



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

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Report No.: SZEM180400252002
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TEST REPORT

Application No.: SZEM1804002520CR
Applicant: Sensoro Co., LTD.
Address of Applicant: Room 2807 Building 1B, Wangjing SOHO, No 10 Wangjing Street,
Chaoyang District, Beijing, China
Manufacturer: Sensoro Co., LTD.
Address of Manufacturer: Room 2807 Building 1B, Wangjing SOHO, No 10 Wangjing Street,
Chaoyang District, Beijing, China
Factory: Sensoro Co., LTD.
Address of Factory: Room 2807 Building 1B, Wangjing SOHO, No 10 Wangjing Street,
Chaoyang District, Beijing, China

Equipment Under Test (EUT):

EUT Name: α Humiture Sensor
Model No.: IEQ.TH-14B
Trade mark: SENSORO
FCC ID: 2ADYO-S0015B5
Standard(s) : 47 CFR Part 15, Subpart C 15.247
Date of Receipt: 2018-04-03
Date of Test: 2018-04-19 to 2018-05-25
Date of Issue: 2018-06-06

| | |
|---------------------|--------------|
| Test Result: | Pass* |
|---------------------|--------------|

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





Keny Xu
EMC Laboratory 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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| <i>Revision Record</i> | | | | |
|------------------------|----------------|-------------|-----------------|---------------|
| <i>Version</i> | <i>Chapter</i> | <i>Date</i> | <i>Modifier</i> | <i>Remark</i> |
| 01 | | 2018-06-06 | | Original |
| | | | | |
| | | | | |

| Authorized for issue by: | | | | |
|--------------------------|--|---|--|--|
| | |  | | |
| | | <hr/> | | |
| | | Vincent Chen /Project Engineer | | |
| | |  | | |
| | | <hr/> | | |
| | | Eric Fu /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) | Pass |

| 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 |



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4 General Information

4.1 Details of E.U.T.

| | |
|---------------------|------------------------------------|
| Power supply: | Powered by Lithium Battery DC 3.6V |
| Antenna Gain | 0.96dBi |
| Antenna Type | PCB Antenna |
| Channel Spacing | 2MHz |
| Modulation Type | GFSK |
| Number of Channels | 40 |
| Operation Frequency | 2402MHz to 2480MHz |

4.2 Description of Support Units

The EUT has been tested as an independent unit.

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 | RF conducted power | $\pm 0.75\text{dB}$ |
| 5 | RF power density | $\pm 2.84\text{dB}$ |
| 6 | Conducted Spurious emissions | $\pm 0.75\text{dB}$ |
| 7 | RF Radiated power | $\pm 4.5\text{dB}$ (below 1GHz) |
| | | $\pm 4.8\text{dB}$ (above 1GHz) |
| 8 | Radiated Spurious emission test | $\pm 4.5\text{dB}$ (Below 1GHz) |
| | | $\pm 4.8\text{dB}$ (Above 1GHz) |
| 9 | Temperature test | $\pm 1^\circ\text{C}$ |
| 10 | Humidity test | $\pm 3\%$ |
| 11 | Supply voltages | $\pm 1.5\%$ |
| 12 | 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.

Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

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.

- **Industry Canada (IC)**

Two 3m Semi-anechoic chambers and the 10m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1, 4620C-2, 4620C-3.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None



5 Equipment List

| Minimum 6dB Bandwidth | | | | | |
|-----------------------|----------------------|-------------------------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2017-09-27 | 2018-09-26 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2017-09-27 | 2018-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2017-07-13 | 2018-07-12 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2017-09-27 | 2018-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2017-09-27 | 2018-09-26 |

| Conducted Peak Output Power | | | | | |
|-----------------------------|----------------------|-------------------------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2017-09-27 | 2018-09-26 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2017-09-27 | 2018-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2017-07-13 | 2018-07-12 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2017-09-27 | 2018-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2017-09-27 | 2018-09-26 |

| Power Spectrum Density | | | | | |
|------------------------|----------------------|-------------------------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2017-09-27 | 2018-09-26 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2017-09-27 | 2018-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2017-07-13 | 2018-07-12 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2017-09-27 | 2018-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2017-09-27 | 2018-09-26 |

| Conducted Band Edges Measurement | | | | | |
|----------------------------------|----------------------|-------------------------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2017-09-27 | 2018-09-26 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2017-09-27 | 2018-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2017-07-13 | 2018-07-12 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2017-09-27 | 2018-09-26 |



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| | | | | | |
|-------------|-----------------|------|-----------|------------|------------|
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2017-09-27 | 2018-09-26 |
|-------------|-----------------|------|-----------|------------|------------|

| Conducted Spurious Emissions | | | | | |
|-------------------------------------|----------------------|-------------------------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2017-09-27 | 2018-09-26 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2017-09-27 | 2018-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2017-07-13 | 2018-07-12 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2017-09-27 | 2018-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2017-09-27 | 2018-09-26 |

| Radiated Emissions which fall in the restricted bands | | | | | |
|--|------------------------------------|-------------------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| 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 | 2017-07-13 | 2018-07-12 |
| Spectrum Analyzer | Rohde & Schwarz | FSU43 | SEM004-08 | 2018-04-02 | 2019-04-01 |
| BiConiLog Antenna (26-3000MHz) | ETS-Lindgren | 3142C | SEM003-01 | 2017-06-27 | 2020-06-26 |
| 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 (0.1-1300MHz) | HP | 8447D | SEM005-02 | 2017-09-27 | 2018-09-26 |
| Low Noise Amplifier(100MHz-18GHz) | Black Diamond Series | BDLNA-0118-352810 | SEM005-05 | 2017-09-27 | 2018-09-27 |
| Pre-amplifier(18-26GHz) | Rohde & Schwarz | CH14-H052 | SEM005-17 | 2018-04-02 | 2019-04-01 |
| Pre-amplifier (26GHz-40GHz) | Compliance Directions Systems Inc. | PAP-2640-50 | SEM005-08 | 2018-04-02 | 2019-04-01 |
| DC Power Supply | Zhao Xin | RXN-305D | SEM011-02 | 2017-09-27 | 2018-09-26 |
| Active Loop Antenna | ETS-Lindgren | 6502 | SEM003-08 | 2017-08-22 | 2020-08-21 |
| Band filter | N/A | N/A | SEM023-01 | N/A | N/A |



| Radiated Spurious Emissions | | | | | |
|------------------------------------|------------------------------------|-------------------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| 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 | 2017-07-13 | 2018-07-12 |
| Spectrum Analyzer | Rohde & Schwarz | FSU43 | SEM004-08 | 2018-04-02 | 2019-04-01 |
| BiConiLog Antenna (26-3000MHz) | ETS-Lindgren | 3142C | SEM003-01 | 2017-06-27 | 2020-06-26 |
| 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 (0.1-1300MHz) | HP | 8447D | SEM005-02 | 2017-09-27 | 2018-09-26 |
| Low Noise Amplifier (100MHz-18GHz) | Black Diamond Series | BDLNA-0118-352810 | SEM005-05 | 2017-09-27 | 2018-09-27 |
| Pre-amplifier(18-26GHz) | Rohde & Schwarz | CH14-H052 | SEM005-17 | 2018-04-02 | 2019-04-01 |
| Pre-amplifier (26GHz-40GHz) | Compliance Directions Systems Inc. | PAP-2640-50 | SEM005-08 | 2018-04-02 | 2019-04-01 |
| DC Power Supply | Zhao Xin | RXN-305D | SEM011-02 | 2017-09-27 | 2018-09-26 |
| Active Loop Antenna | ETS-Lindgren | 6502 | SEM003-08 | 2017-08-22 | 2020-08-21 |
| Band filter | N/A | N/A | SEM023-01 | N/A | N/A |

| General used equipment | | | | | |
|---------------------------------|---|----------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| Humidity/ Temperature Indicator | Shanghai Meteorological Industry Factory | ZJ1-2B | SEM002-03 | 2017-09-29 | 2018-09-28 |
| Humidity/ Temperature Indicator | Shanghai Meteorological Industry Factory | ZJ1-2B | SEM002-04 | 2017-09-29 | 2018-09-28 |
| Humidity/ Temperature Indicator | Mingle | N/A | SEM002-08 | 2017-09-29 | 2018-09-28 |
| Barometer | Changchun Meteorological Industry Factory | DYM3 | SEM002-01 | 2018-04-08 | 2019-04-07 |

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 PCB antenna on the main PCB and no consideration of replacement. The best case gain of the antenna is 0.96dBi.

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: | ≥500 kHz |

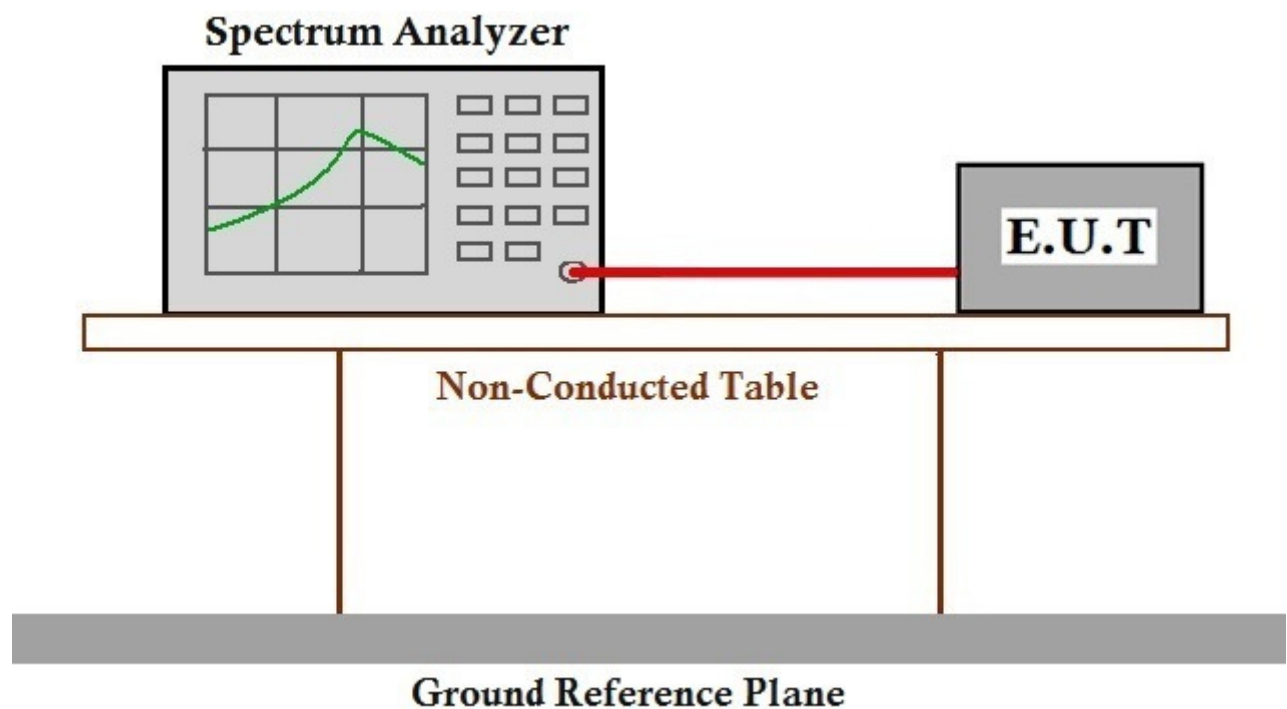
7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 23.4 °C Humidity: 45.8 % RH Atmospheric Pressure: 1020 mbar

Test mode b: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 15.247

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:

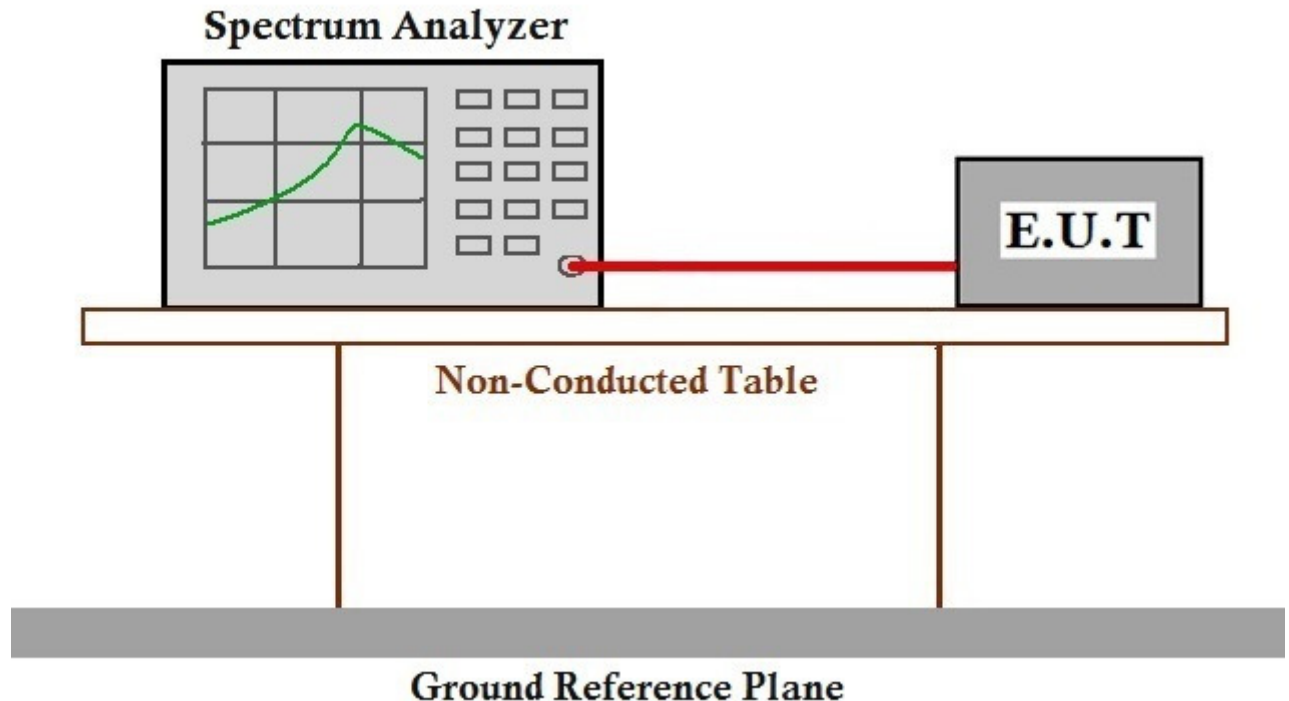
| Frequency range(MHz) | Output power of the intentional radiator(watt) |
|----------------------|--|
| 902-928 | 1 for ≥ 50 hopping channels |
| | 0.25 for $25 \leq$ hopping channels < 50 |
| | 1 for digital modulation |
| 2400-2483.5 | 1 for ≥ 75 non-overlapping hopping channels |
| | 0.125 for all 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: 23.4 °C Humidity: 45.8 % RH Atmospheric Pressure: 1020 mbar
 Test mode b: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

