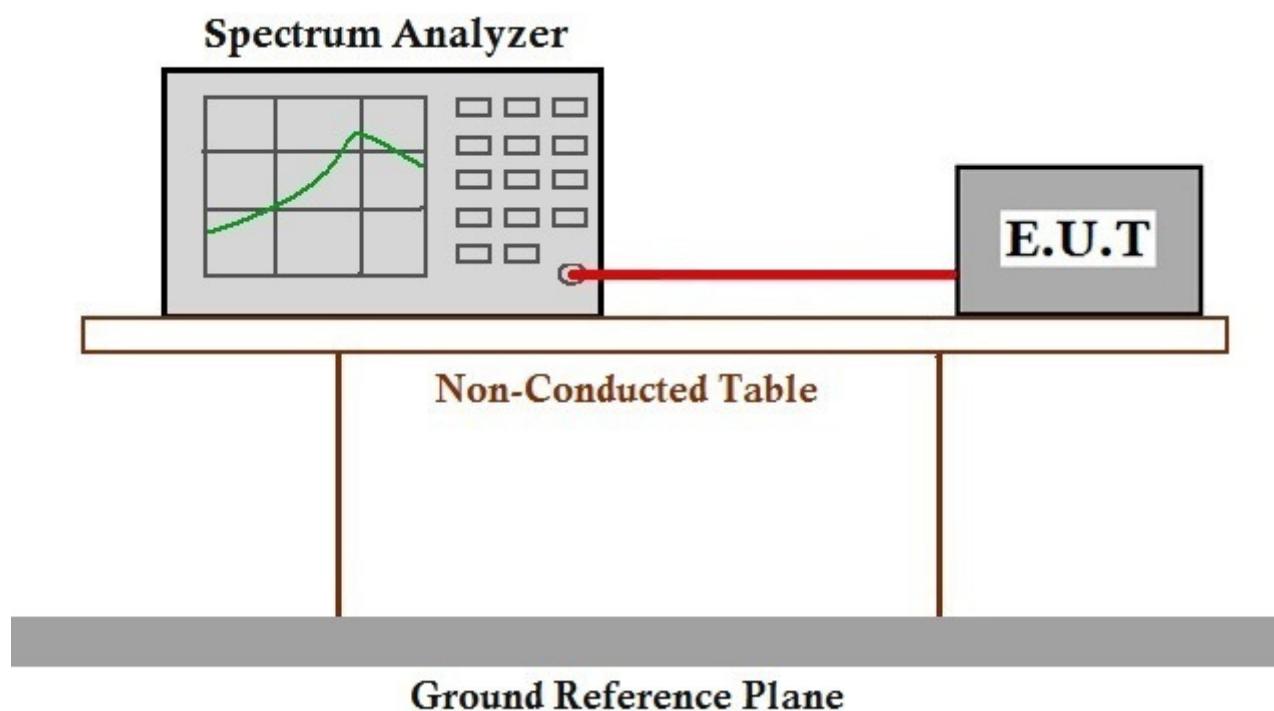
### 7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 26.6 °C Humidity: 44.9 % RH Atmospheric Pressure: 1005 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 15.247

## 7.6 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)) |

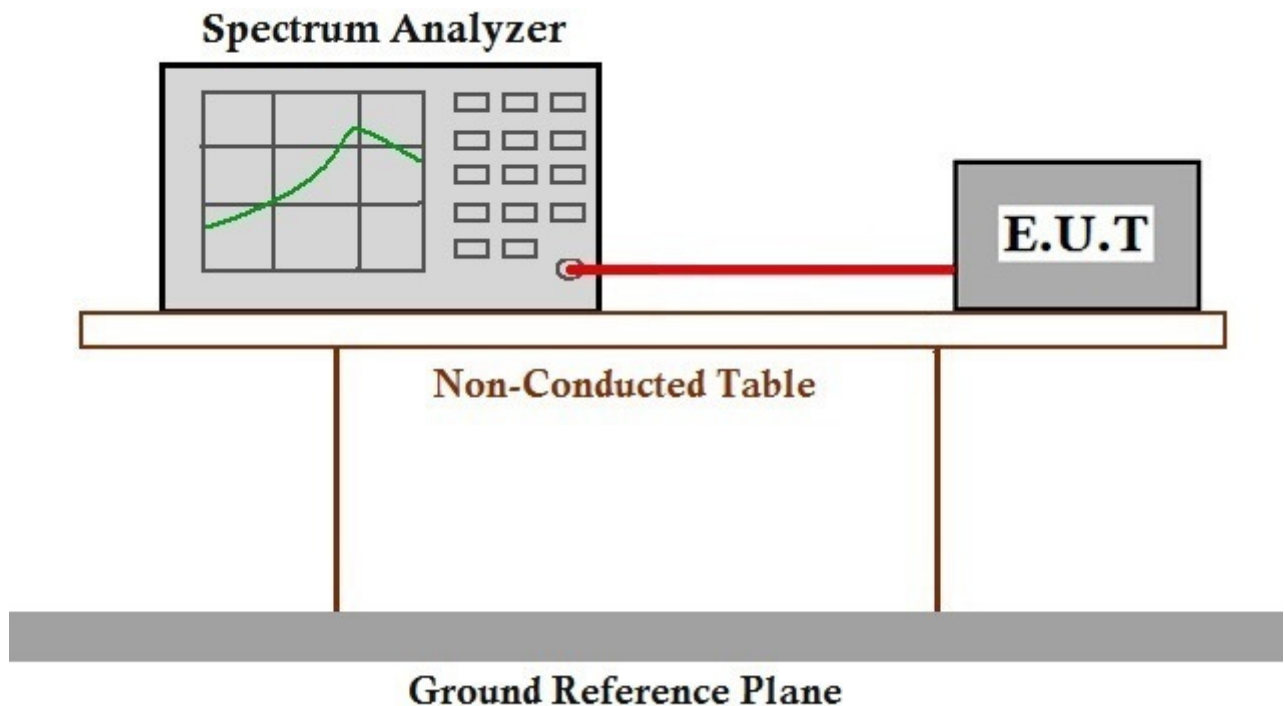


### 7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 26.6 °C Humidity: 44.8 % RH Atmospheric Pressure: 1005 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

The detailed test data see: Appendix 15.247

## 7.7 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  
Measurement Distance: 3m  
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                            |

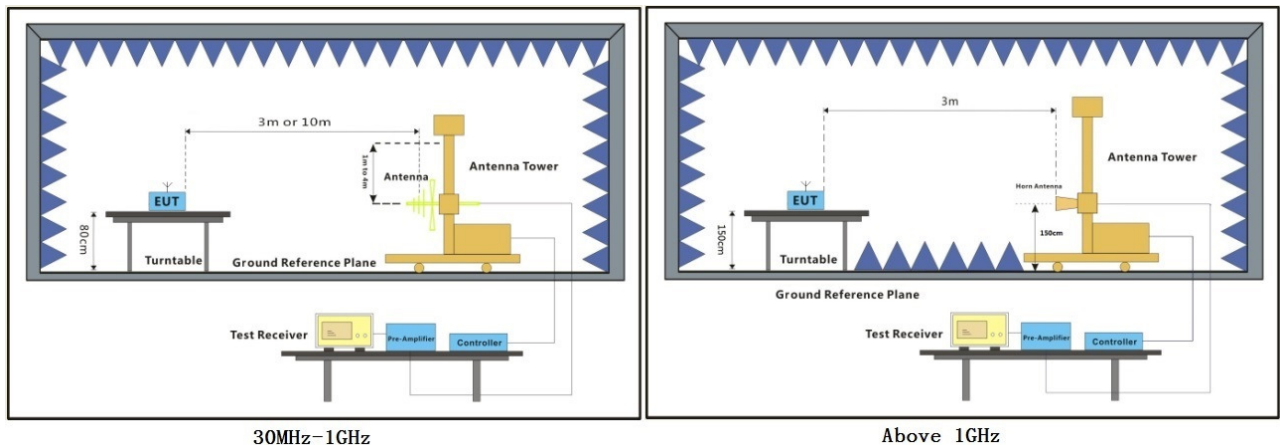
Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field 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: 22.4 °C Humidity: 56.3 % RH Atmospheric Pressure: 1005 mbar  
Test mode a:TX mode\_Keep the EUT in continuously transmitting mode with GFSK modulation

### 7.7.2 Test Setup Diagram



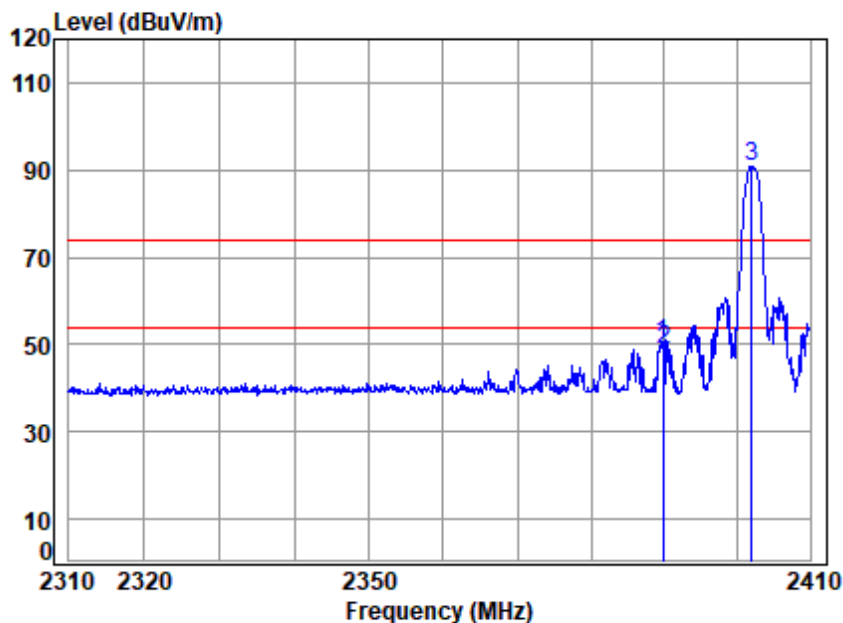
### 7.7.3 Measurement Procedure and Data

- 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: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp 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



Site : chamber  
Condition: 3m HORIZONTAL  
Job No : 17944CR\17945CR  
Mode : 2402 Band edge  
Note : BLE

|     | Freq     | Cable Loss | Ant Factor | Preamplifier Factor | Read Level | Level  | Limit Line | Over Limit | Remark |
|-----|----------|------------|------------|---------------------|------------|--------|------------|------------|--------|
|     | MHz      | dB         | dB/m       | dB                  | dBuV       | dBuV/m | dBuV/m     | dB         |        |
| 1   | 2389.862 | 5.47       | 28.52      | 41.17               | 57.19      | 50.01  | 74.00      | -23.99     | peak   |
| 2   | 2390.000 | 5.47       | 28.52      | 41.17               | 56.21      | 49.03  | 74.00      | -24.97     | peak   |
| 3 * | 2402.000 | 5.49       | 28.54      | 41.18               | 97.79      | 90.64  | 74.00      | 16.64      | peak   |



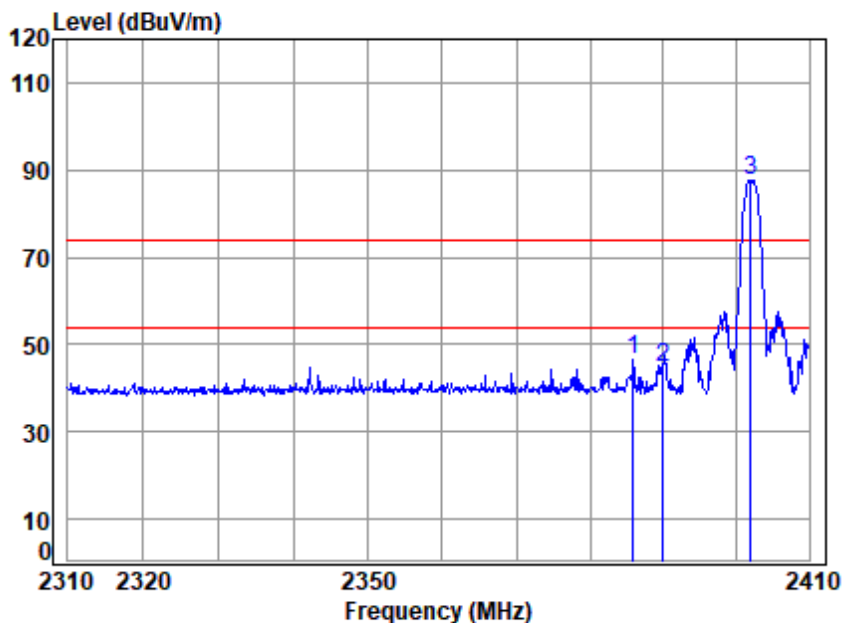
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Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:Low