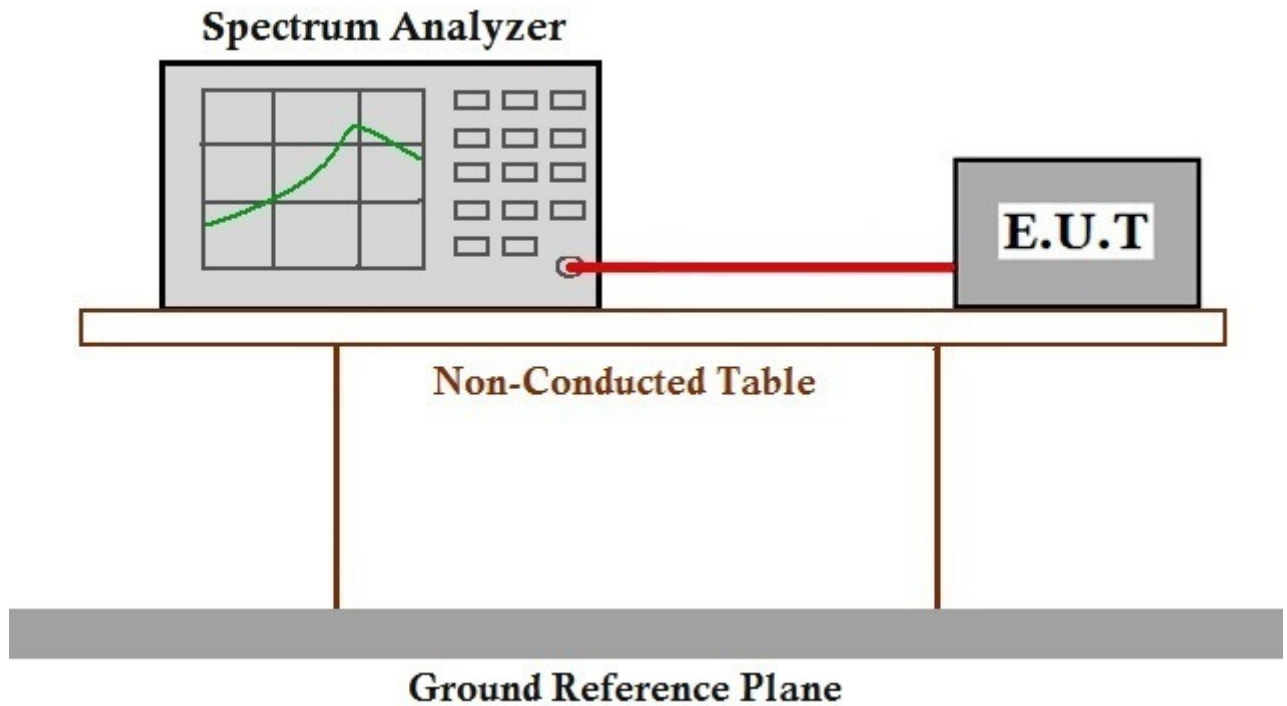
7.3 Power Spectrum Density

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: 23.4 °C Humidity: 45.7 % RH Atmospheric Pressure: 1020 mbar
 Test mode b: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

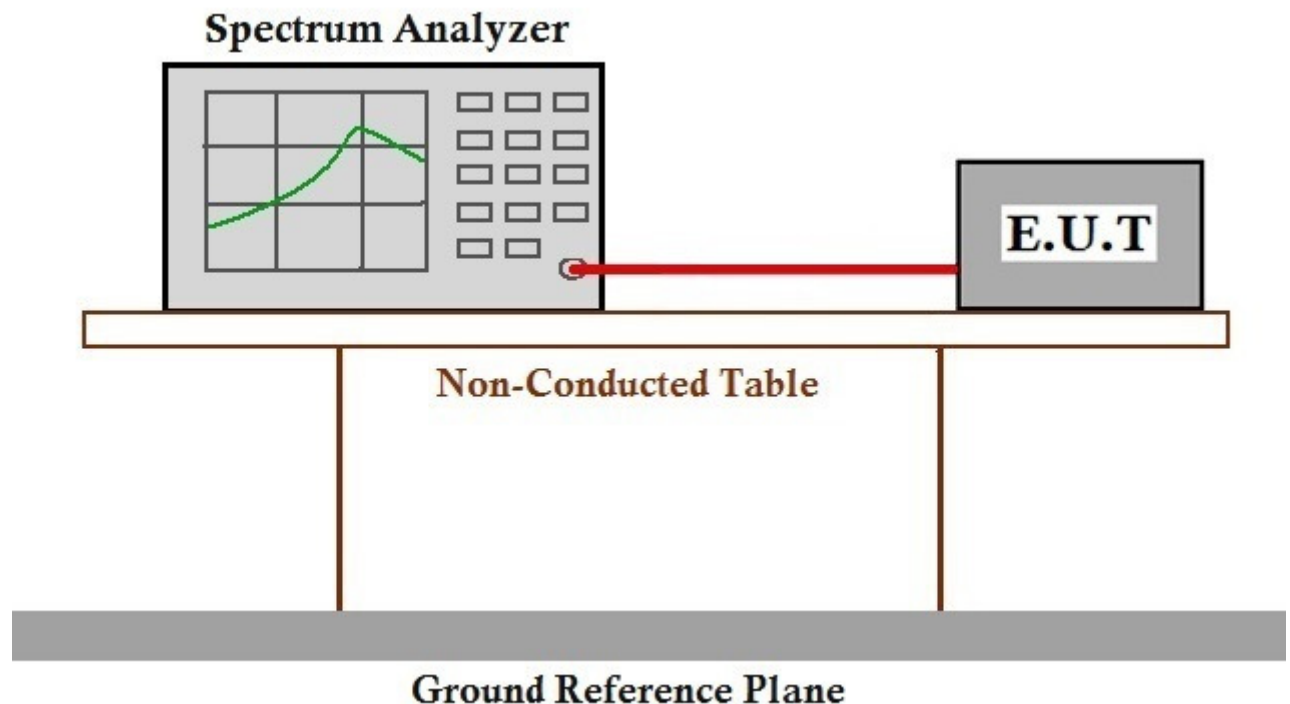
7.4 Conducted Band Edges Measurement

| | |
|------------------|---|
| 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: | 23.4 °C | Humidity: | 45.8 % RH |
| | | Atmospheric Pressure: | 1020 mbar |
| Test mode | b: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

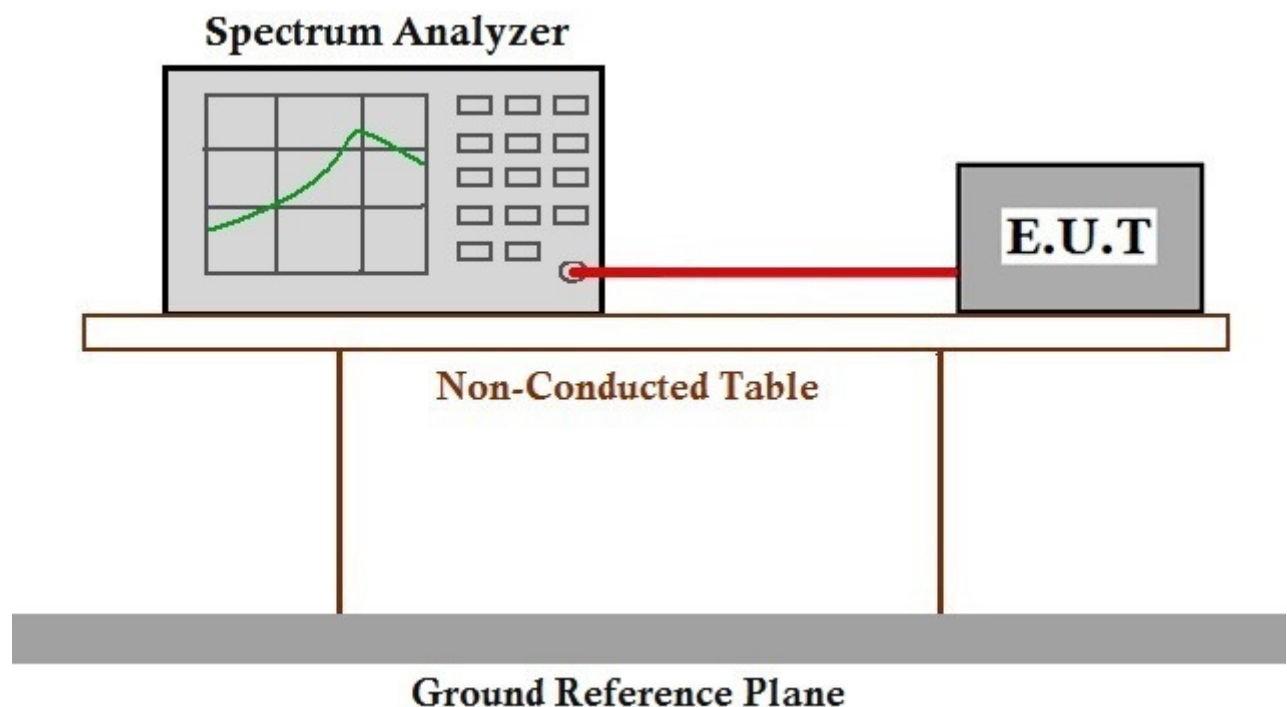
7.5 Conducted Spurious Emissions

| | |
|------------------|---|
| 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: | 23.4 °C | Humidity: | 45.7 % RH |
| | | Atmospheric Pressure: | 1020 mbar |
| Test mode | b: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 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.

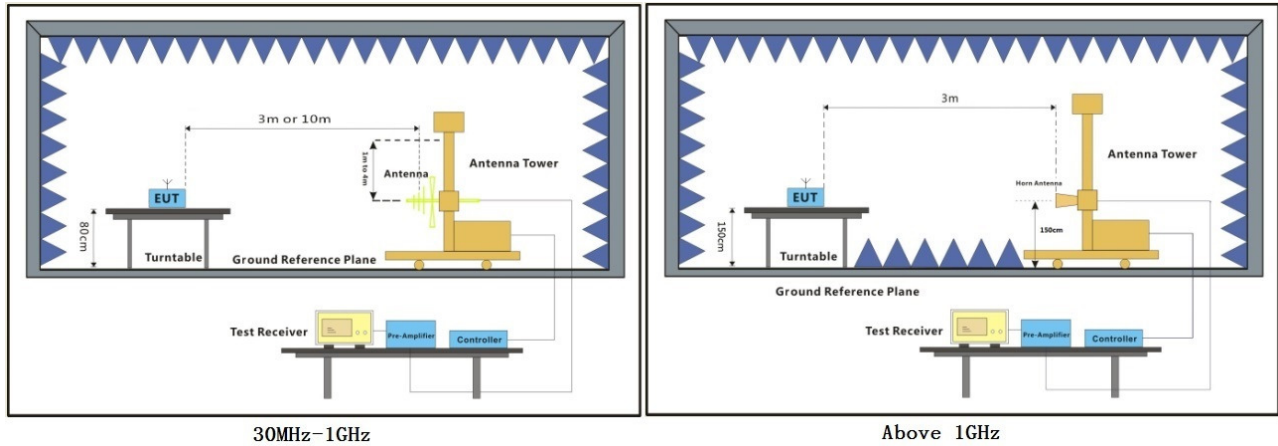
7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 20.1 °C Humidity: 50.8 % RH Atmospheric Pressure: 1020 mbar

Test mode b: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

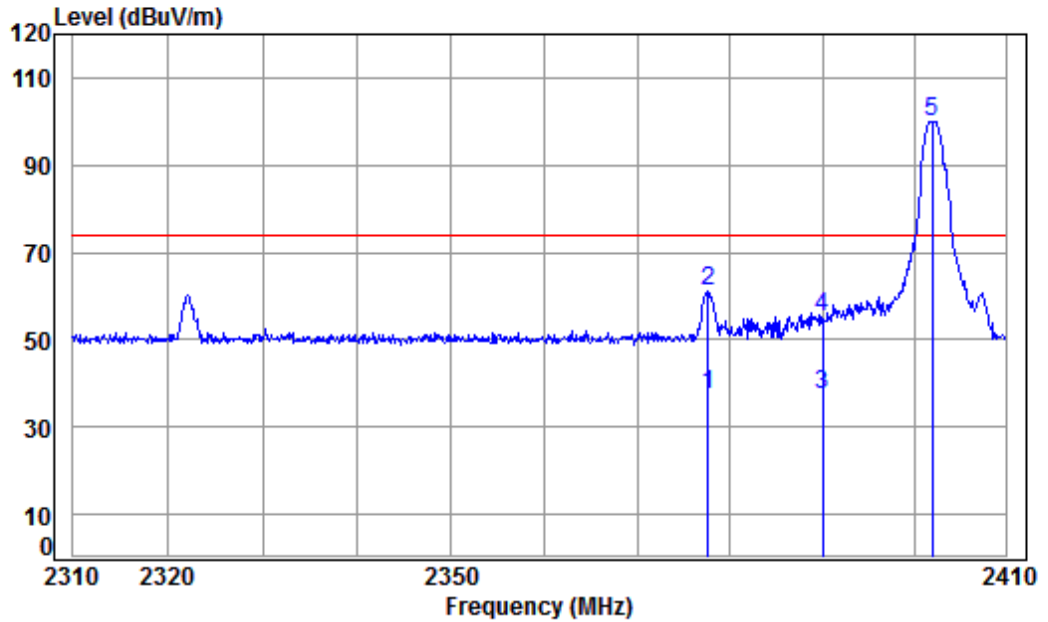
- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 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: 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:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

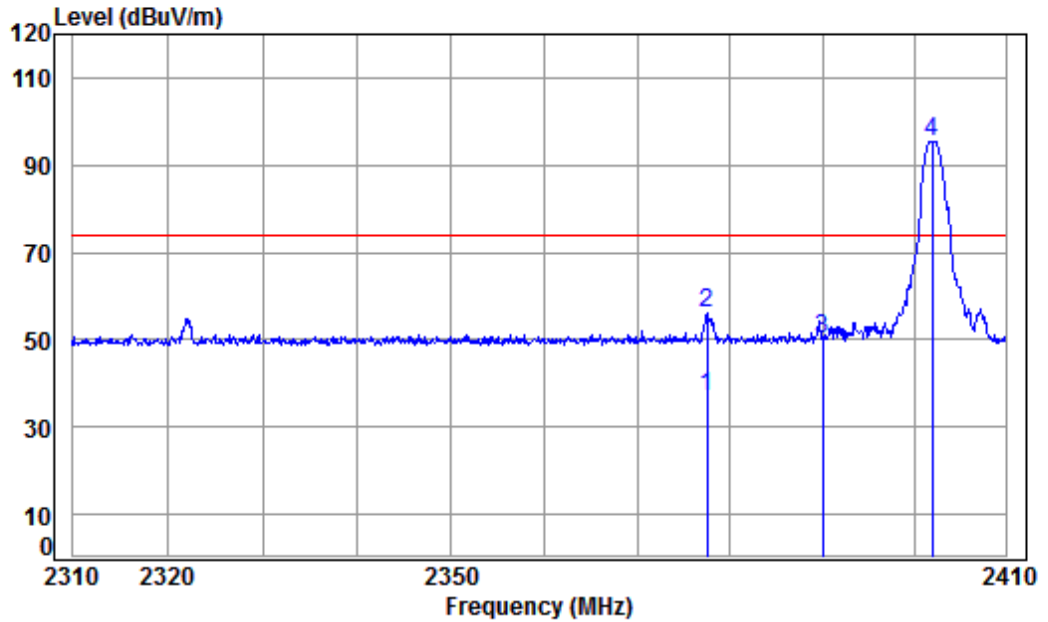


Condition: 3m HORIZONTAL
 Job No : 02520CR
 Mode : 2402 Band edge
 Note : BT

| | 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 | 2377.638 | 5.46 | 29.04 | 41.87 | 44.60 | 37.23 | 54.00 | -16.77 | Average |
| 2 | 2377.638 | 5.46 | 29.04 | 41.87 | 68.45 | 61.08 | 74.00 | -12.92 | peak |
| 3 av | 2390.000 | 5.47 | 29.08 | 41.87 | 44.61 | 37.29 | 54.00 | -16.71 | Average |
| 4 | 2390.000 | 5.47 | 29.08 | 41.87 | 62.46 | 55.14 | 74.00 | -18.86 | peak |
| 5 pp | 2402.000 | 5.49 | 29.11 | 41.88 | 107.28 | 100.00 | 74.00 | 26.00 | peak |



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

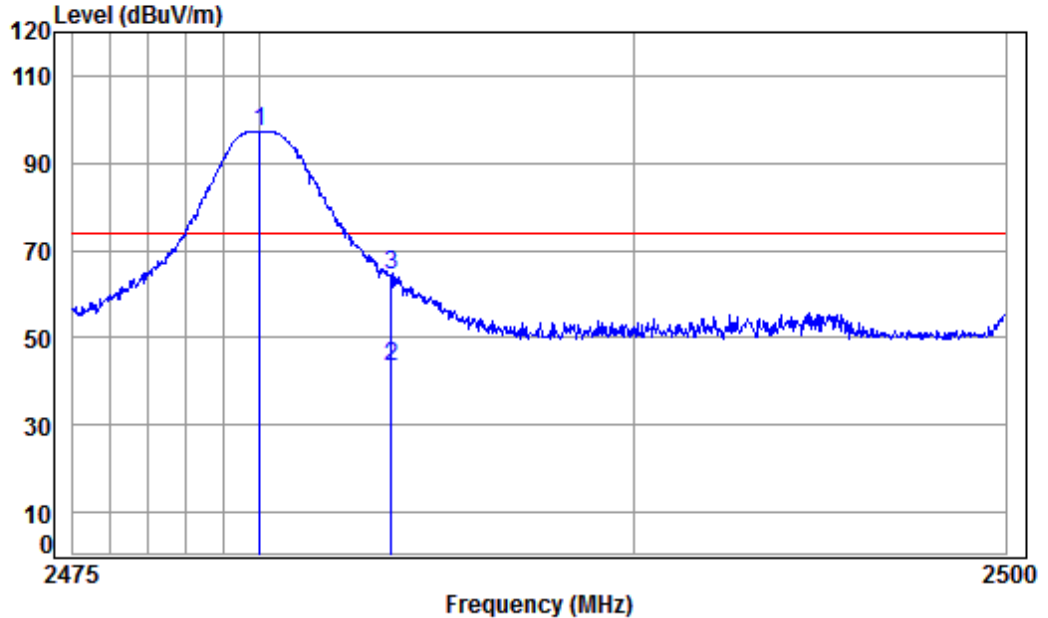


Condition: 3m VERTICAL
Job No : 02520CR
Mode : 2402 Band edge
Note : BT

| | | Cable | Ant | Preamp | Read | Limit | Over | | |
|---|-------------|-------|--------|--------|--------|--------|--------|--------|---------|
| | Freq | Loss | Factor | Factor | Level | Line | Limit | Remark | |
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | av 2377.538 | 5.46 | 29.04 | 41.87 | 44.20 | 36.83 | 54.00 | -17.17 | Average |
| 2 | 2377.538 | 5.46 | 29.04 | 41.87 | 63.66 | 56.29 | 74.00 | -17.71 | peak |
| 3 | 2390.000 | 5.47 | 29.08 | 41.87 | 57.57 | 50.25 | 74.00 | -23.75 | peak |
| 4 | pp 2402.000 | 5.49 | 29.11 | 41.88 | 102.58 | 95.30 | 74.00 | 21.30 | peak |



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

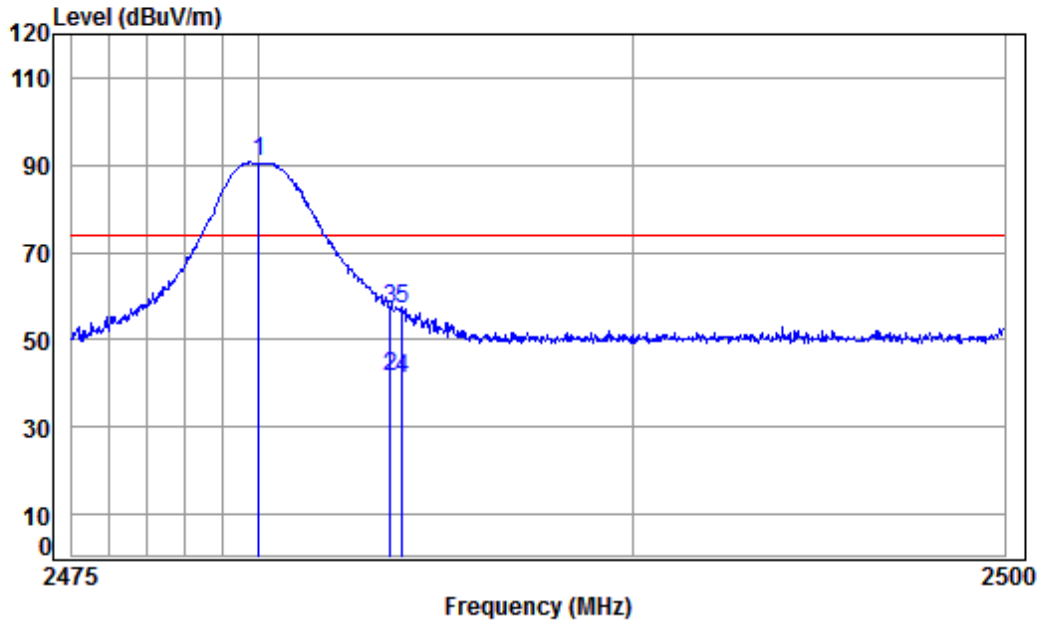


Condition: 3m HORIZONTAL
Job No : 02520CR
Mode : 2480 Band edge
Note : BT

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Limit Level | Over Limit | Remark |
|------|----------|------------|------------|---------------|------------|-------------|------------|----------------|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dB | |
| 1 pp | 2480.000 | 5.59 | 29.34 | 41.91 | 104.31 | 97.33 | 74.00 | 23.33 peak |
| 2 av | 2483.500 | 5.60 | 29.35 | 41.91 | 50.10 | 43.14 | 54.00 | -10.86 Average |
| 3 | 2483.500 | 5.60 | 29.35 | 41.91 | 71.40 | 64.44 | 74.00 | -9.56 peak |



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



Condition: 3m VERTICAL
Job No : 02520CR
Mode : 2480 Band edge
Note : BT

| | | 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 | pp 2480.000 | 5.59 | 29.34 | 41.91 | 97.58 | 90.60 | 74.00 | 16.60 | peak |
| 2 | av 2483.500 | 5.60 | 29.35 | 41.91 | 48.50 | 41.54 | 54.00 | -12.46 | Average |
| 3 | 2483.500 | 5.60 | 29.35 | 41.91 | 64.03 | 57.07 | 74.00 | -16.93 | peak |
| 4 | 2483.821 | 5.60 | 29.35 | 41.91 | 48.20 | 41.24 | 54.00 | -12.76 | Average |
| 5 | 2483.821 | 5.60 | 29.35 | 41.91 | 64.17 | 57.21 | 74.00 | -16.79 | peak |



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

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.

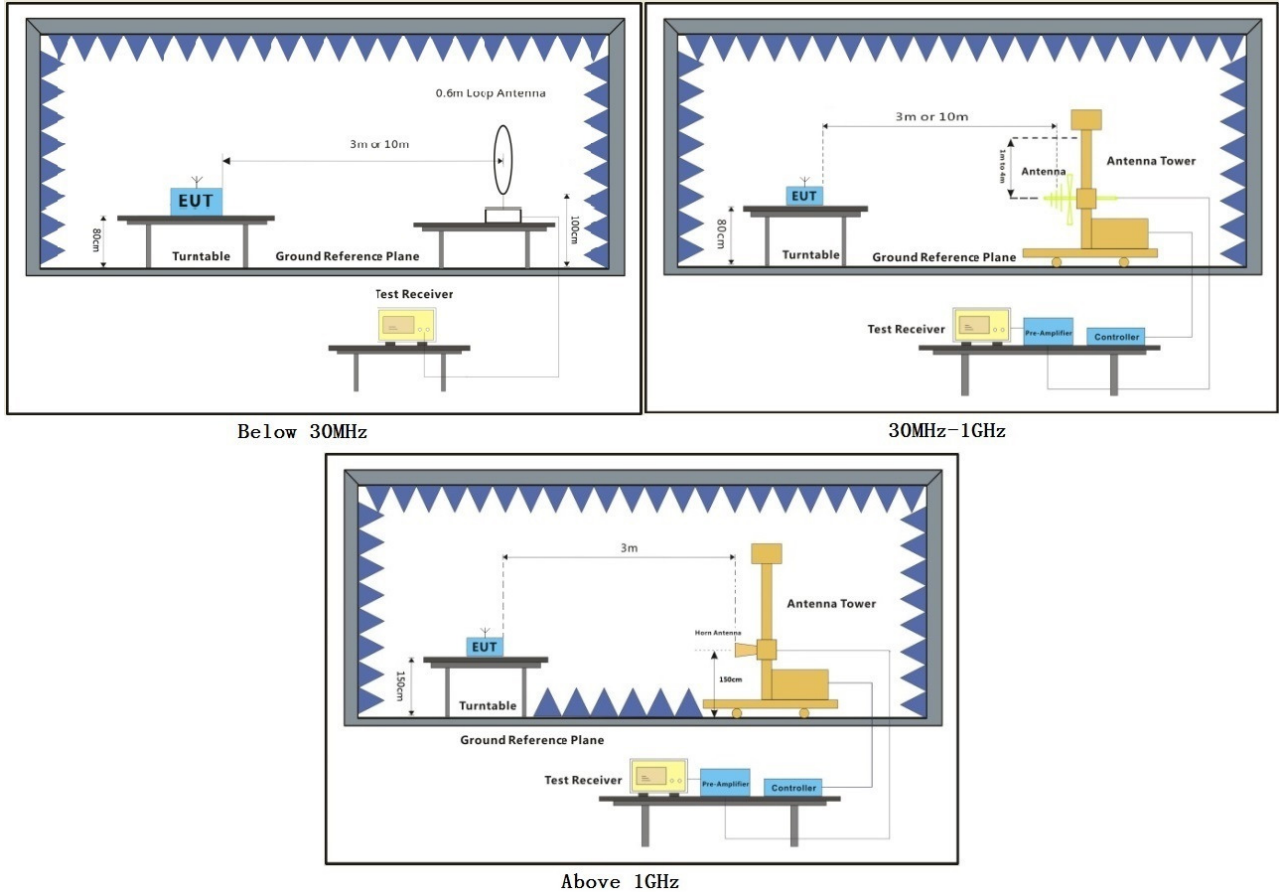
7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 23.5 °C Humidity: 55 % RH Atmospheric Pressure: 1020 mbar

Test mode b: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

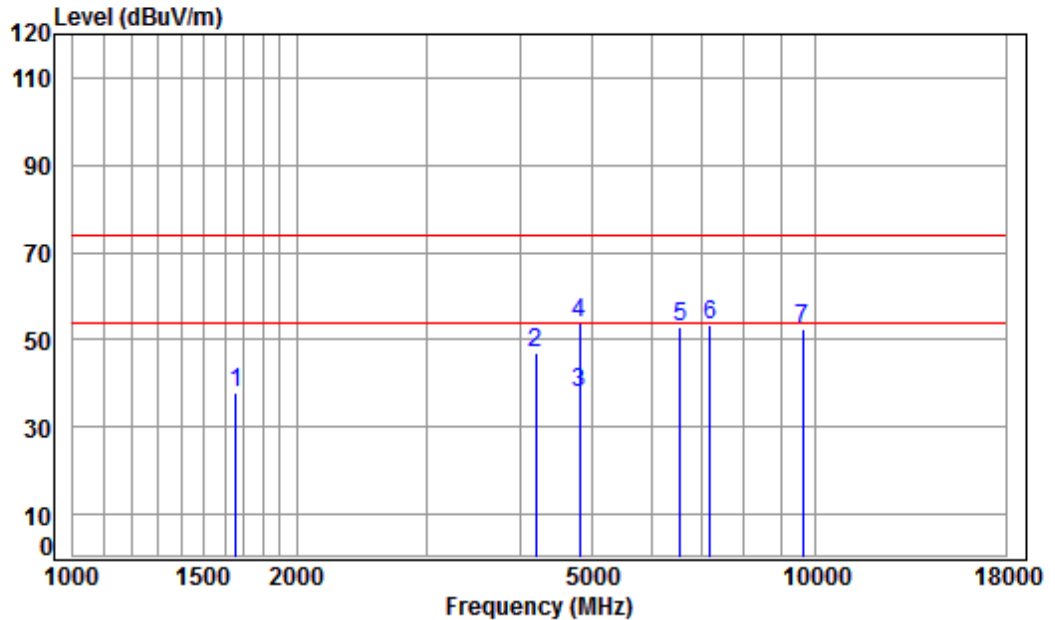
- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 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 in the report.