Site : chamber  
Condition: 3m VERTICAL  
Job No : 17944CR\17945CR  
Mode : 2402 Band edge  
Note : BLE

|     | Freq     | Cable Loss | Ant Factor | Preamplifier Factor | Read Level | Level  | Limit Line | Over Limit | Remark |
|-----|----------|------------|------------|---------------------|------------|--------|------------|------------|--------|
|     | MHz      | dB         | dB/m       | dB                  | dBuV       | dBuV/m | dBuV/m     | dB         |        |
| 1   | 2385.916 | 5.47       | 28.51      | 41.17               | 53.64      | 46.45  | 74.00      | -27.55     | peak   |
| 2   | 2390.000 | 5.47       | 28.52      | 41.17               | 52.08      | 44.90  | 74.00      | -29.10     | peak   |
| 3 * | 2402.000 | 5.49       | 28.54      | 41.18               | 94.65      | 87.50  | 74.00      | 13.50      | peak   |

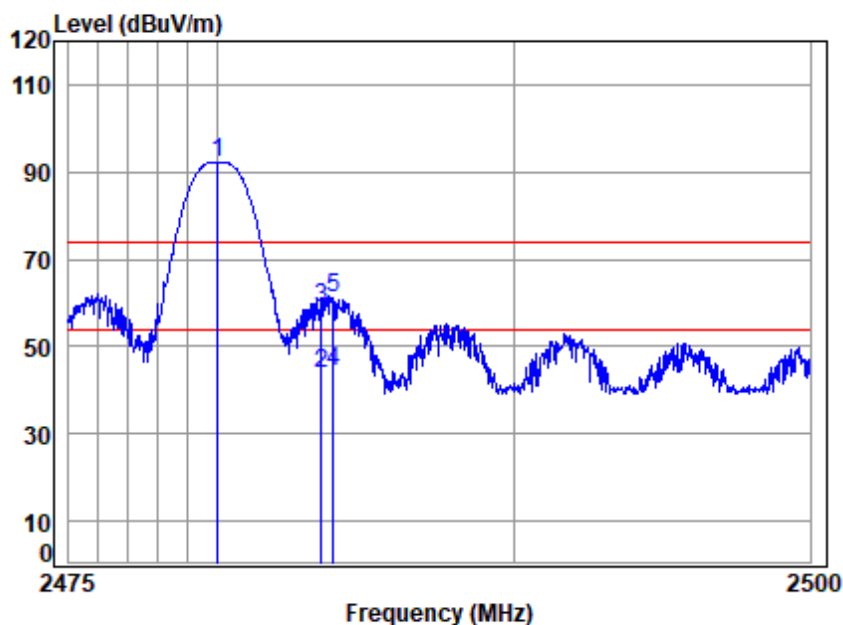


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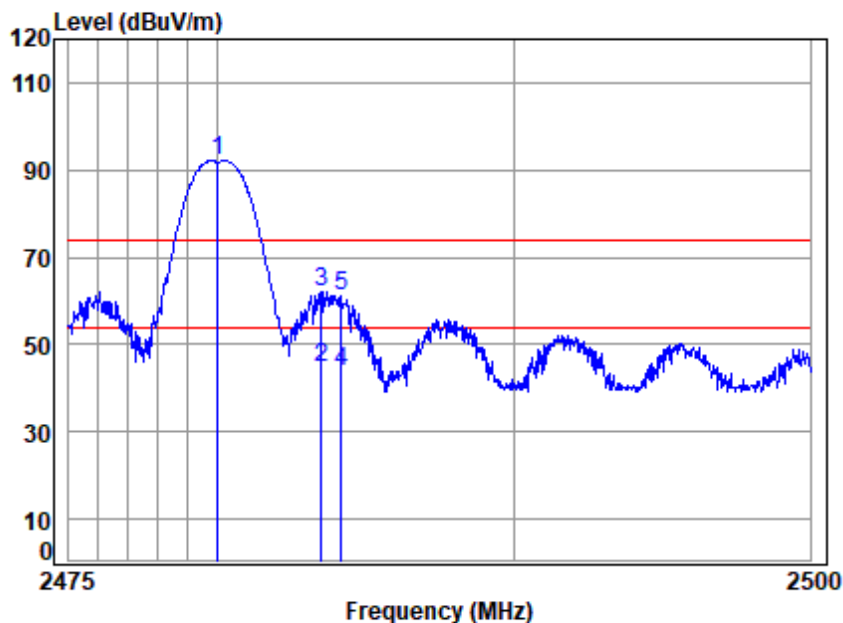
Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:High



Site : chamber  
Condition: 3m HORIZONTAL  
Job No : 17944CR\17945CR  
Mode : 2480 Band edge  
Note : BLE

|      |          | Cable | Ant    | Preamp | Read  | Limit  | Over   |                |
|------|----------|-------|--------|--------|-------|--------|--------|----------------|
| Freq |          | Loss  | Factor | Factor | Level | Level  | Line   | Limit Remark   |
| MHz  |          | dB    | dB/m   | dB     | dBuV  | dBuV/m | dBuV/m | dB             |
| 1 *  | 2480.000 | 5.59  | 28.67  | 41.21  | 99.09 | 92.14  | 74.00  | 18.14 peak     |
| 2    | 2483.500 | 5.60  | 28.67  | 41.21  | 50.52 | 43.58  | 54.00  | -10.42 Average |
| 3    | 2483.500 | 5.60  | 28.67  | 41.21  | 65.96 | 59.02  | 74.00  | -14.98 peak    |
| 4    | 2483.896 | 5.60  | 28.67  | 41.21  | 50.99 | 44.05  | 54.00  | -9.95 Average  |
| 5    | 2483.896 | 5.60  | 28.67  | 41.21  | 68.18 | 61.24  | 74.00  | -12.76 peak    |

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



Site : chamber  
Condition: 3m VERTICAL  
Job No : 17944CR\17945CR  
Mode : 2480 Band edge  
Note : BLE

|              |      | Cable  | Ant    | Preamp | Read   | Limit  | Over   |         |
|--------------|------|--------|--------|--------|--------|--------|--------|---------|
| Freq         | Loss | Factor | Factor | Level  | Level  | Line   | Limit  | Remark  |
| MHz          | dB   | dB/m   | dB     | dBuV   | dBuV/m | dBuV/m | dB     |         |
| 1 * 2480.000 | 5.59 | 28.67  | 41.21  | 99.02  | 92.07  | 74.00  | 18.07  | peak    |
| 2 2483.500   | 5.60 | 28.67  | 41.21  | 51.43  | 44.49  | 54.00  | -9.51  | Average |
| 3 2483.500   | 5.60 | 28.67  | 41.21  | 68.99  | 62.05  | 74.00  | -11.95 | peak    |
| 4 2484.146   | 5.60 | 28.67  | 41.21  | 50.89  | 43.95  | 54.00  | -10.05 | Average |
| 5 2484.146   | 5.60 | 28.67  | 41.21  | 68.24  | 61.30  | 74.00  | -12.70 | peak    |



## 7.8 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  
Measurement Distance: 3m  
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.





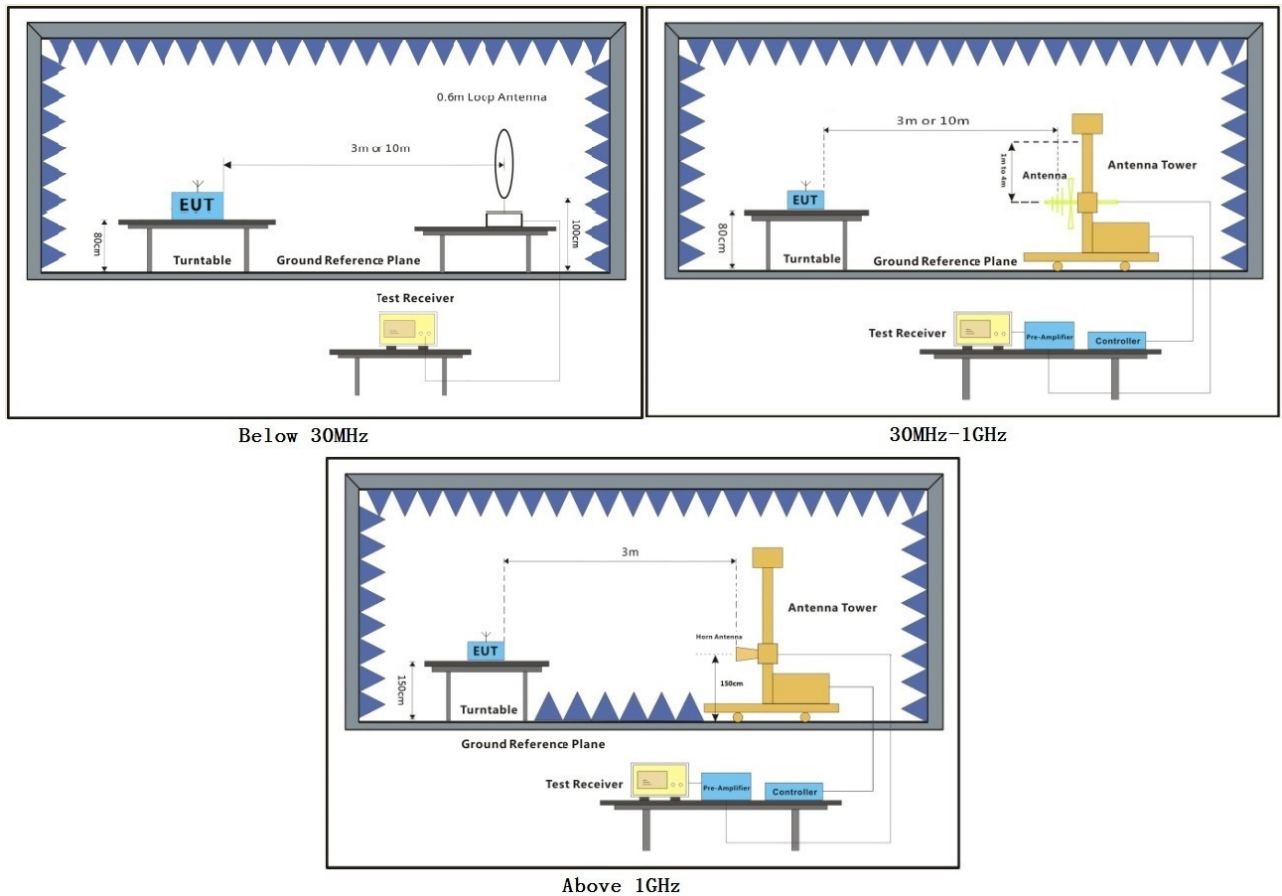
### 7.8.1 E.U.T. Operation

Operating Environment:

Temperature: 25 °C Humidity: 51 % RH Atmospheric Pressure: 1005 mbar

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

### 7.8.2 Test Setup Diagram



### 7.8.3 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.

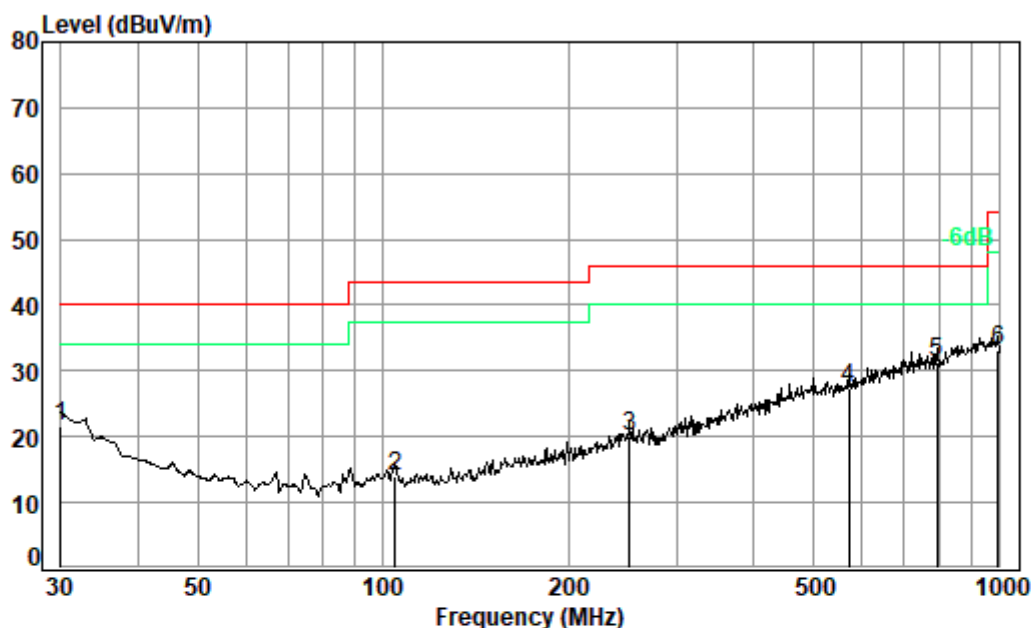
#### Remark:

- 1) For emission below 1GHz, through pre-scan found the worst case is the highest 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 in the report.

30MHz~1GHz

QP value:

Mode: a; Polarization: Horizontal;



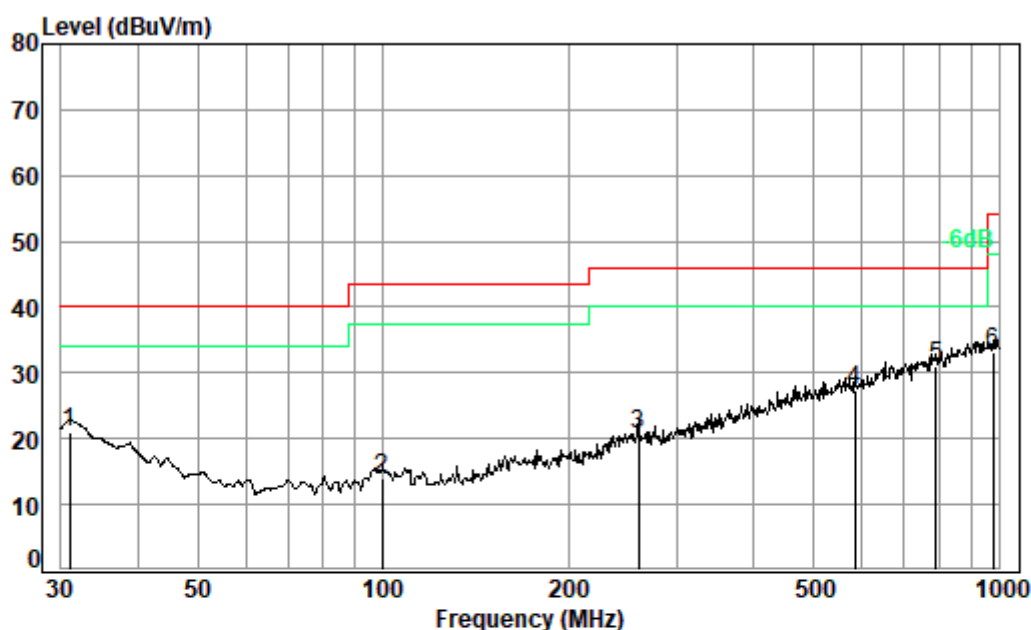
Condition: 3m HORIZONTAL

Job No. : 17944CR

Test Mode: a

|      | Freq   | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level  | Limit Line | Over Limit |
|------|--------|------------|------------|---------------|------------|--------|------------|------------|
|      | MHz    | dB         | dB/m       | dB            | dBuV       | dBuV/m | dBuV/m     | dB         |
| 1    | 30.00  | 0.60       | 22.50      | 27.73         | 26.36      | 21.73  | 40.00      | -18.27     |
| 2    | 104.54 | 1.21       | 13.78      | 27.61         | 26.57      | 13.95  | 43.50      | -29.55     |
| 3    | 251.18 | 1.68       | 18.97      | 27.01         | 26.49      | 20.13  | 46.00      | -25.87     |
| 4    | 570.61 | 2.67       | 26.05      | 28.08         | 26.74      | 27.38  | 46.00      | -18.62     |
| 5 pp | 793.40 | 3.18       | 28.46      | 27.73         | 27.45      | 31.36  | 46.00      | -14.64     |
| 6    | 996.50 | 3.70       | 30.28      | 26.92         | 26.19      | 33.25  | 54.00      | -20.75     |

Mode :a; Polarization: Vertical



Condition: 3m VERTICAL

Job No. : 17944CR

Test Mode: a

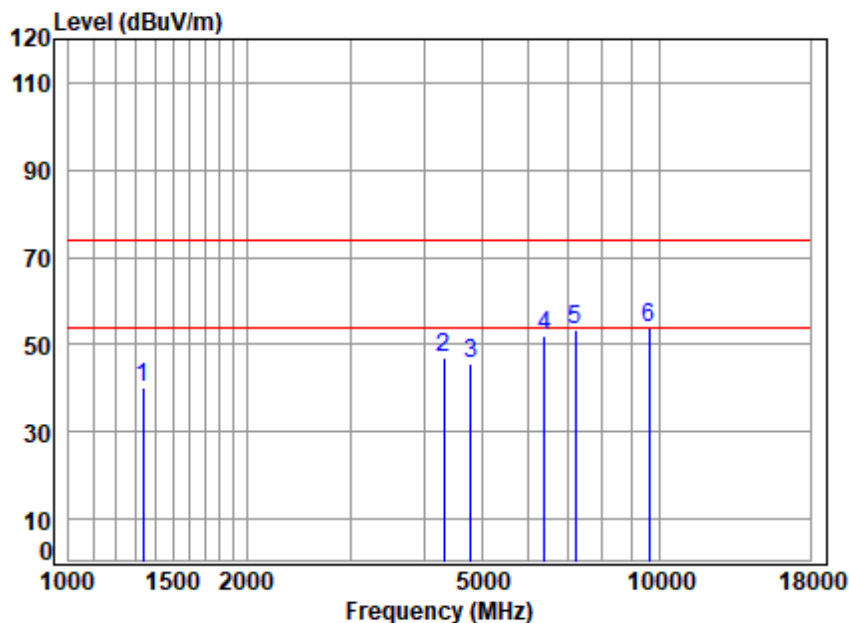
|      | Freq   | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level  | Limit  | Over   |
|------|--------|------------|------------|---------------|------------|--------|--------|--------|
|      | MHz    | dB         | dB/m       | dB            | dBuV       | dBuV/m | dBuV/m | dB     |
| 1    | 30.96  | 0.60       | 21.95      | 27.73         | 26.20      | 21.02  | 40.00  | -18.98 |
| 2    | 99.88  | 1.20       | 13.99      | 27.64         | 26.43      | 13.98  | 43.50  | -29.52 |
| 3    | 260.14 | 1.72       | 19.10      | 26.99         | 26.85      | 20.68  | 46.00  | -25.32 |
| 4    | 582.74 | 2.68       | 26.28      | 28.12         | 26.68      | 27.52  | 46.00  | -18.48 |
| 5 pp | 790.62 | 3.18       | 28.45      | 27.74         | 27.11      | 31.00  | 46.00  | -15.00 |
| 6    | 979.18 | 3.68       | 30.20      | 26.99         | 26.11      | 33.00  | 54.00  | -21.00 |

Note: the final values are QP values.



**Above 1GHz**

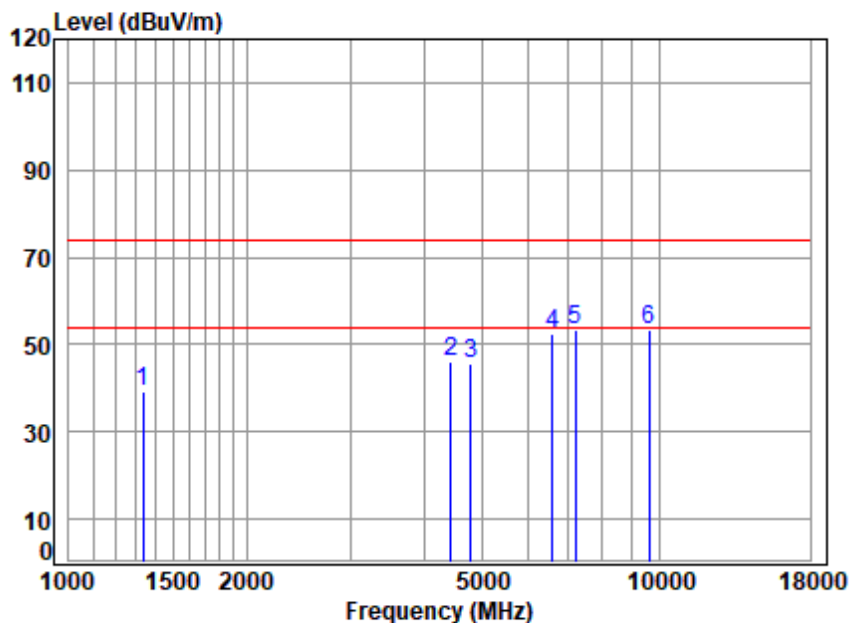
Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low



Site : chamber  
Condition: 3m HORIZONTAL  
Job No : 17944CR\17945CR  
Mode : 2402 TX RSE  
Note : BLE 1M

|   | Freq     | Cable Loss | Ant Factor | Preamplifier Factor | Read Level | Level  | Limit Line | Over Limit | Remark |
|---|----------|------------|------------|---------------------|------------|--------|------------|------------|--------|
|   | MHz      | dB         | dB/m       | dB                  | dBuV       | dBuV/m | dBuV/m     | dB         |        |
| 1 | 1335.141 | 4.93       | 25.11      | 40.59               | 50.57      | 40.02  | 74.00      | -33.98     | peak   |
| 2 | 4316.859 | 7.36       | 33.60      | 43.11               | 48.93      | 46.78  | 74.00      | -27.22     | peak   |
| 3 | 4804.000 | 7.89       | 34.16      | 43.61               | 46.99      | 45.43  | 74.00      | -28.57     | peak   |
| 4 | 6395.654 | 11.34      | 35.02      | 42.49               | 48.06      | 51.93  | 74.00      | -22.07     | peak   |
| 5 | 7206.000 | 10.08      | 36.42      | 41.86               | 48.68      | 53.32  | 74.00      | -20.68     | peak   |
| 6 | 9608.000 | 10.75      | 37.52      | 38.43               | 44.07      | 53.91  | 74.00      | -20.09     | peak   |