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

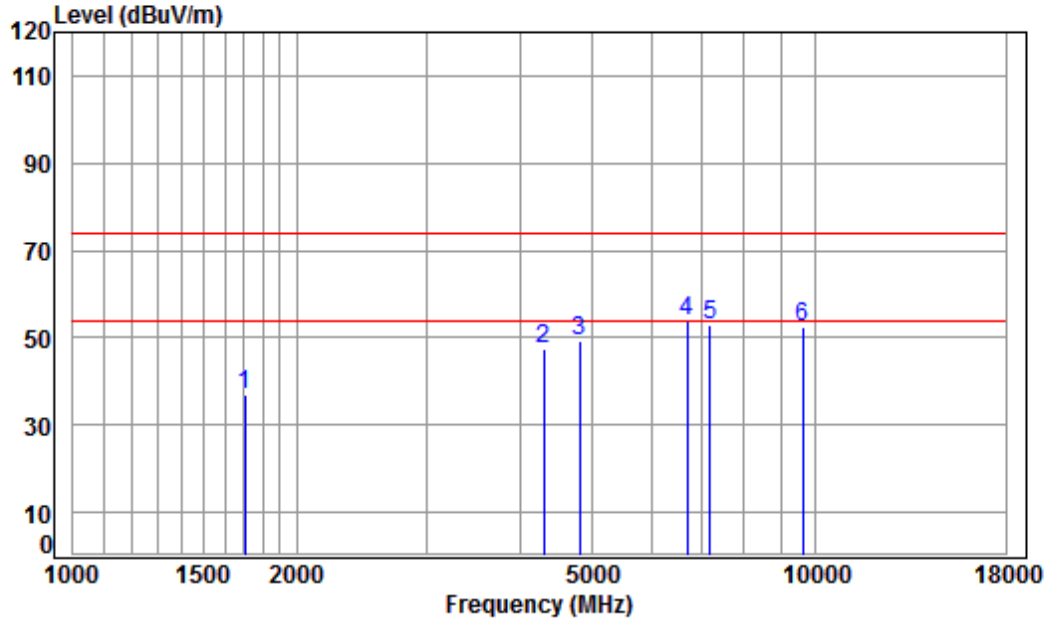


Condition: 3m HORIZONTAL
Job No : 02520CR
Mode : 2402 TX SE
Note :

| | 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 | 1658.337 | 5.28 | 26.50 | 41.51 | 47.74 | 38.01 | 74.00 | -35.99 | peak |
| 2 | 4193.872 | 7.21 | 33.60 | 42.36 | 48.74 | 47.19 | 74.00 | -26.81 | peak |
| 3 | pp 4804.000 | 7.89 | 34.16 | 42.47 | 38.30 | 37.88 | 54.00 | -16.12 | Average |
| 4 | pk 4804.000 | 7.89 | 34.16 | 42.47 | 54.18 | 53.76 | 74.00 | -20.24 | peak |
| 5 | 6564.209 | 11.35 | 35.29 | 41.17 | 47.49 | 52.96 | 74.00 | -21.04 | peak |
| 6 | 7206.000 | 10.08 | 36.42 | 40.71 | 47.67 | 53.46 | 74.00 | -20.54 | peak |
| 7 | 9608.000 | 10.75 | 37.52 | 37.74 | 41.99 | 52.52 | 74.00 | -21.48 | peak |



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

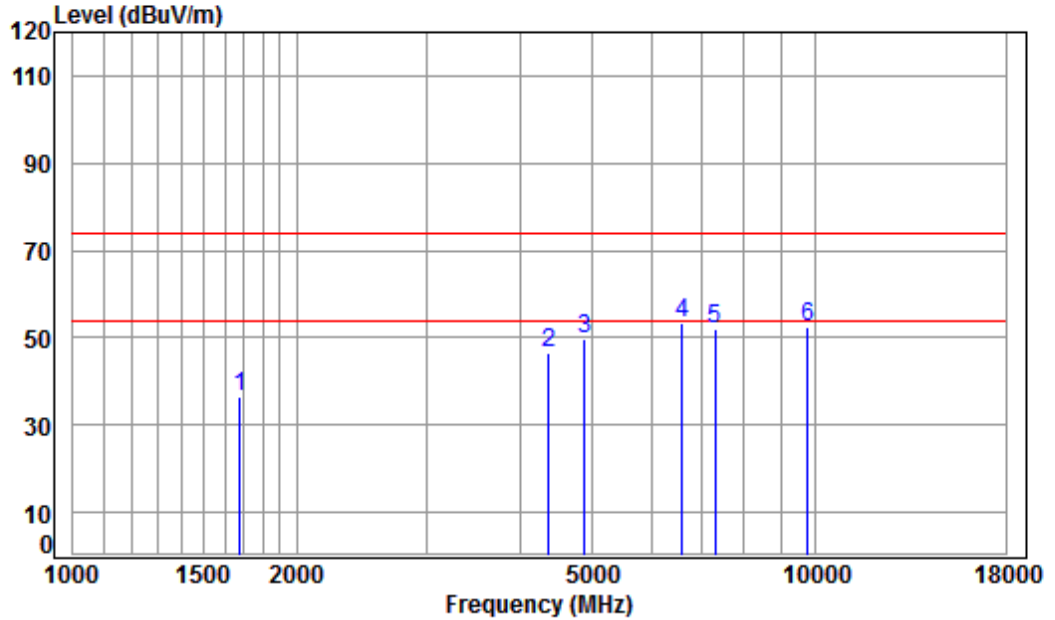


Condition: 3m VERTICAL
Job No : 02520CR
Mode : 2402 TX SE
Note :

| | 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 | 1702.042 | 5.23 | 26.68 | 41.53 | 46.54 | 36.92 | 74.00 | -37.08 | peak |
| 2 | 4304.400 | 7.34 | 33.60 | 42.38 | 48.75 | 47.31 | 74.00 | -26.69 | peak |
| 3 | 4804.000 | 7.89 | 34.16 | 42.47 | 49.80 | 49.38 | 74.00 | -24.62 | peak |
| 4 pp | 6717.762 | 10.91 | 35.72 | 41.05 | 48.23 | 53.81 | 74.00 | -20.19 | peak |
| 5 | 7206.000 | 10.08 | 36.42 | 40.71 | 47.30 | 53.09 | 74.00 | -20.91 | peak |
| 6 | 9608.000 | 10.75 | 37.52 | 37.74 | 42.04 | 52.57 | 74.00 | -21.43 | peak |



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



Condition: 3m HORIZONTAL

Job No : 02520CR

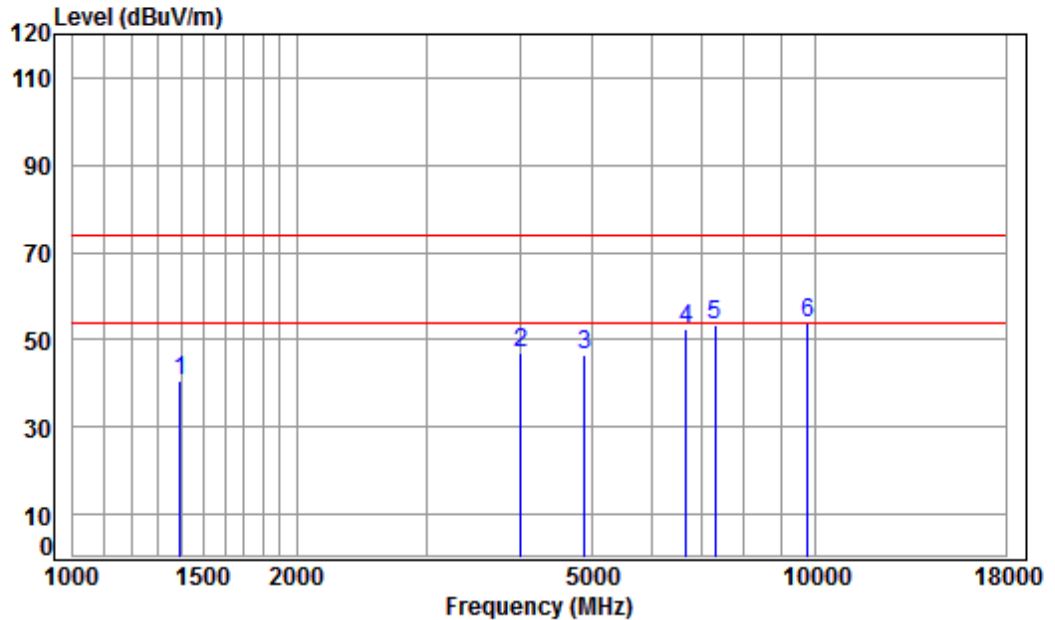
Mode : 2440 TX SE

Note :

| | 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 | 1677.621 | 5.25 | 26.58 | 41.52 | 46.17 | 36.48 | 74.00 | -37.52 | peak |
| 2 | 4367.058 | 7.41 | 33.60 | 42.39 | 47.72 | 46.34 | 74.00 | -27.66 | peak |
| 3 | 4880.000 | 7.97 | 34.29 | 42.48 | 50.07 | 49.85 | 74.00 | -24.15 | peak |
| 4 pp | 6602.265 | 11.24 | 35.39 | 41.14 | 47.95 | 53.44 | 74.00 | -20.56 | peak |
| 5 | 7320.000 | 10.05 | 36.37 | 40.63 | 46.24 | 52.03 | 74.00 | -21.97 | peak |
| 6 | 9760.000 | 10.82 | 37.55 | 37.53 | 41.81 | 52.65 | 74.00 | -21.35 | peak |



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

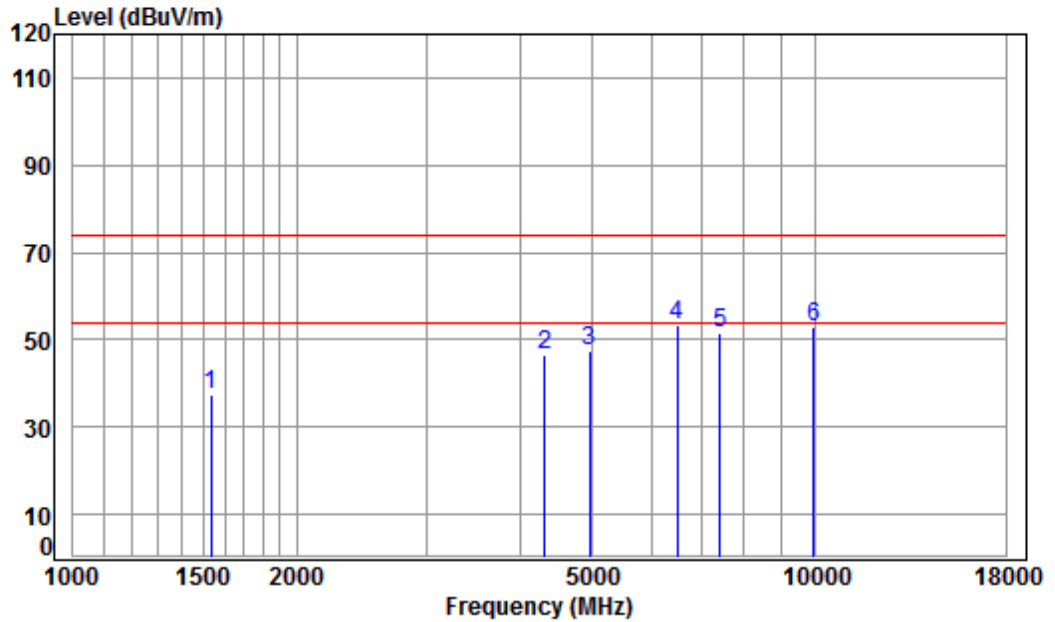


Condition: 3m VERTICAL
 Job No : 02520CR
 Mode : 2440 TX SE
 Note :

| | 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 | 1394.300 | 5.13 | 25.37 | 41.33 | 51.30 | 40.47 | 74.00 | -33.53 | peak |
| 2 | 4004.339 | 6.99 | 33.60 | 42.33 | 48.61 | 46.87 | 74.00 | -27.13 | peak |
| 3 | 4880.000 | 7.97 | 34.29 | 42.48 | 46.96 | 46.74 | 74.00 | -27.26 | peak |
| 4 | 6698.373 | 10.97 | 35.67 | 41.07 | 46.67 | 52.24 | 74.00 | -21.76 | peak |
| 5 | 7320.000 | 10.05 | 36.37 | 40.63 | 47.41 | 53.20 | 74.00 | -20.80 | peak |
| 6 | pp 9760.000 | 10.82 | 37.55 | 37.53 | 42.95 | 53.79 | 74.00 | -20.21 | peak |



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

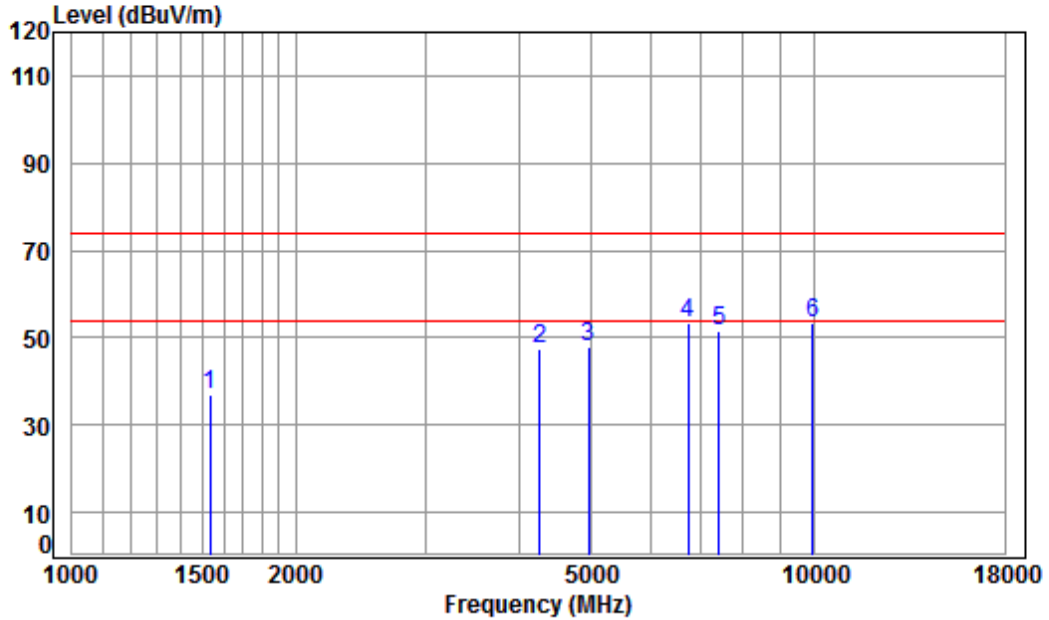


Condition: 3m HORIZONTAL
 Job No : 02520CR
 Mode : 2480 TX SE
 Note :

| | 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 | 1533.841 | 5.44 | 25.96 | 41.43 | 47.29 | 37.26 | 74.00 | -36.74 | peak |
| 2 | 4316.859 | 7.36 | 33.60 | 42.38 | 48.15 | 46.73 | 74.00 | -27.27 | peak |
| 3 | 4960.000 | 8.05 | 34.43 | 42.49 | 47.63 | 47.62 | 74.00 | -26.38 | peak |
| 4 pp | 6507.536 | 11.52 | 35.12 | 41.21 | 47.96 | 53.39 | 74.00 | -20.61 | peak |
| 5 | 7440.000 | 10.02 | 36.32 | 40.56 | 45.97 | 51.75 | 74.00 | -22.25 | peak |
| 6 | 9920.000 | 10.90 | 37.58 | 37.31 | 41.88 | 53.05 | 74.00 | -20.95 | peak |