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



Site : chamber  
Condition: 3m VERTICAL  
Job No : 17944CR\17945CR  
Mode : 2402 TX RSE  
Note : BLE 1M

|   | Freq     | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level  | Limit Line | Over Limit | Remark |
|---|----------|------------|------------|---------------|------------|--------|------------|------------|--------|
|   | MHz      | dB         | dB/m       | dB            | dBuV       | dBuV/m | dBuV/m     | dB         |        |
| 1 | 1335.141 | 4.93       | 25.11      | 40.59         | 49.86      | 39.31  | 74.00      | -34.69     | peak   |
| 2 | 4443.453 | 7.50       | 33.60      | 43.25         | 48.42      | 46.27  | 74.00      | -27.73     | peak   |
| 3 | 4804.000 | 7.89       | 34.16      | 43.61         | 47.17      | 45.61  | 74.00      | -28.39     | peak   |
| 4 | 6583.209 | 11.30      | 35.34      | 42.34         | 48.04      | 52.34  | 74.00      | -21.66     | peak   |
| 5 | 7206.000 | 10.08      | 36.42      | 41.86         | 48.52      | 53.16  | 74.00      | -20.84     | peak   |
| 6 | 9608.000 | 10.75      | 37.52      | 38.43         | 43.51      | 53.35  | 74.00      | -20.65     | peak   |

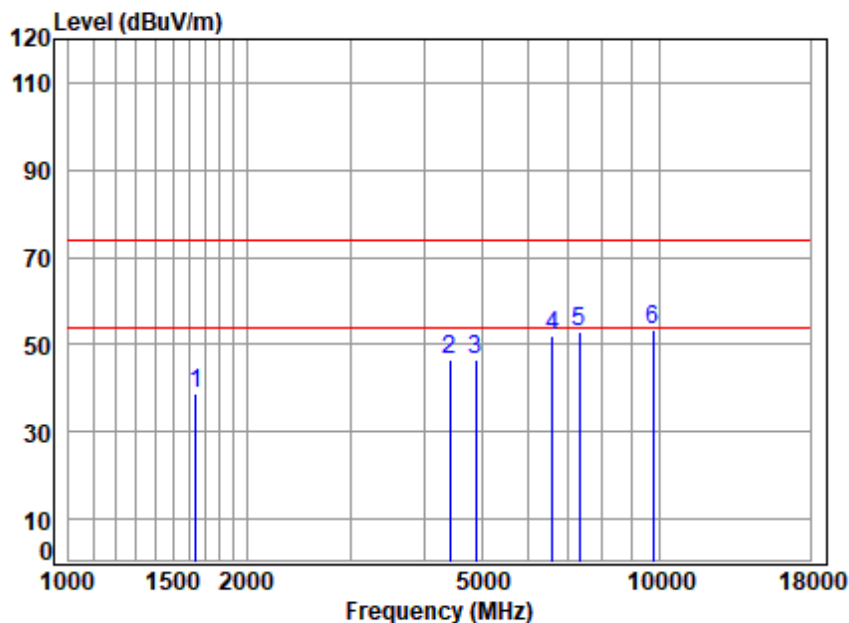


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Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:middle



Site : chamber  
Condition: 3m HORIZONTAL  
Job No : 17944CR\17945CR  
Mode : 2440 TX RSE  
Note : BLE 1M

|   | Freq     | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level  | Limit Line | Over Limit | Remark |
|---|----------|------------|------------|---------------|------------|--------|------------|------------|--------|
|   | MHz      | dB         | dB/m       | dB            | dBuV       | dBuV/m | dBuV/m     | dB         |        |
| 1 | 1644.019 | 5.30       | 26.44      | 40.80         | 48.02      | 38.96  | 74.00      | -35.04     | peak   |
| 2 | 4417.841 | 7.47       | 33.60      | 43.22         | 48.50      | 46.35  | 74.00      | -27.65     | peak   |
| 3 | 4880.000 | 7.97       | 34.29      | 43.69         | 47.79      | 46.36  | 74.00      | -27.64     | peak   |
| 4 | 6583.209 | 11.30      | 35.34      | 42.34         | 47.55      | 51.85  | 74.00      | -22.15     | peak   |
| 5 | 7320.000 | 10.05      | 36.37      | 41.77         | 48.25      | 52.90  | 74.00      | -21.10     | peak   |
| 6 | 9760.000 | 10.82      | 37.55      | 38.18         | 43.17      | 53.36  | 74.00      | -20.64     | peak   |

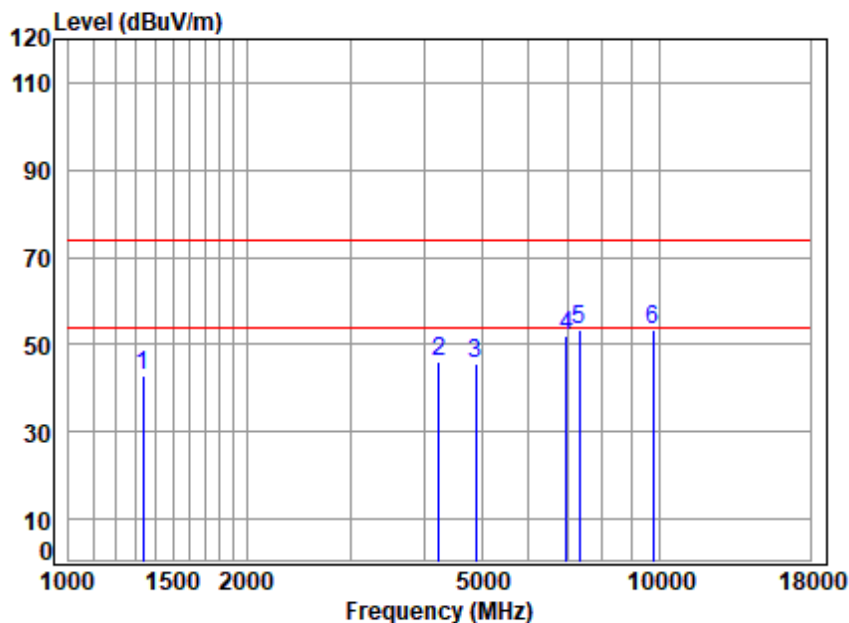


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Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:middle



Site : chamber  
Condition: 3m VERTICAL  
Job No : 17944CR\17945CR  
Mode : 2440 TX RSE  
Note : BLE 1M

|   | Freq     | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level  | Limit Line | Over Limit | Remark |
|---|----------|------------|------------|---------------|------------|--------|------------|------------|--------|
|   | MHz      | dB         | dB/m       | dB            | dBuV       | dBuV/m | dBuV/m     | dB         |        |
| 1 | 1335.141 | 4.93       | 25.11      | 40.59         | 53.47      | 42.92  | 74.00      | -31.08     | peak   |
| 2 | 4230.396 | 7.26       | 33.60      | 43.01         | 48.19      | 46.04  | 74.00      | -27.96     | peak   |
| 3 | 4880.000 | 7.97       | 34.29      | 43.69         | 47.12      | 45.69  | 74.00      | -28.31     | peak   |
| 4 | 6954.852 | 10.25      | 36.38      | 42.04         | 47.39      | 51.98  | 74.00      | -22.02     | peak   |
| 5 | 7320.000 | 10.05      | 36.37      | 41.77         | 48.53      | 53.18  | 74.00      | -20.82     | peak   |
| 6 | 9760.000 | 10.82      | 37.55      | 38.18         | 43.30      | 53.49  | 74.00      | -20.51     | peak   |



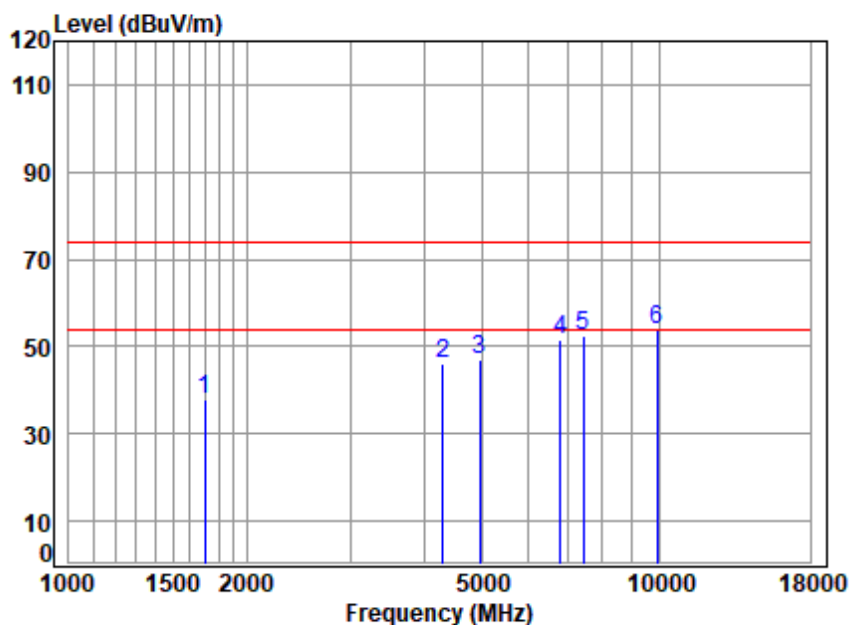
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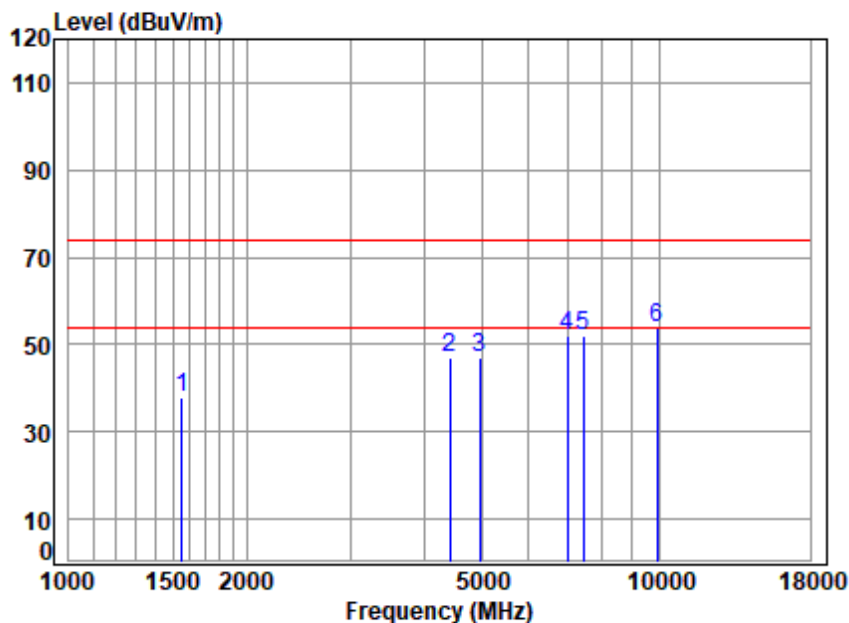
Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:High



Site : chamber  
Condition: 3m HORIZONTAL  
Job No : 17944CR\17945CR  
Mode : 2480 TX RSE  
Note : BLE 1M

|   | Freq     | Cable Loss | Ant Factor | Preamplifier Factor | Read Level | Level  | Limit Line | Over Limit | Remark |
|---|----------|------------|------------|---------------------|------------|--------|------------|------------|--------|
|   | MHz      | dB         | dB/m       | dB                  | dBuV       | dBuV/m | dBuV/m     | dB         |        |
| 1 | 1697.129 | 5.23       | 26.66      | 40.83               | 46.60      | 37.66  | 74.00      | -36.34     | peak   |
| 2 | 4304.400 | 7.34       | 33.60      | 43.10               | 48.33      | 46.17  | 74.00      | -27.83     | peak   |
| 3 | 4960.000 | 8.05       | 34.43      | 43.76               | 48.06      | 46.78  | 74.00      | -27.22     | peak   |
| 4 | 6795.879 | 10.69      | 35.94      | 42.17               | 47.29      | 51.75  | 74.00      | -22.25     | peak   |
| 5 | 7440.000 | 10.02      | 36.32      | 41.69               | 47.96      | 52.61  | 74.00      | -21.39     | peak   |
| 6 | 9920.000 | 10.90      | 37.58      | 37.93               | 43.14      | 53.69  | 74.00      | -20.31     | peak   |

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



Site : chamber  
Condition: 3m VERTICAL  
Job No : 17944CR\17945CR  
Mode : 2480 TX RSE  
Note : BLE 1M

|   | Freq     | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level  | Limit Line | Over Limit | Remark |
|---|----------|------------|------------|---------------|------------|--------|------------|------------|--------|
|   | MHz      | dB         | dB/m       | dB            | dBuV       | dBuV/m | dBuV/m     | dB         |        |
| 1 | 1551.677 | 5.41       | 26.04      | 40.74         | 47.12      | 37.83  | 74.00      | -36.17     | peak   |
| 2 | 4417.841 | 7.47       | 33.60      | 43.22         | 49.10      | 46.95  | 74.00      | -27.05     | peak   |
| 3 | 4960.000 | 8.05       | 34.43      | 43.76         | 48.27      | 46.99  | 74.00      | -27.01     | peak   |
| 4 | 6995.172 | 10.14      | 36.49      | 42.01         | 47.52      | 52.14  | 74.00      | -21.86     | peak   |
| 5 | 7440.000 | 10.02      | 36.32      | 41.69         | 47.53      | 52.18  | 74.00      | -21.82     | peak   |
| 6 | 9920.000 | 10.90      | 37.58      | 37.93         | 43.39      | 53.94  | 74.00      | -20.06     | peak   |



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## 8 Photographs

### 8.1 Test Setup

Please refer to setup photos.

### 8.2 EUT Constructional Details (EUT Photos)

Please refer to external and internal photos for details.



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## 9 Appendix

### 9.1 Appendix 15.247

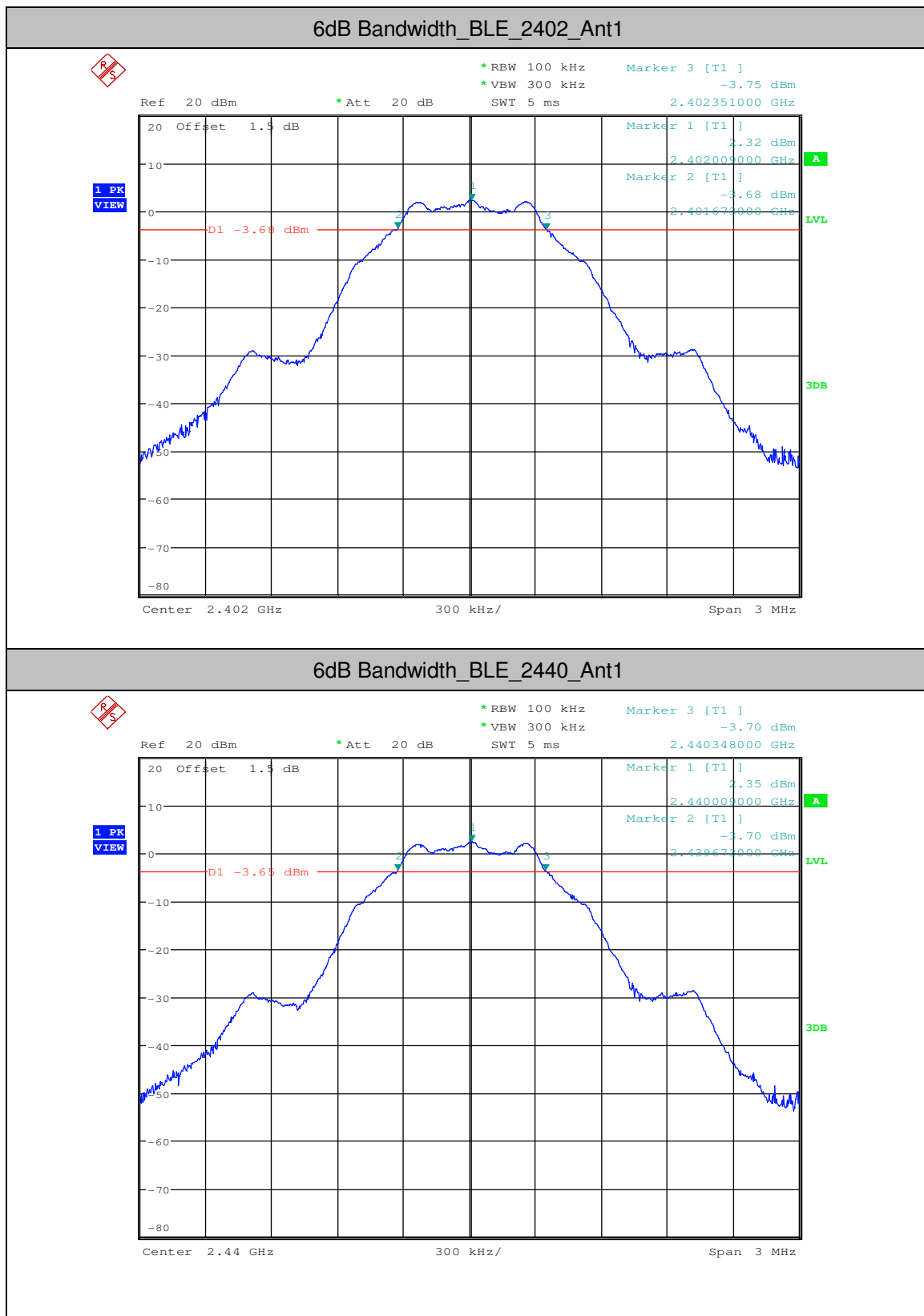
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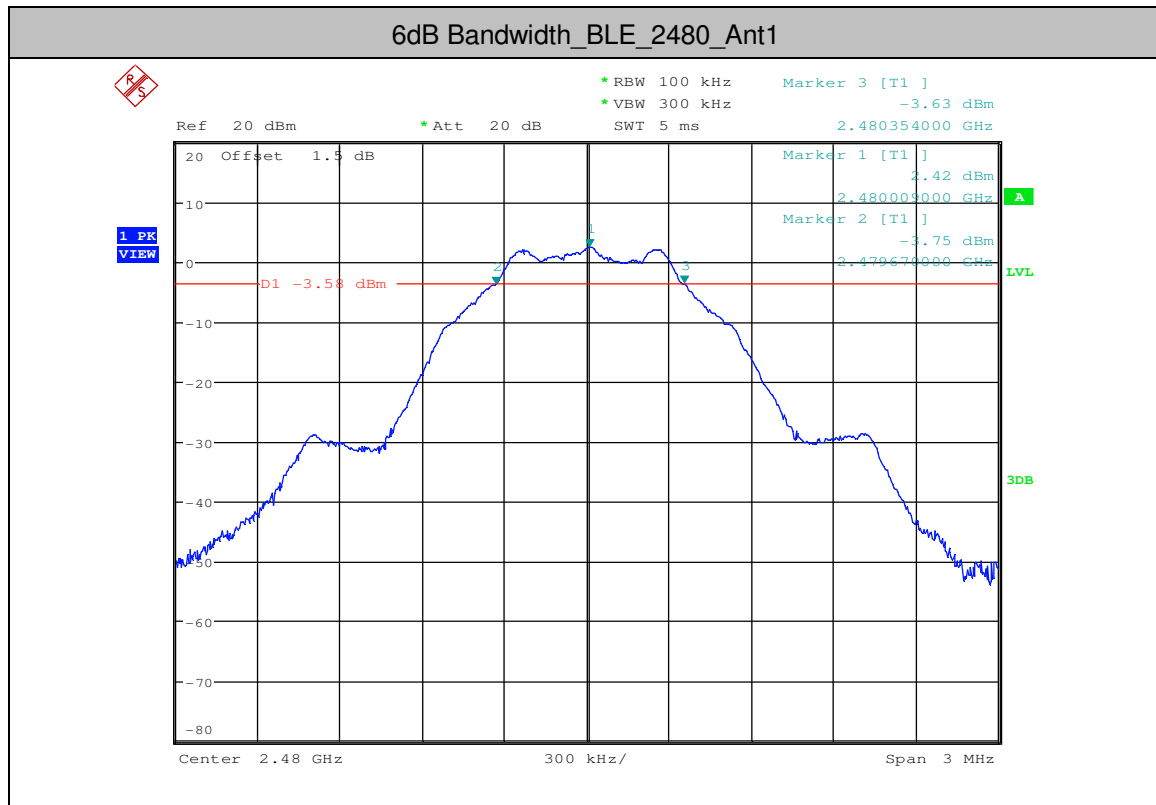
| Test Mode | Test | Ant  | EBW[MHz] | Limit[MHz] | Verdict |
|-----------|------|------|----------|------------|---------|
| BLE       | 2402 | Ant1 | 0.678    | $\geq 0.5$ | PASS    |
| BLE       | 2440 | Ant1 | 0.675    | $\geq 0.5$ | PASS    |
| BLE       | 2480 | Ant1 | 0.684    | $\geq 0.5$ | PASS    |



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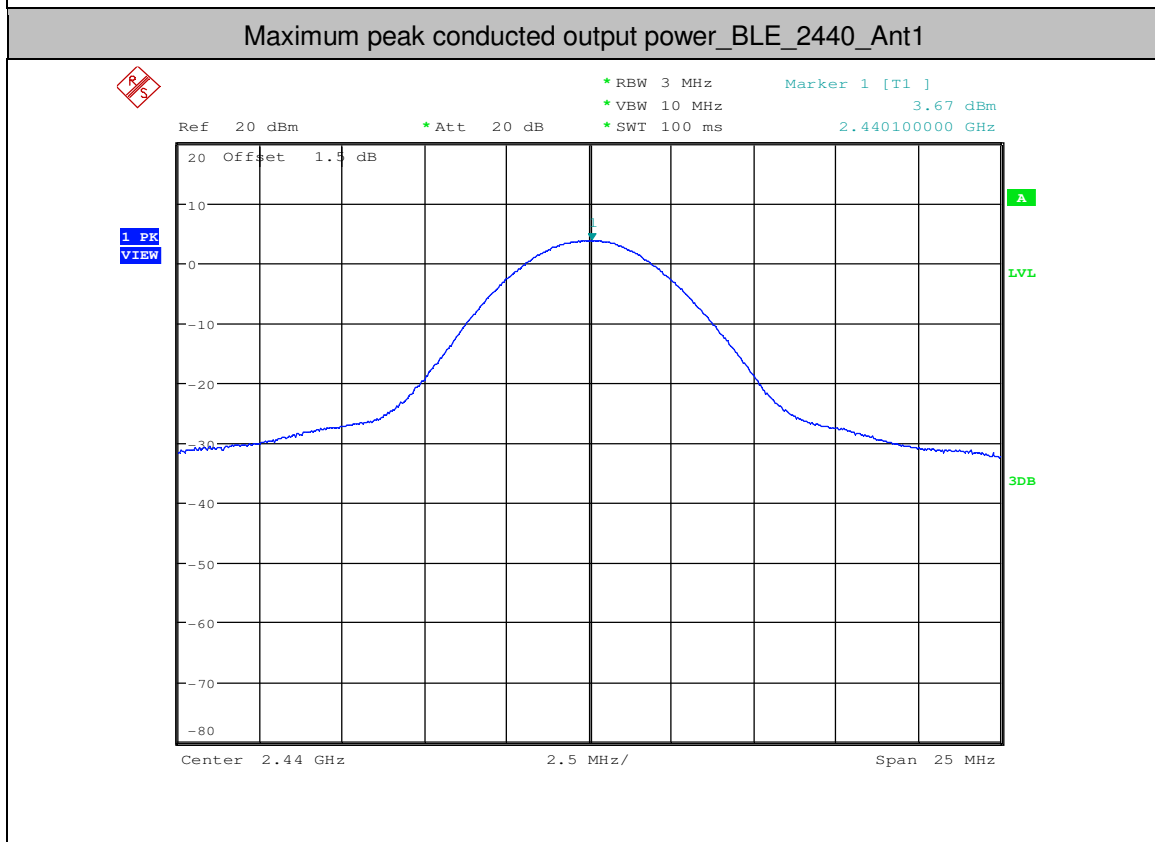
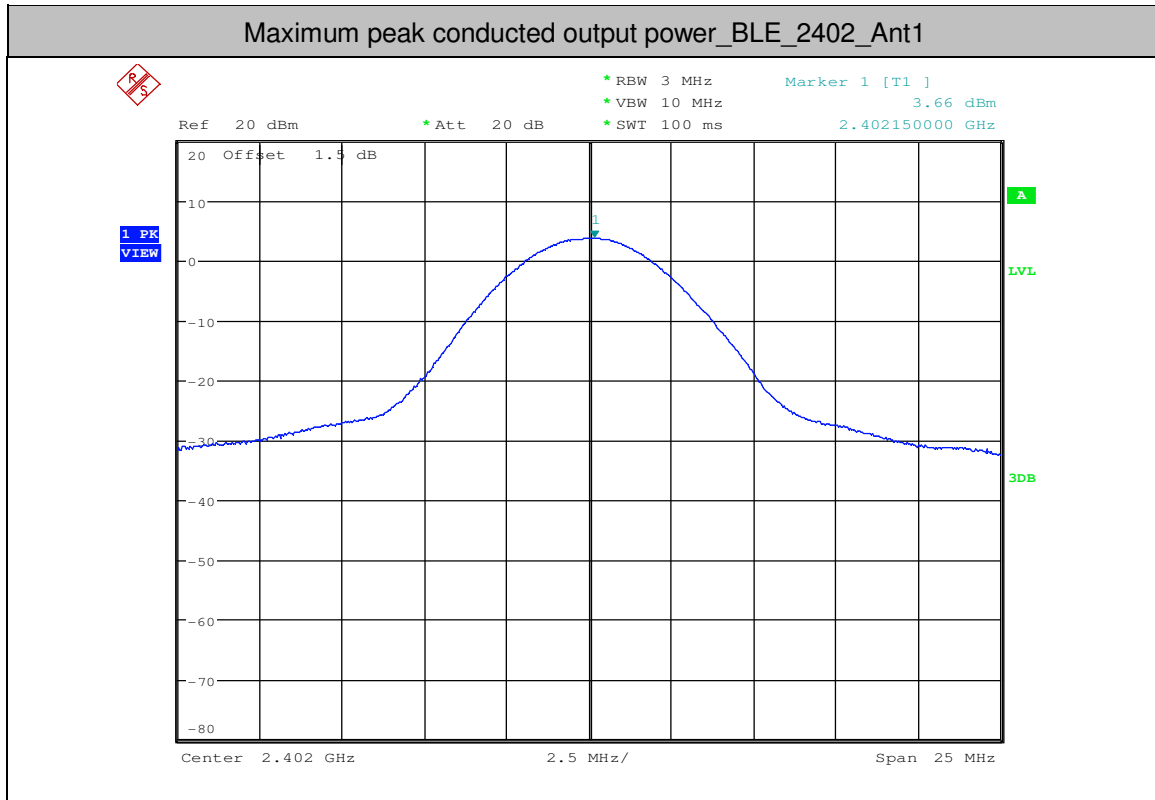