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



Condition: 3m VERTICAL
Job No : 02520CR
Mode : 2480 TX SE
Note :

| | 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 | 1533.841 | 5.44 | 25.96 | 41.43 | 47.05 | 37.02 | 74.00 | -36.98 | peak |
| 2 | 4267.237 | 7.30 | 33.60 | 42.38 | 48.83 | 47.35 | 74.00 | -26.65 | peak |
| 3 | 4960.000 | 8.05 | 34.43 | 42.49 | 47.84 | 47.83 | 74.00 | -26.17 | peak |
| 4 | 6756.708 | 10.80 | 35.83 | 41.03 | 47.63 | 53.23 | 74.00 | -20.77 | peak |
| 5 | 7440.000 | 10.02 | 36.32 | 40.56 | 45.62 | 51.40 | 74.00 | -22.60 | peak |
| 6 | 9920.000 | 10.90 | 37.58 | 37.31 | 42.09 | 53.26 | 74.00 | -20.74 | peak |

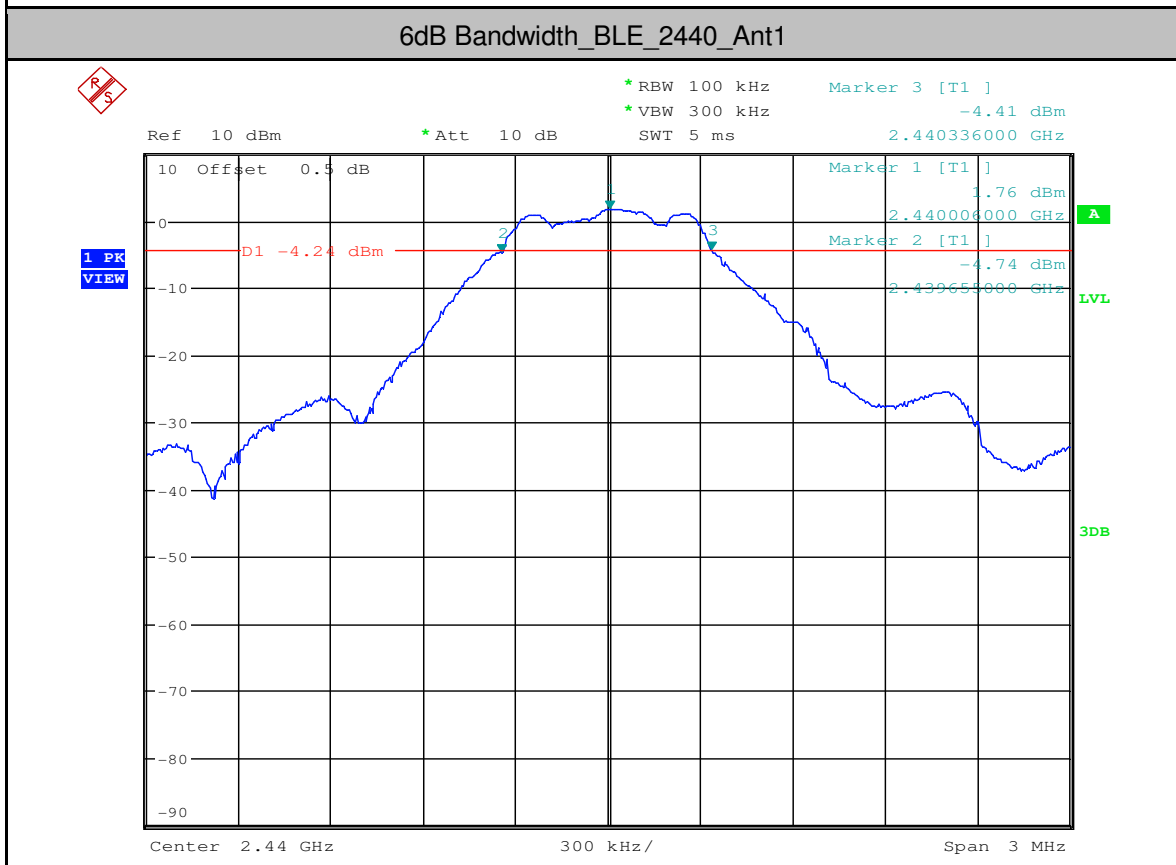
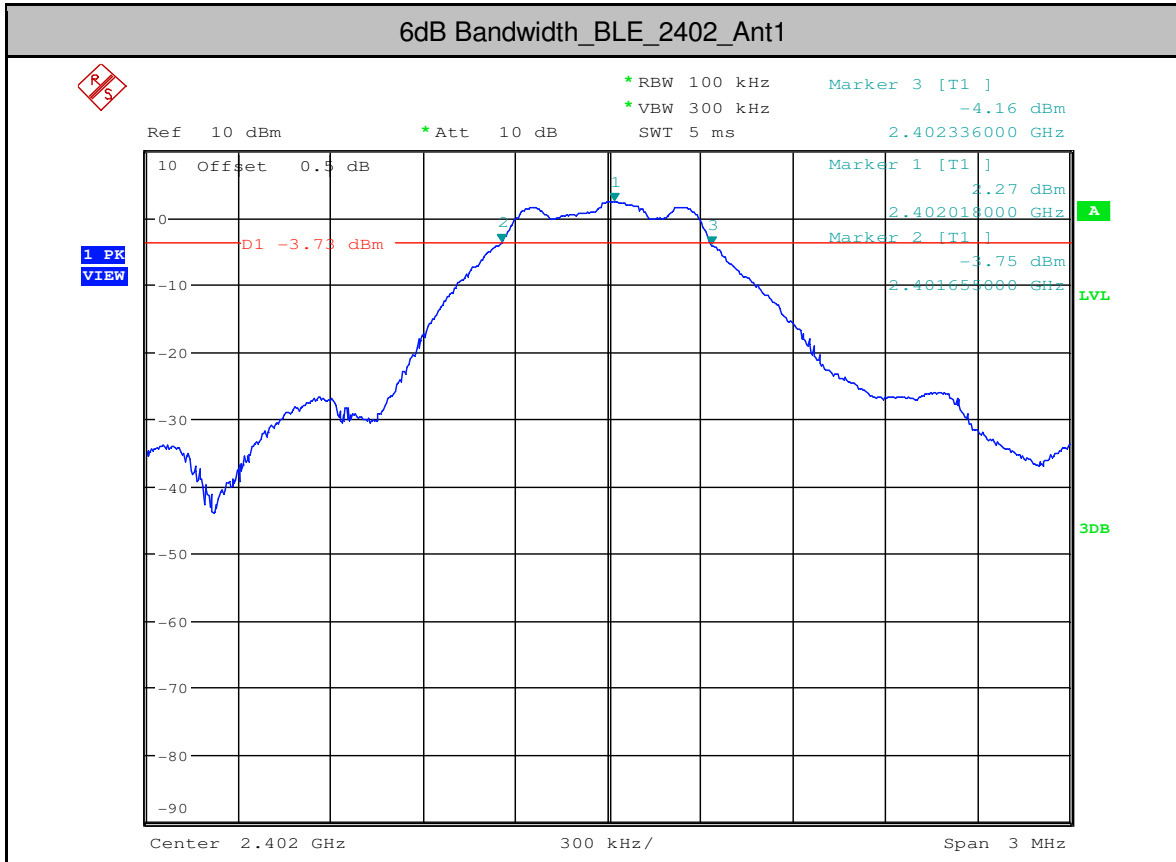


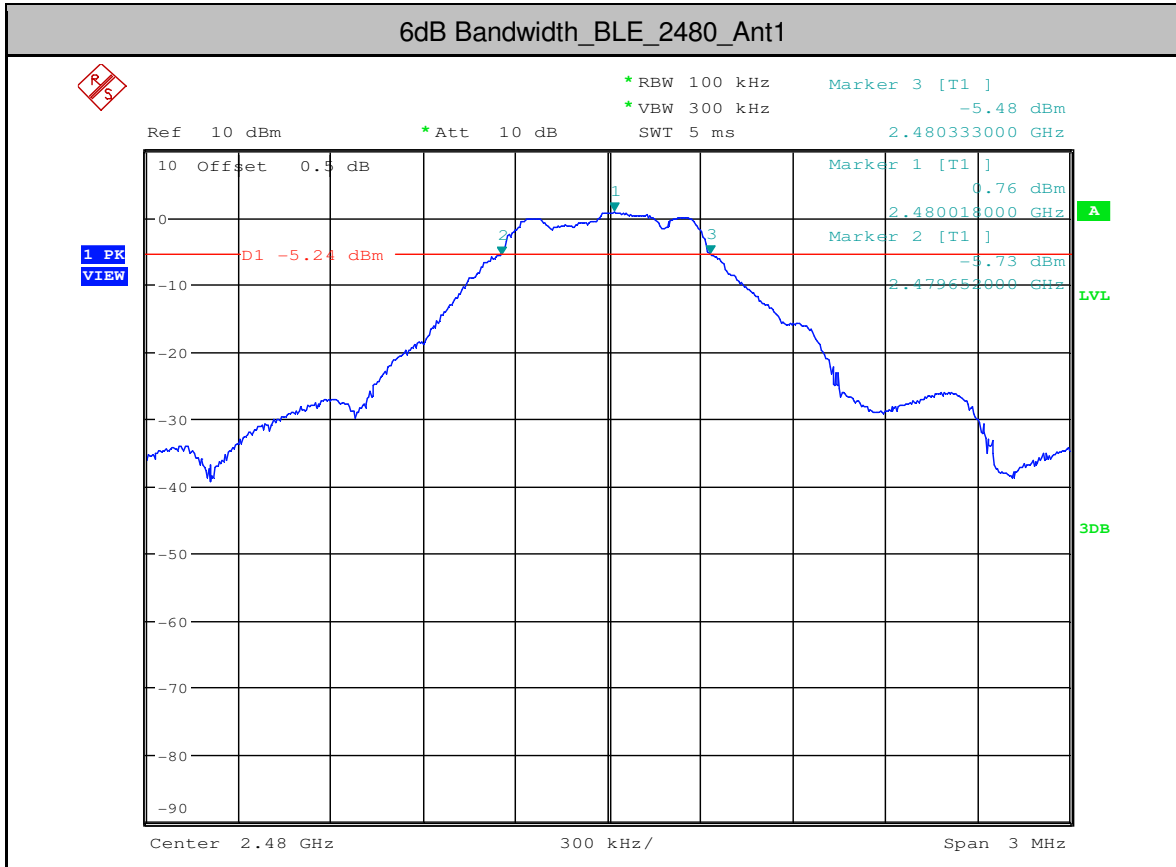
8 Appendix

Appendix 15.247

1.6dB Bandwidth

| Test Mode | Test Channel | Ant | EBW[MHz] | Limit[MHz] | Verdict |
|-----------|--------------|------|----------|------------|---------|
| BLE | 2402 | Ant1 | 0.681 | ≥ 0.5 | PASS |
| BLE | 2440 | Ant1 | 0.681 | ≥ 0.5 | PASS |
| BLE | 2480 | Ant1 | 0.681 | ≥ 0.5 | PASS |