## 2. Maximum peak conducted output power

| Test Mode | Test Channel | Ant  | Power[dBm] | Limit[dBm] | Verdict |
|-----------|--------------|------|------------|------------|---------|
| BLE       | 2402         | Ant1 | 3.66       | <30        | PASS    |
| BLE       | 2440         | Ant1 | 3.67       | <30        | PASS    |
| BLE       | 2480         | Ant1 | 3.74       | <30        | PASS    |



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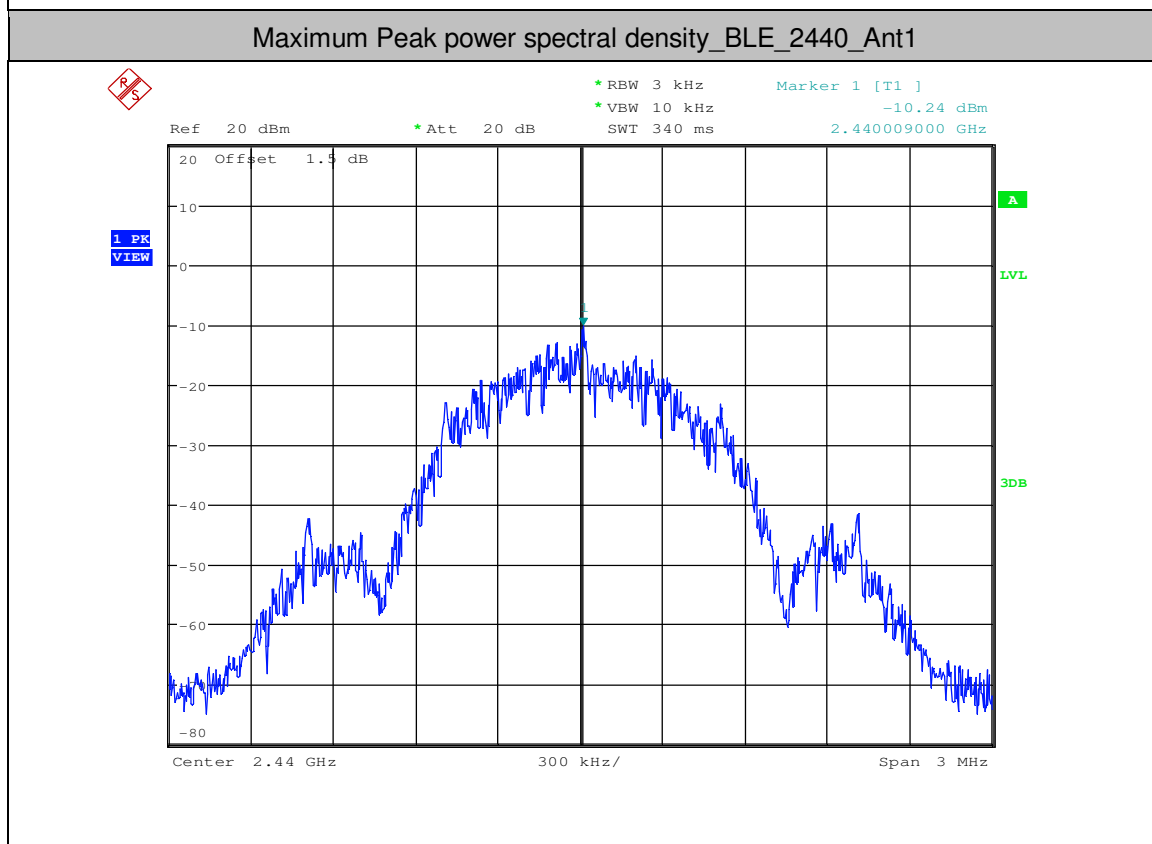
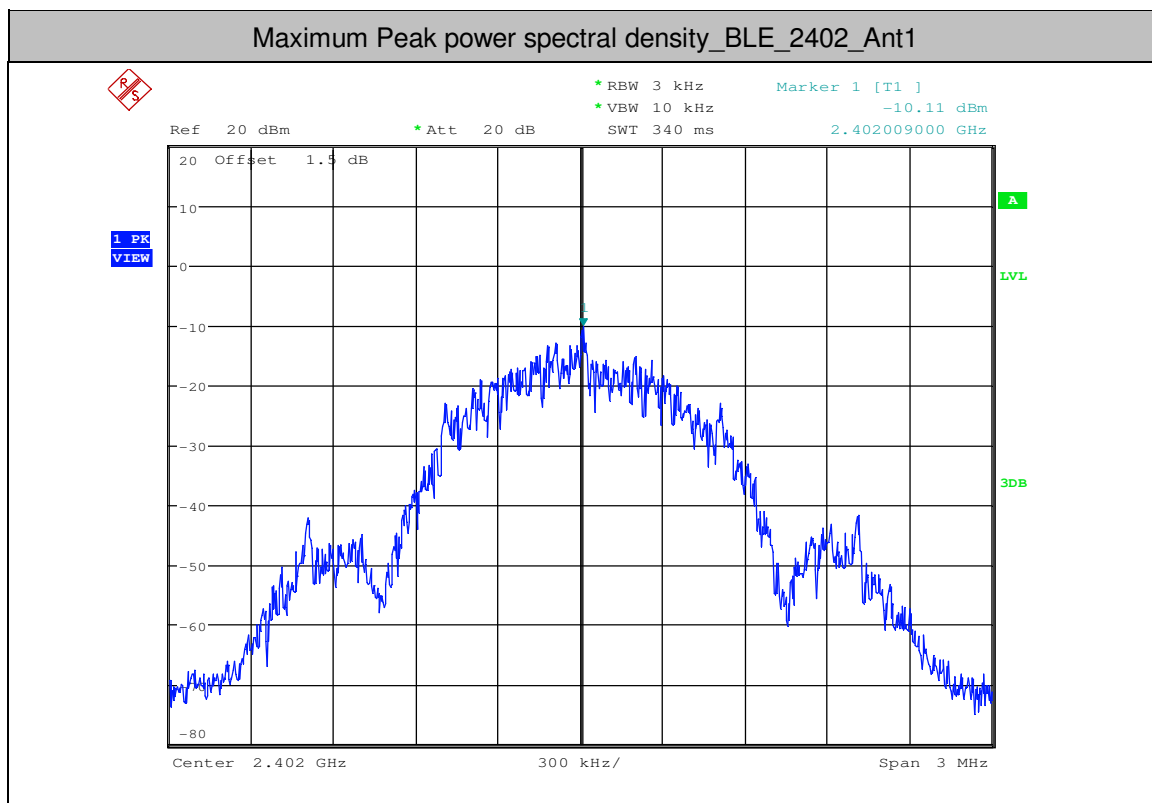
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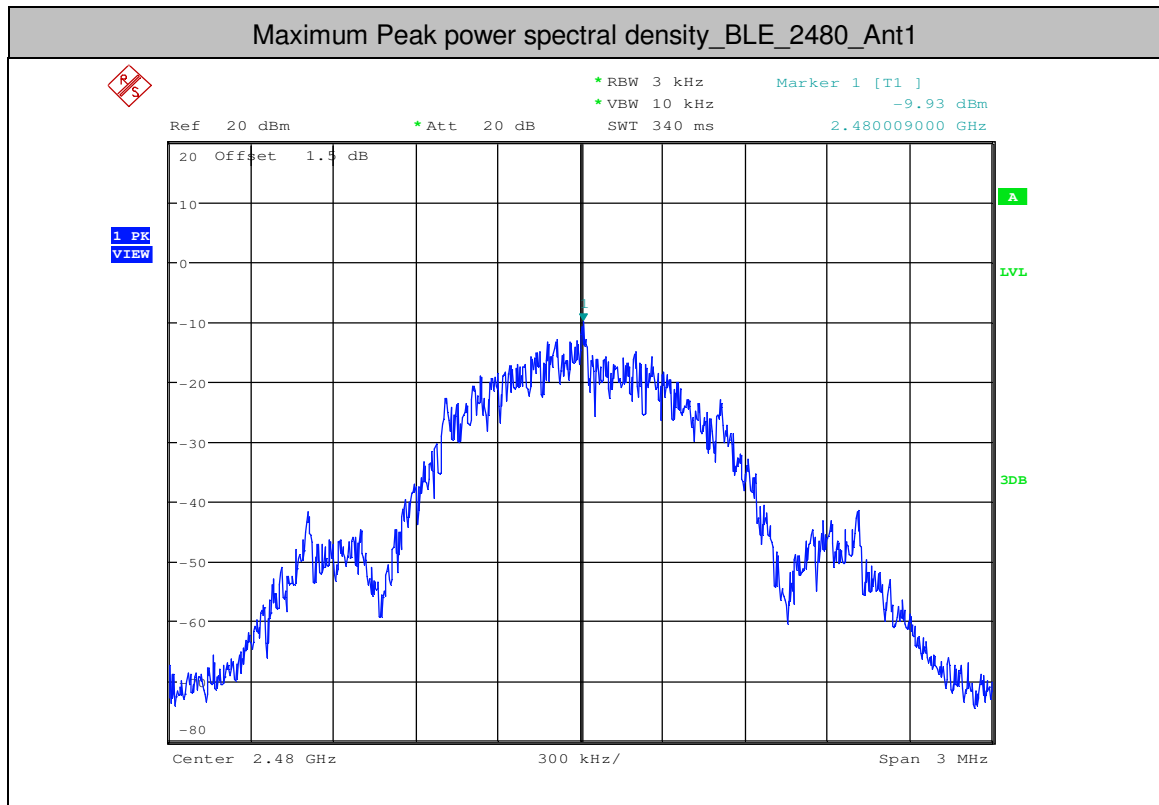


### 3.Maximum Peak power spectral density

| Test Mode | Test Channel | Ant  | PSD[dBm/3kHz] | Limit[dBm/3kHz] | Verdict |
|-----------|--------------|------|---------------|-----------------|---------|
| BLE       | 2402         | Ant1 | -10.11        | <8.00           | PASS    |
| BLE       | 2440         | Ant1 | -10.24        | <8.00           | PASS    |
| BLE       | 2480         | Ant1 | -9.93         | <8.00           | PASS    |

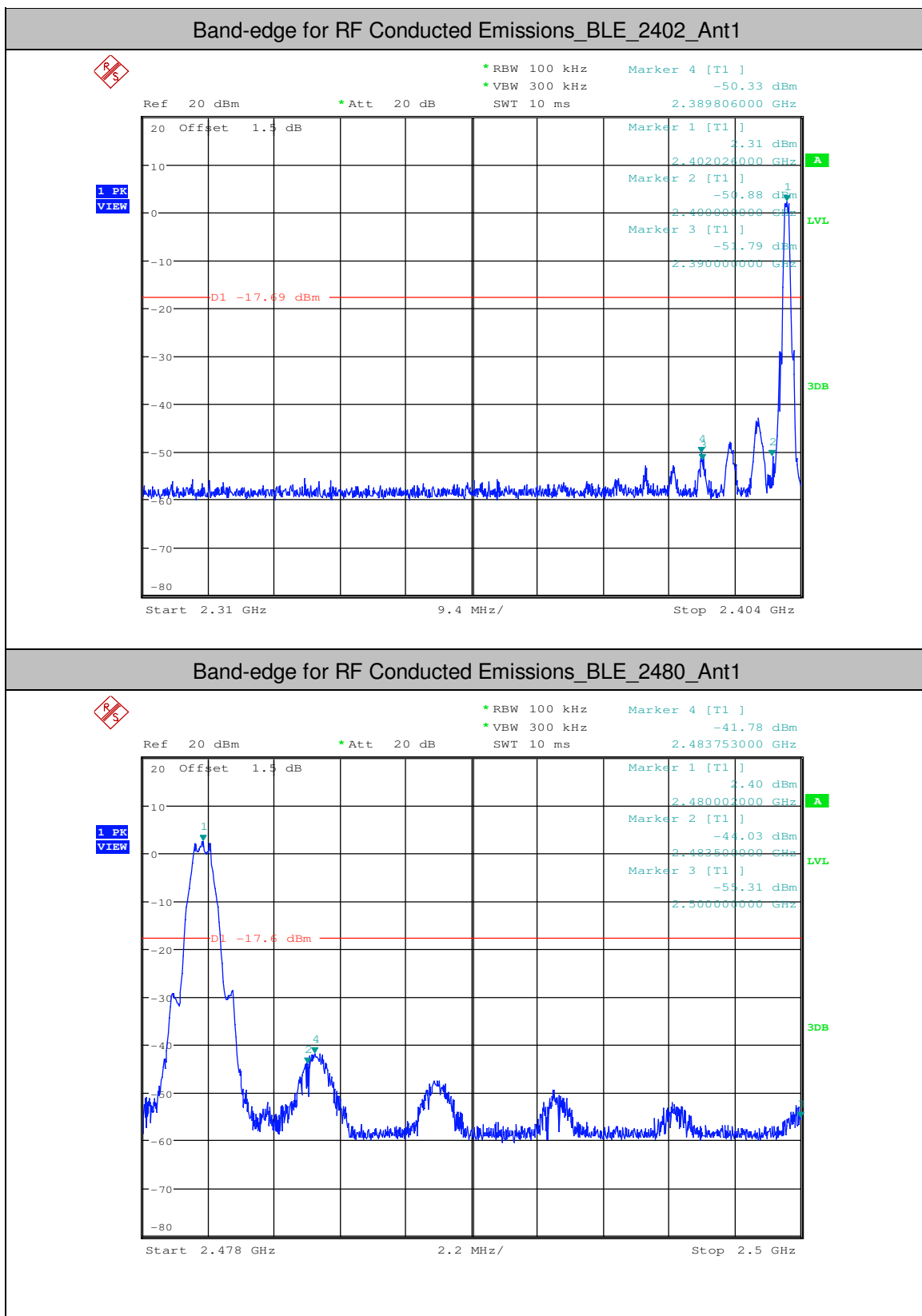






#### 4.Band-edge for RF Conducted Emissions

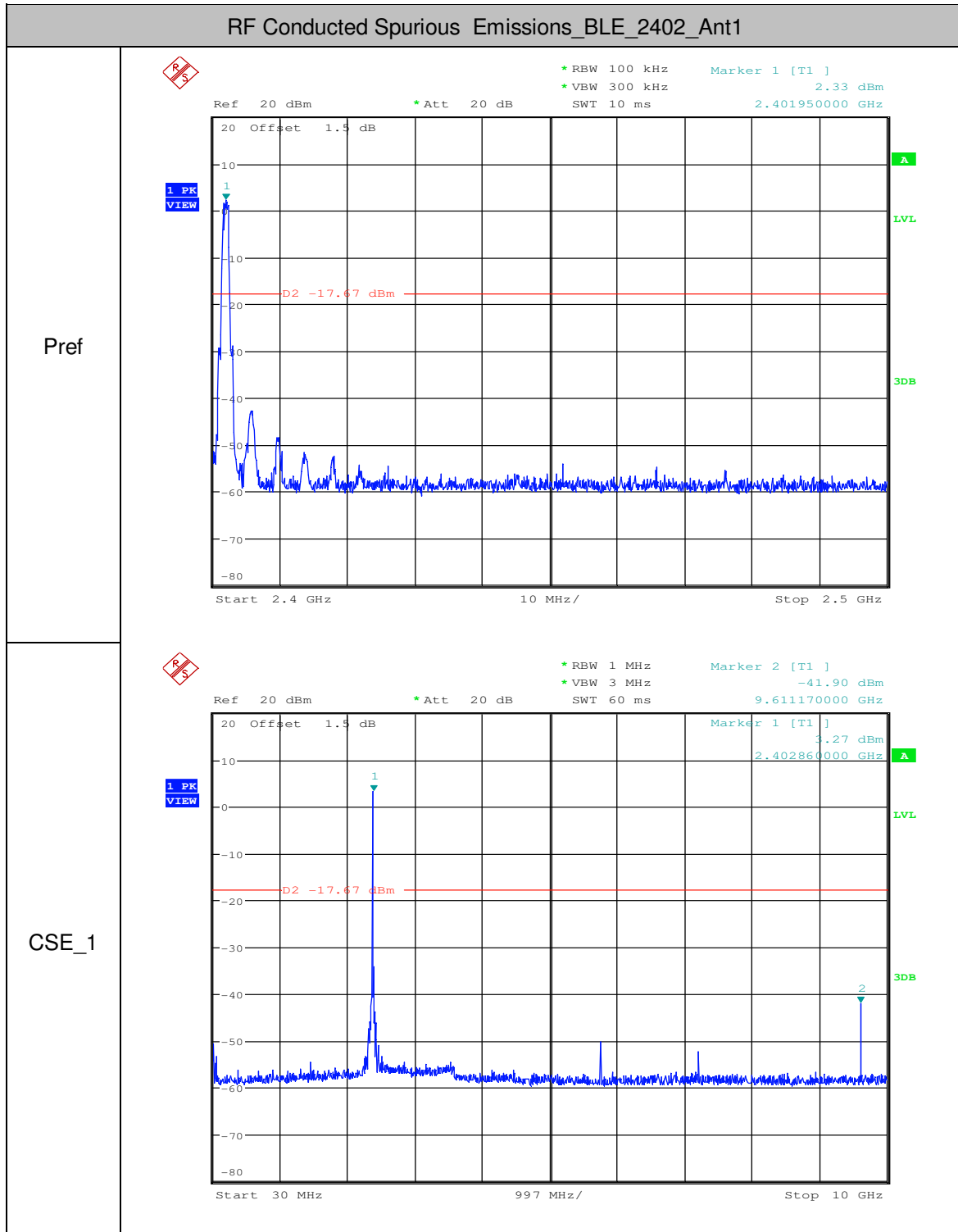
| Test Mode | Test Channel | Ant  | Carrier Power[dBm] | Max. Spurious Level [dBm] | Limit [dBm] | Verdict |
|-----------|--------------|------|--------------------|---------------------------|-------------|---------|
| BLE       | 2402         | Ant1 | 2.310              | -50.328                   | <-17.69     | PASS    |
| BLE       | 2480         | Ant1 | 2.400              | -41.784                   | <-17.6      | PASS    |



## 5.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         | 1000      | 3000      | 2.33      | -41.900          | <-17.67     | PASS    |
| BLE       | 2402         | 10000          | 25000         | 1000      | 3000      | 2.33      | -53.700          | <-17.67     | PASS    |
| BLE       | 2440         | 30             | 10000         | 1000      | 3000      | 2.33      | -38.380          | <-17.67     | PASS    |
| BLE       | 2440         | 10000          | 25000         | 1000      | 3000      | 2.33      | -50.720          | <-17.67     | PASS    |
| BLE       | 2480         | 30             | 10000         | 1000      | 3000      | 2.43      | -35.110          | <-17.57     | PASS    |
| BLE       | 2480         | 10000          | 25000         | 1000      | 3000      | 2.43      | -46.880          | <-17.57     | PASS    |

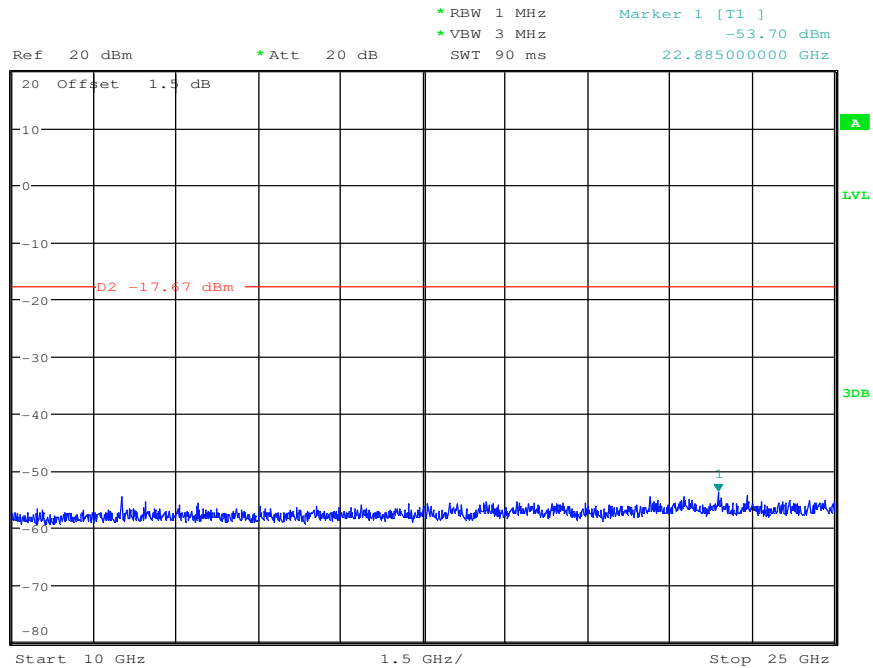




CSE\_2



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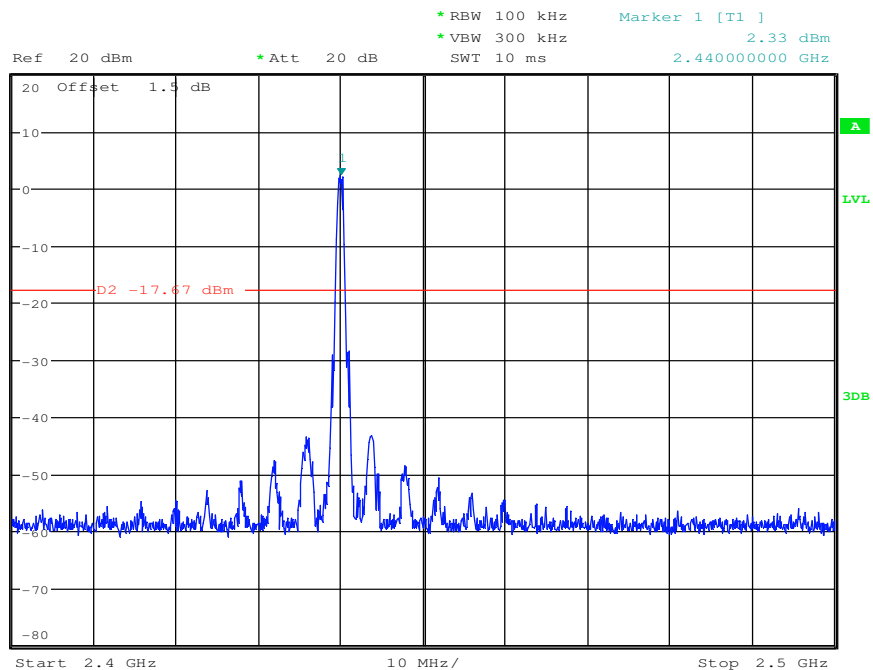