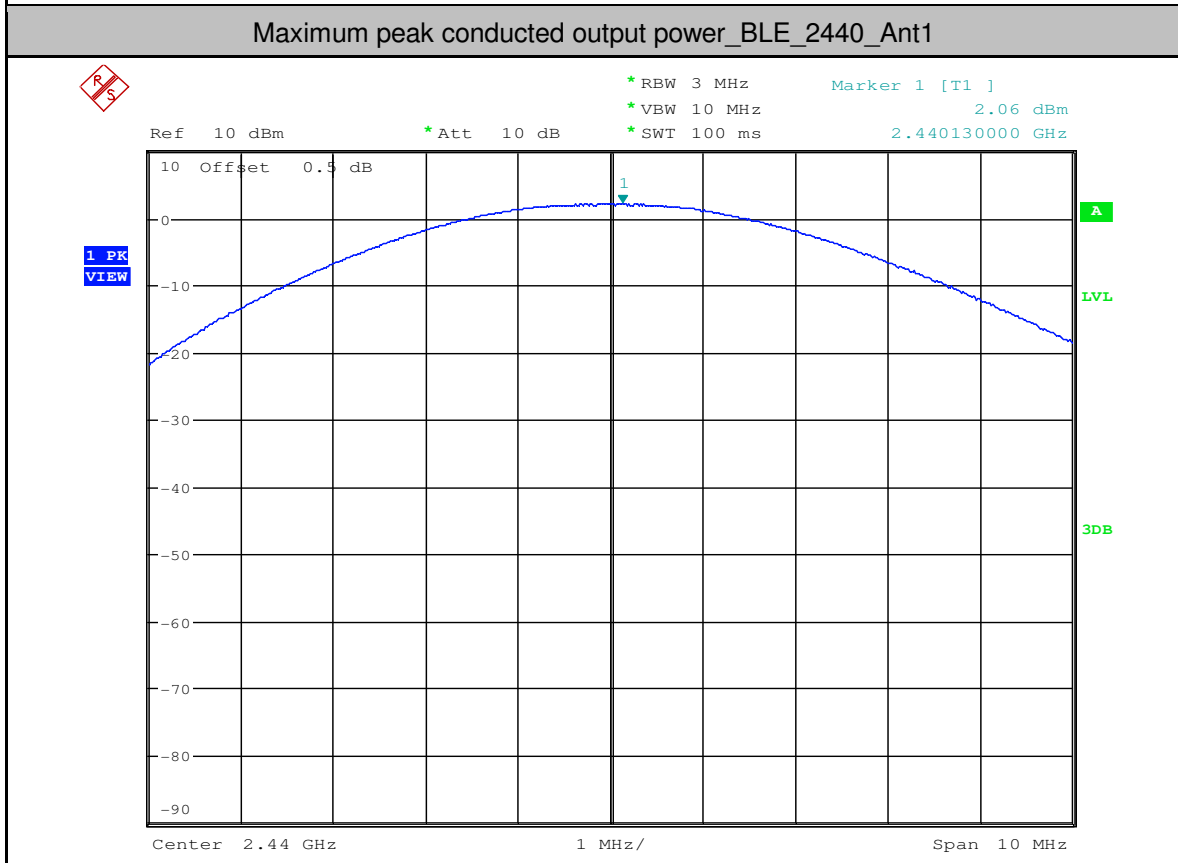
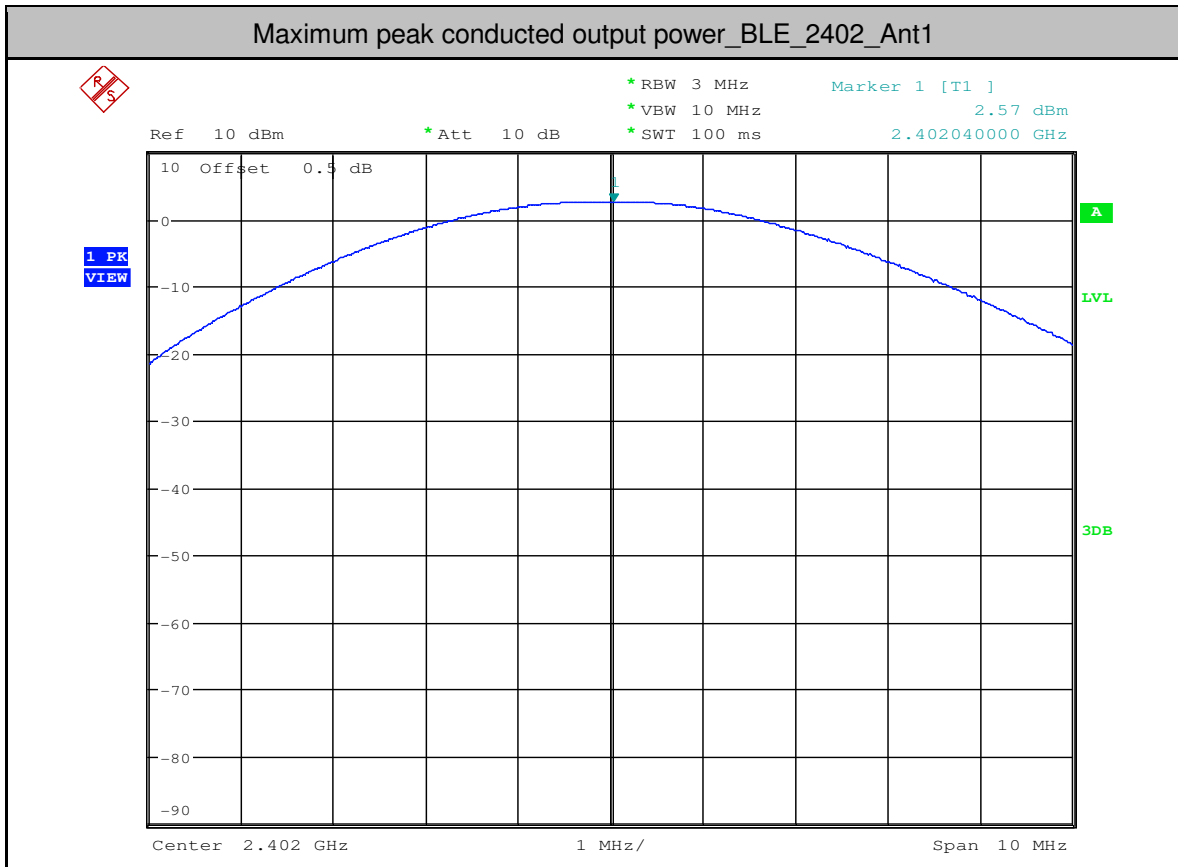


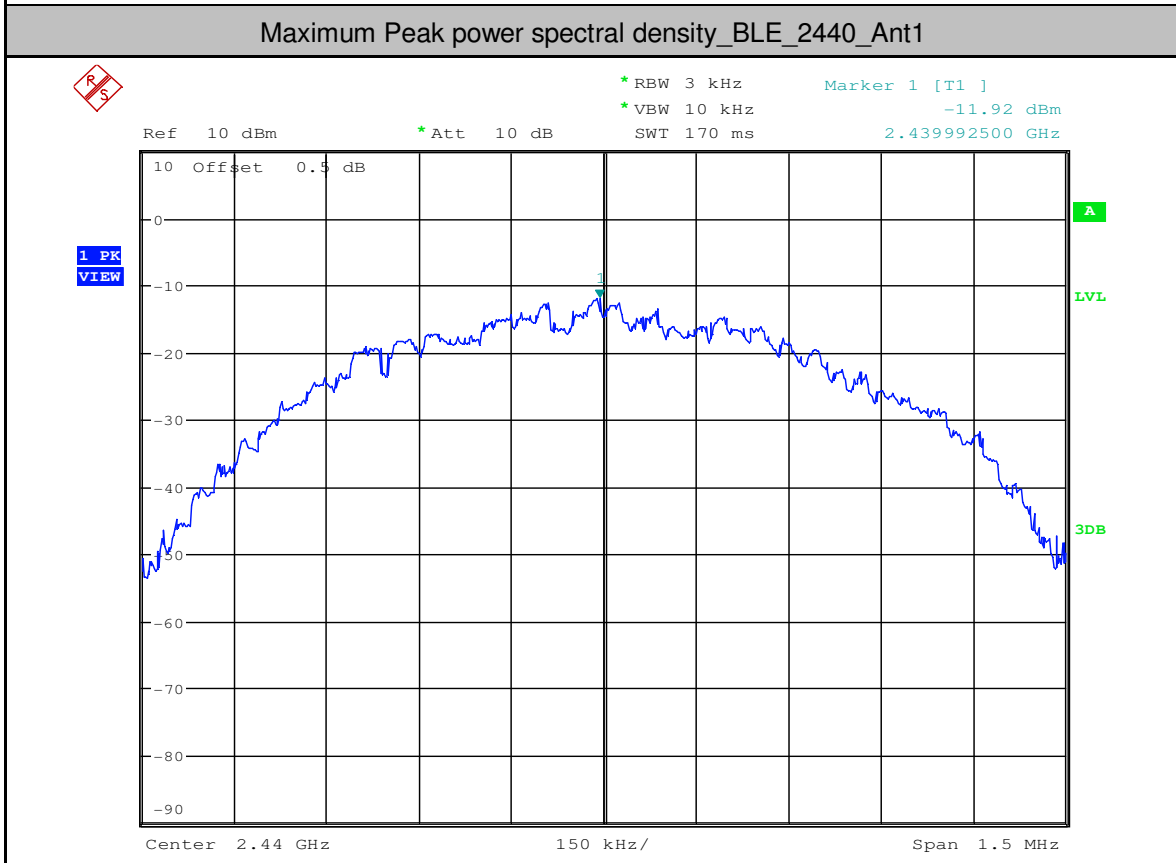
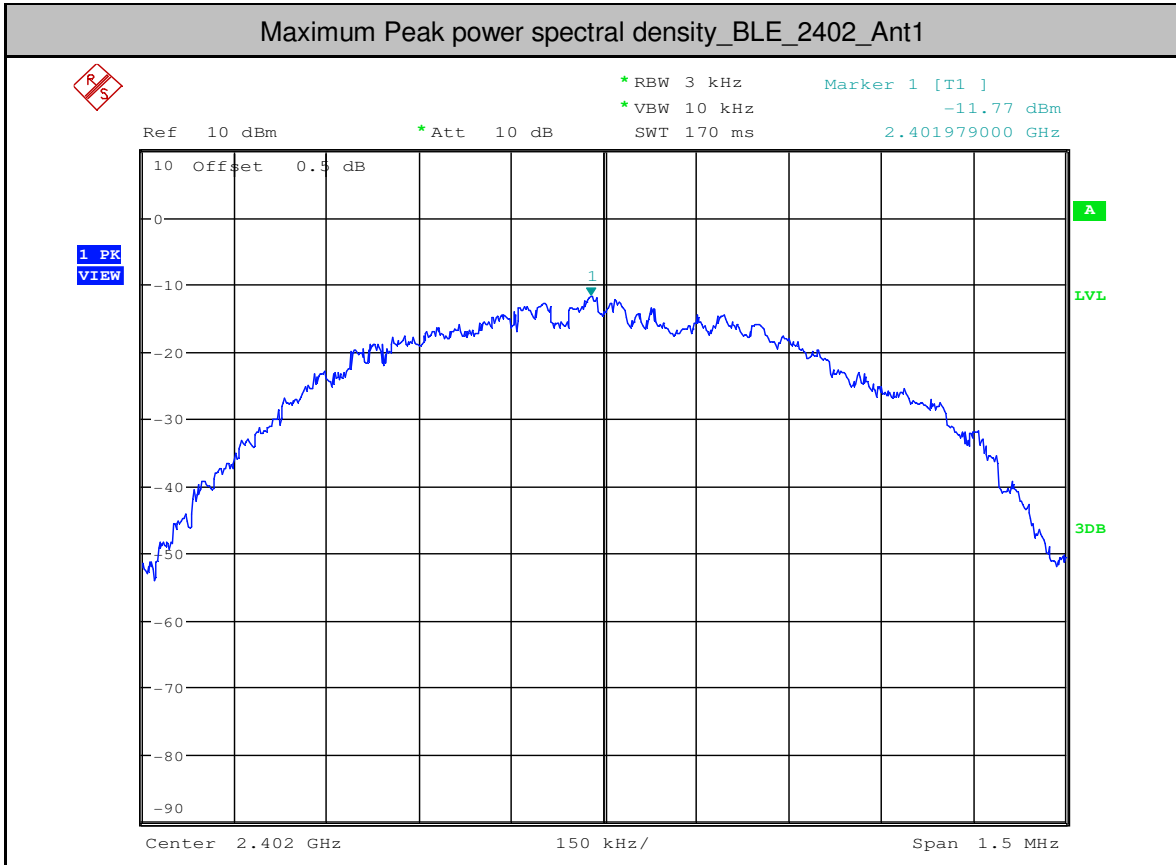


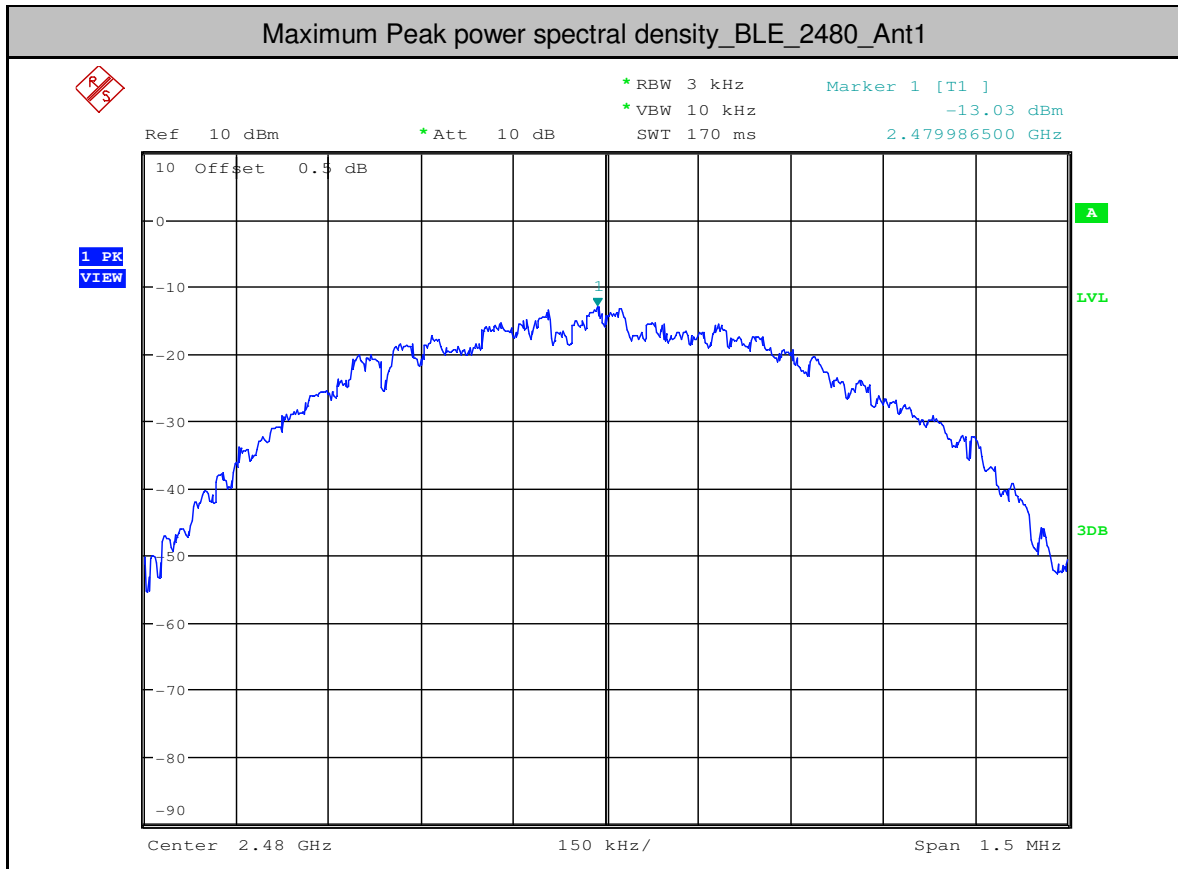


3. Maximum peak conducted output power

| Test Mode | Test Channel | Ant | Power[dBm] | Limit[dBm] | Verdict |
|-----------|--------------|------|------------|------------|---------|
| BLE | 2402 | Ant1 | 2.57 | <30 | PASS |
| BLE | 2440 | Ant1 | 2.06 | <30 | PASS |
| BLE | 2480 | Ant1 | 1.03 | <30 | PASS |

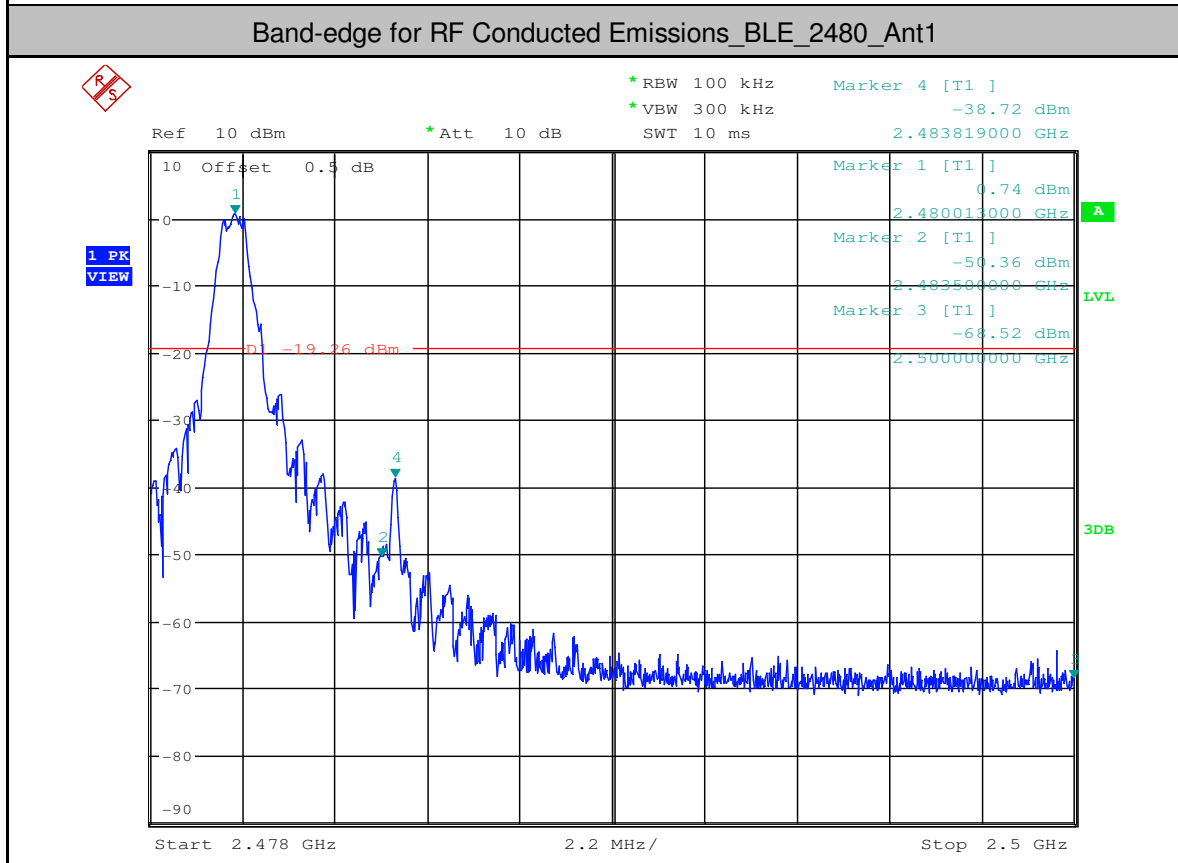
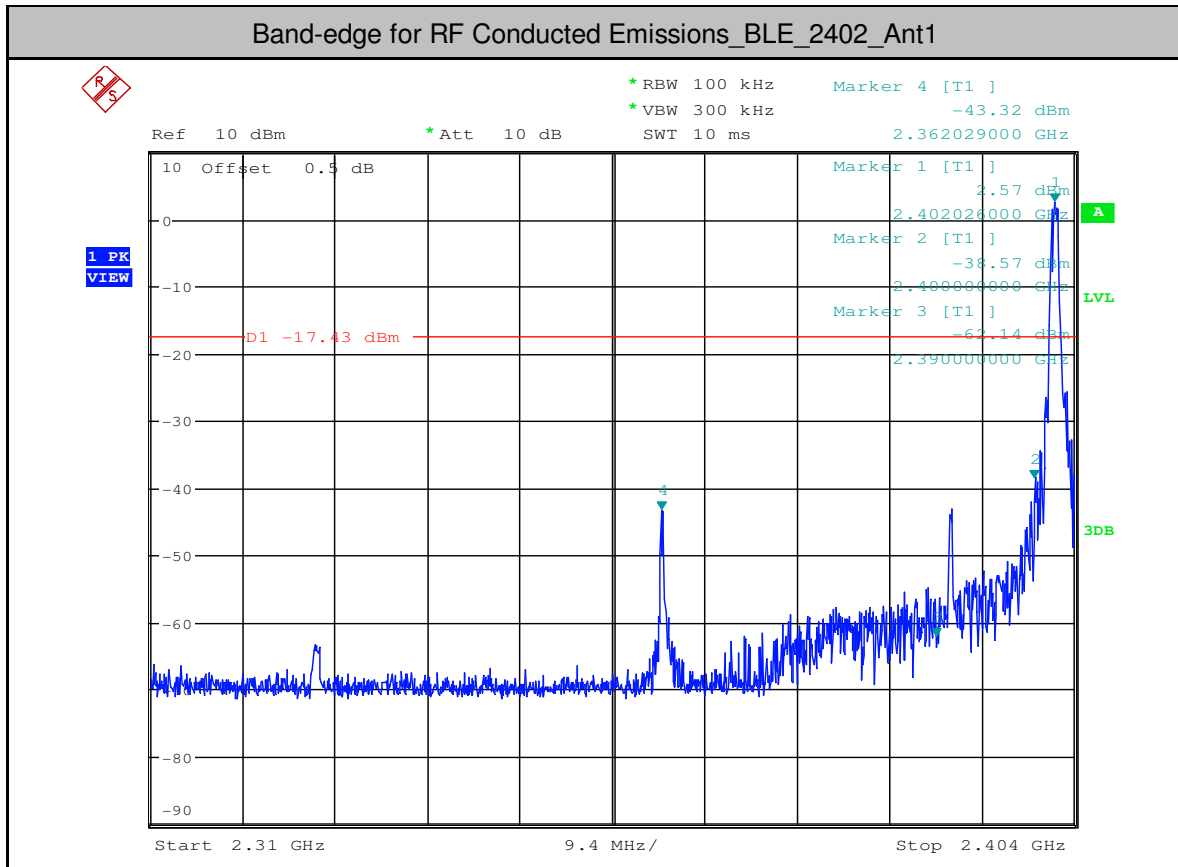






5. Band-edge for RF Conducted Emissions

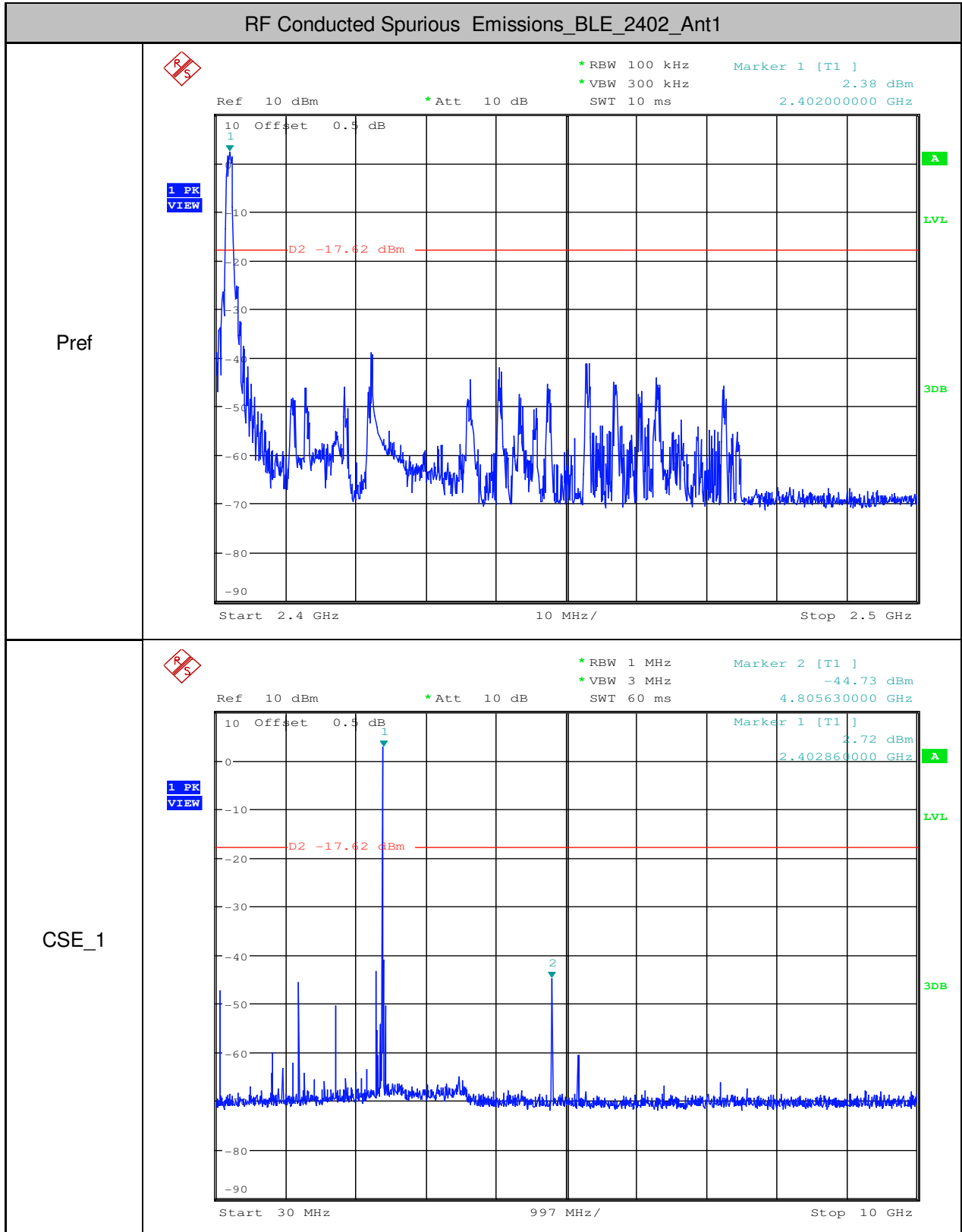
| Test Mode | Test Channel | Ant | Carrier Power[dBm] | Max. Spurious Level [dBm] | Limit [dBm] | Verdict |
|-----------|--------------|------|--------------------|---------------------------|-------------|---------|
| BLE | 2402 | Ant1 | 2.570 | -43.324 | <-17.43 | PASS |
| BLE | 2480 | Ant1 | 0.740 | -38.722 | <-19.26 | PASS |