RF Conducted Spurious Emissions\_BLE\_2440\_Ant1

Pref



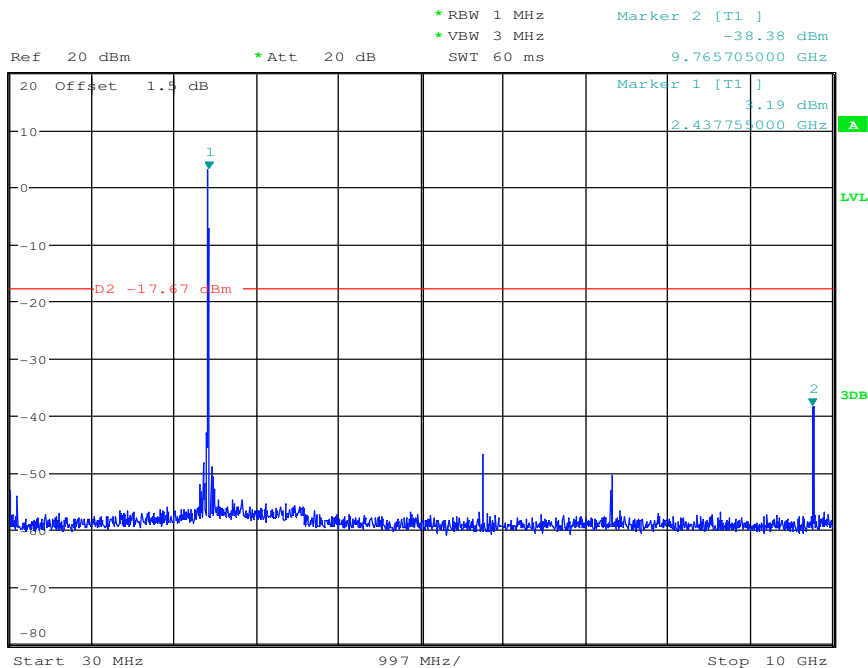
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VIEW



CSE\_1



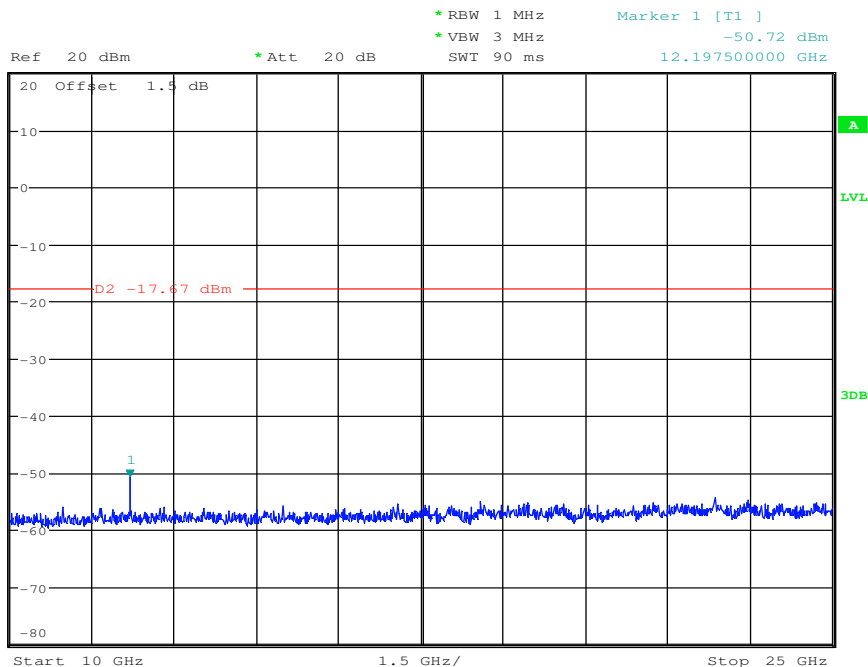
1 PK  
VIEW

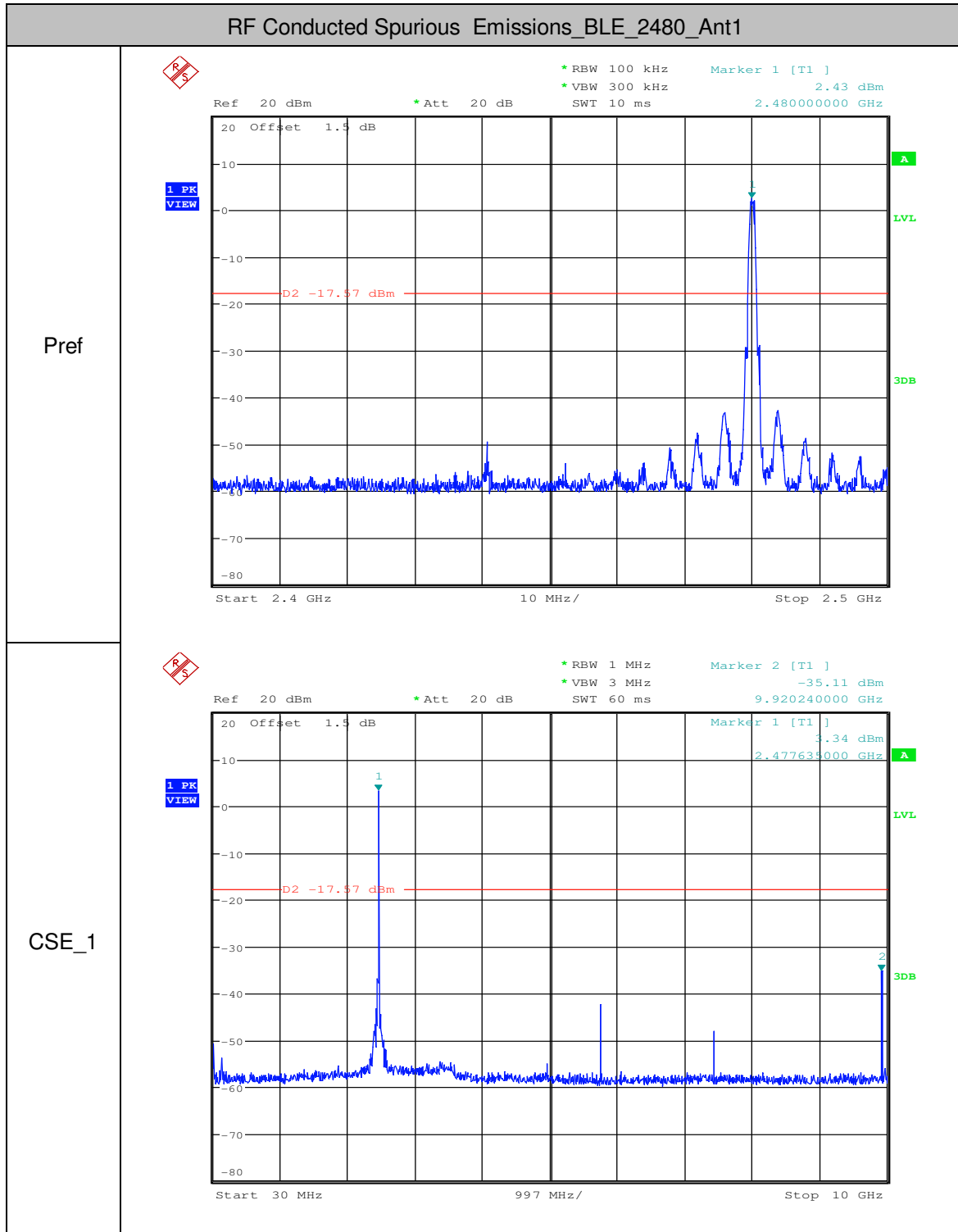


CSE\_2

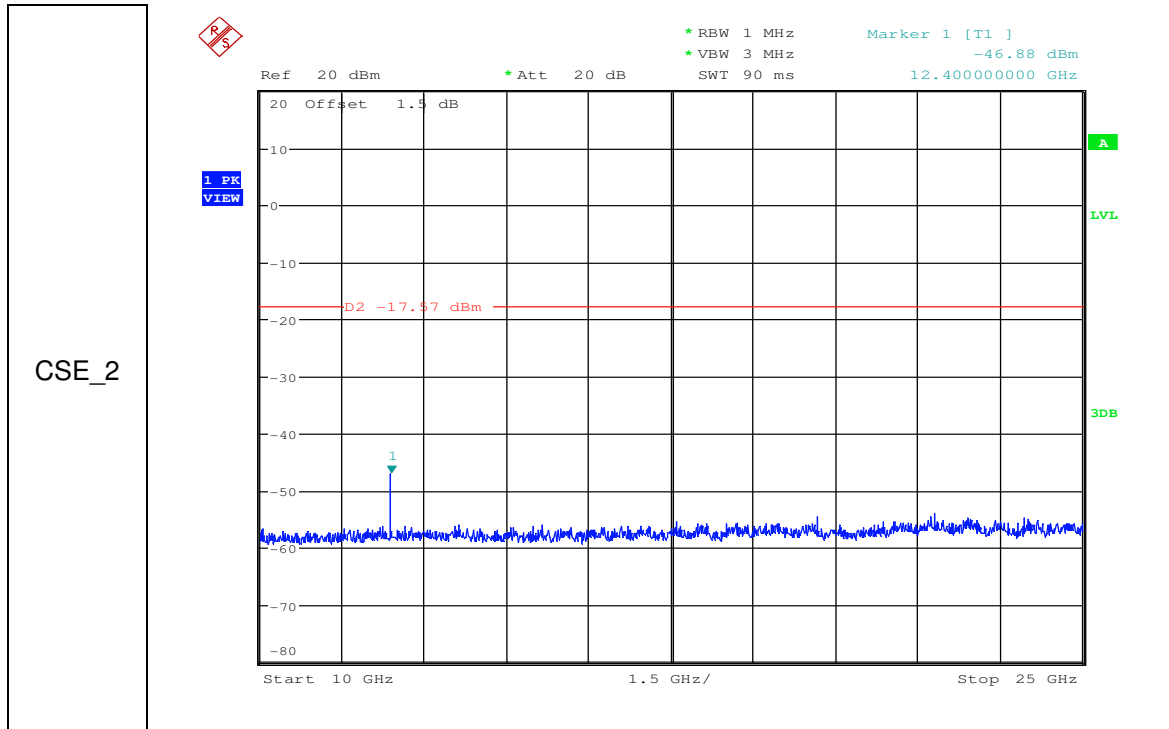


1 PK  
VIEW









- End of the Report -