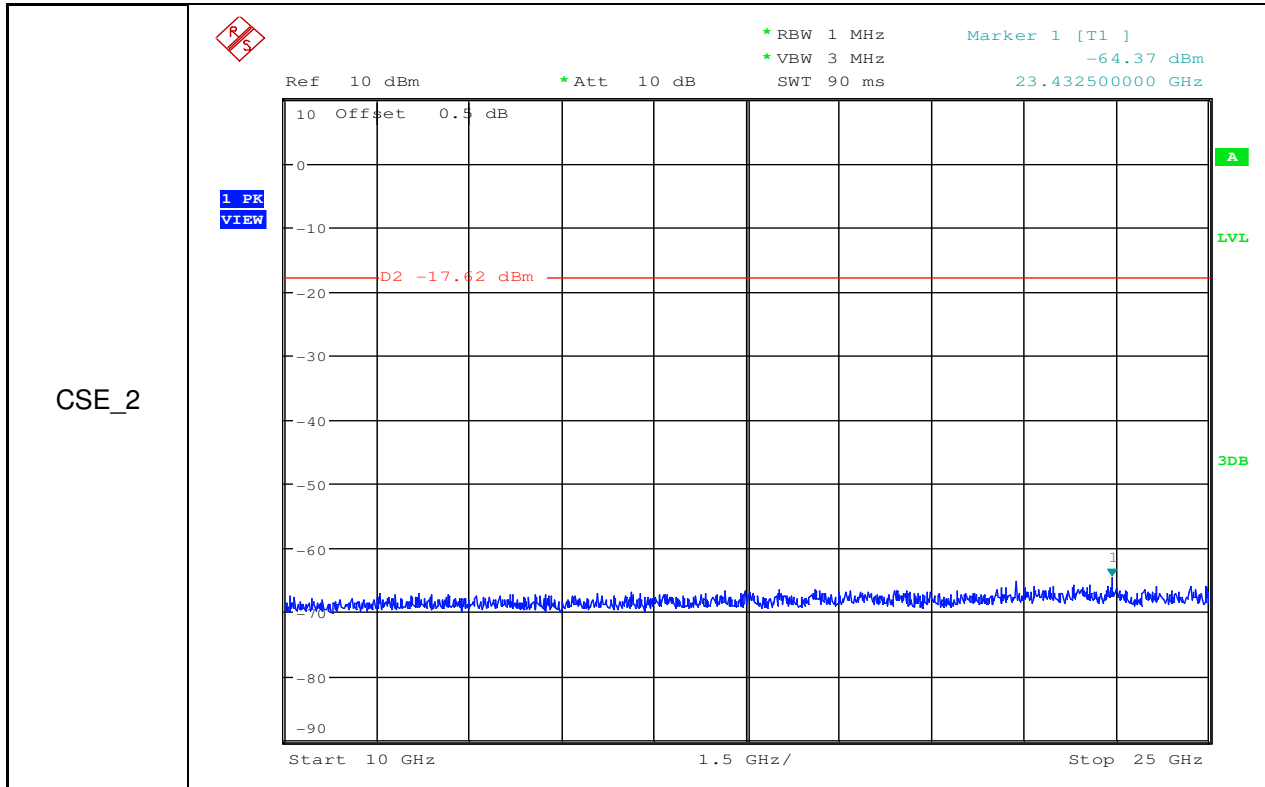




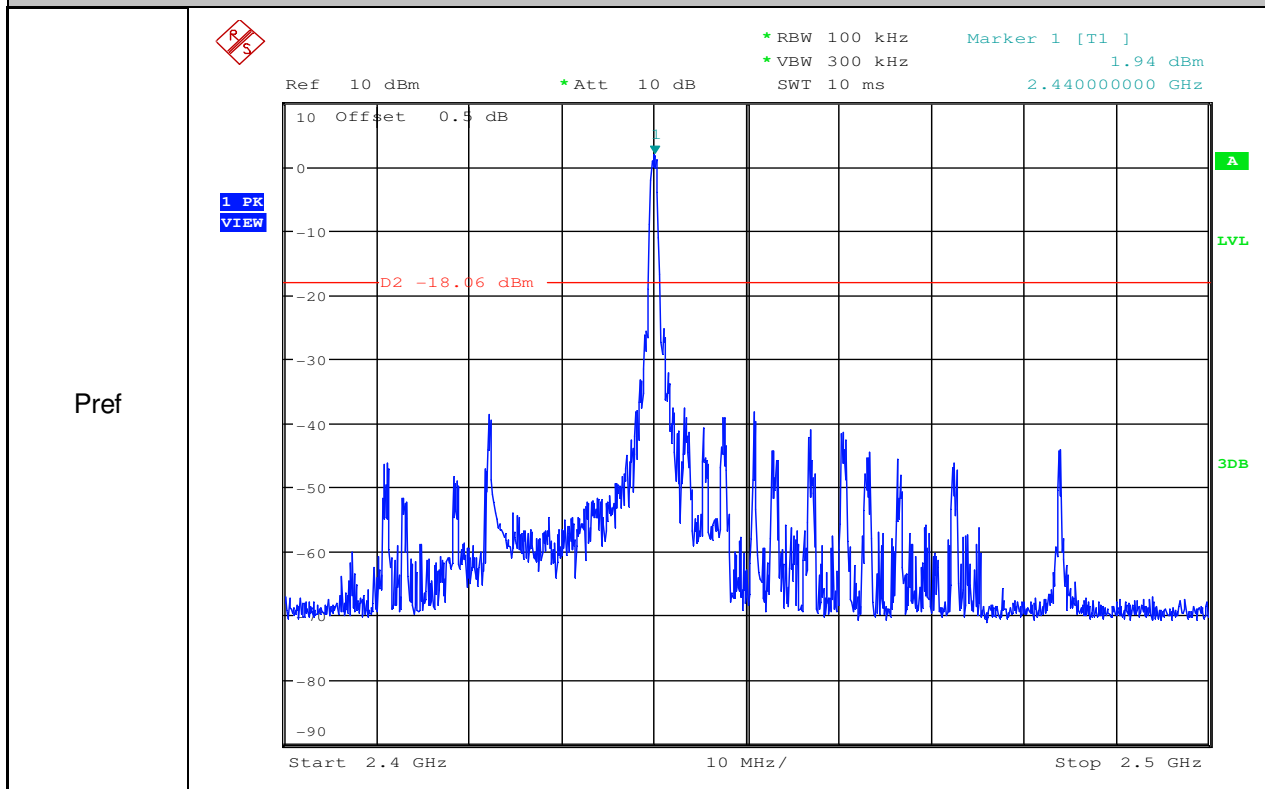
6.RF Conducted Spurious Emissions

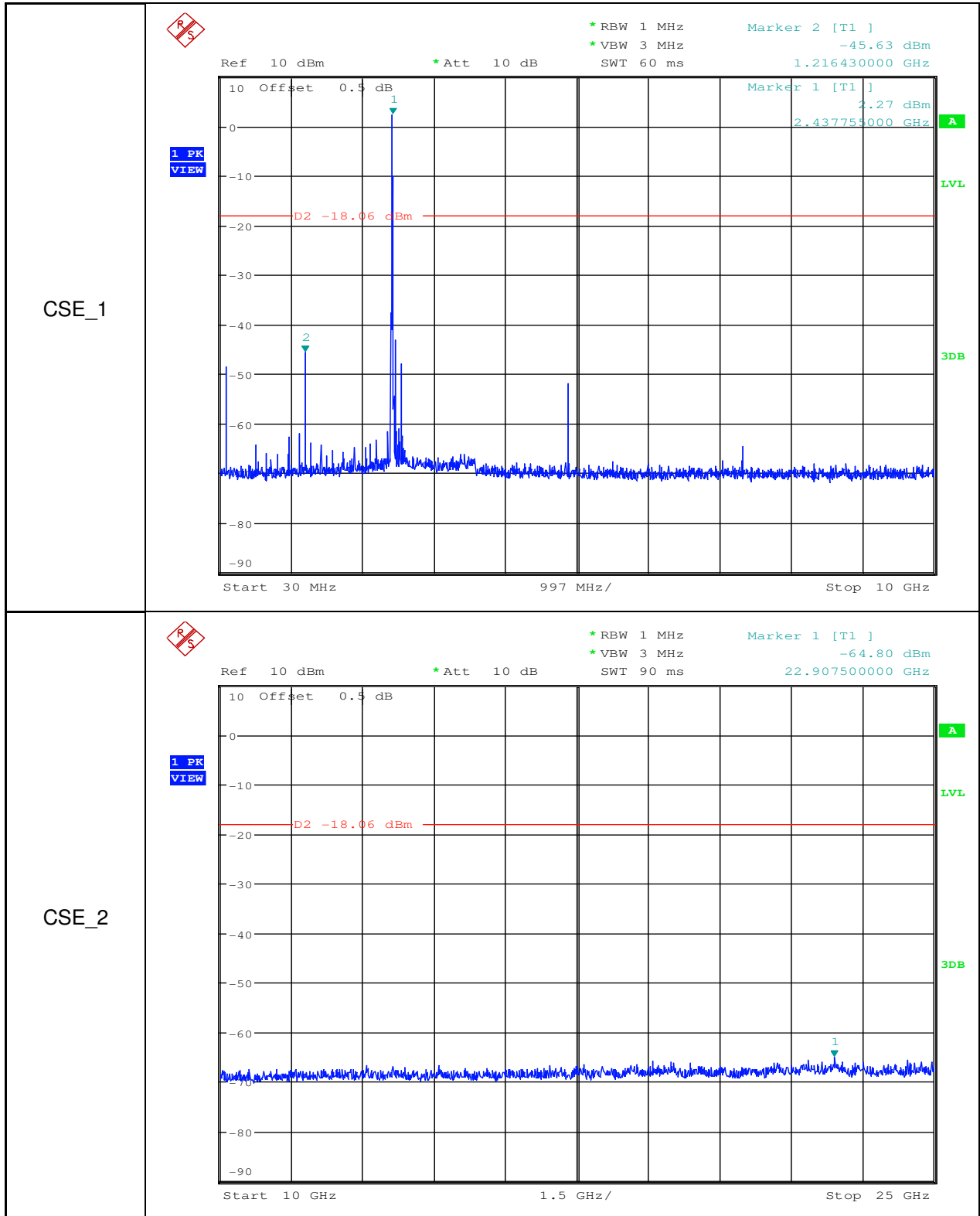
| Test Mode | Test Channel | StartFre [MHz] | StopFre [MHz] | RBW [kHz] | VBW [kHz] | Pref[dBm] | Max. Level [dBm] | Limit [dBm] | Verdict |
|-----------|--------------|----------------|---------------|-----------|-----------|-----------|------------------|-------------|---------|
| BLE | 2402 | 30 | 10000 | 1000 | 3000 | 2.38 | -44.730 | <-17.62 | PASS |
| BLE | 2402 | 10000 | 25000 | 1000 | 3000 | 2.38 | -64.370 | <-17.62 | PASS |
| BLE | 2440 | 30 | 10000 | 1000 | 3000 | 1.94 | -45.630 | <-18.06 | PASS |
| BLE | 2440 | 10000 | 25000 | 1000 | 3000 | 1.94 | -64.800 | <-18.06 | PASS |
| BLE | 2480 | 30 | 10000 | 1000 | 3000 | 0.98 | -45.890 | <-19.02 | PASS |
| BLE | 2480 | 10000 | 25000 | 1000 | 3000 | 0.98 | -64.800 | <-19.02 | PASS |

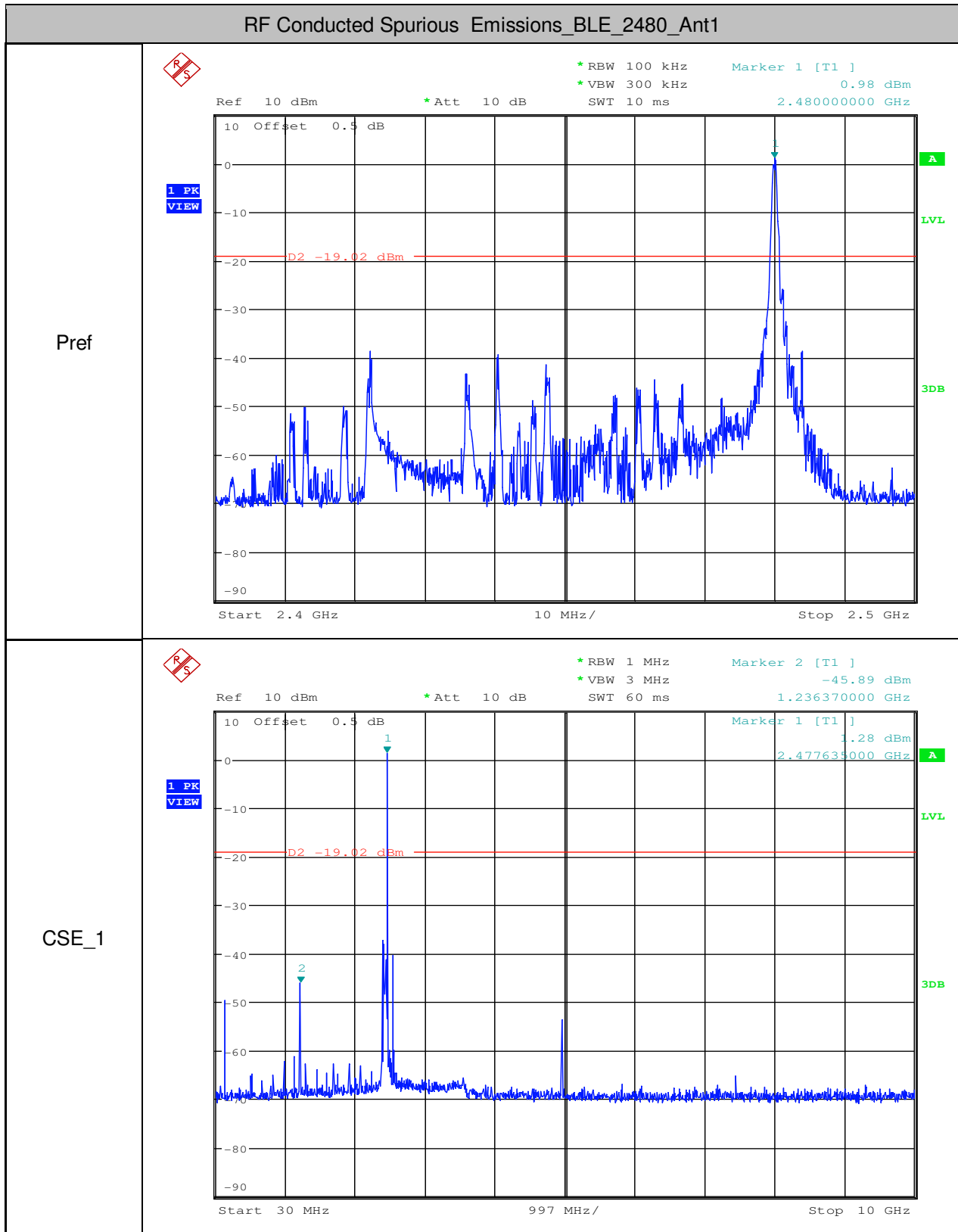


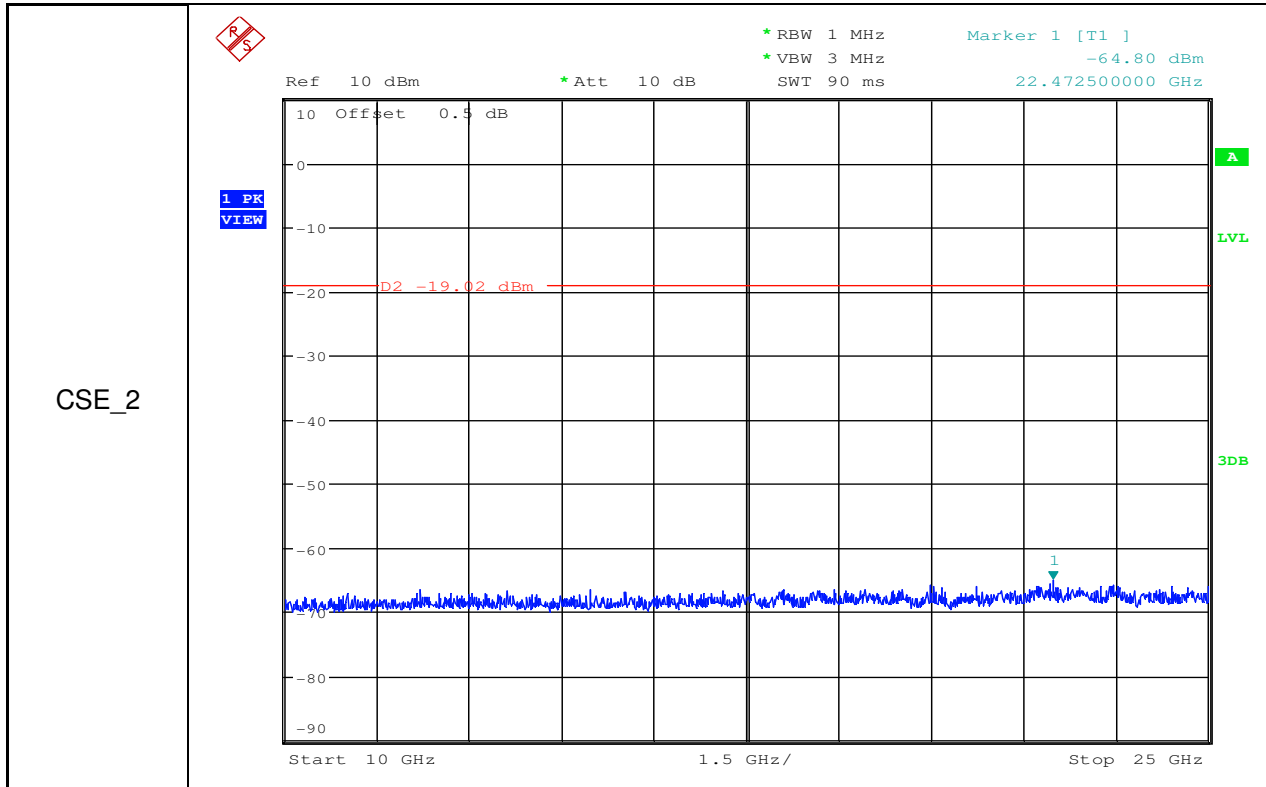


RF Conducted Spurious Emissions_BLE_2440_Ant1









- End of the Report -