



FCC TEST REPORT

FCC ID: PADWF150

On Behalf of

Wahoo Fitness LLC

KICKR RUN

Model No.: WF150

Prepared for : Wahoo Fitness LLC
Address : 90 W. Wieuca Road #110 Atlanta, Georgia 30342, United States

Prepared By : Shenzhen Alpha Product Testing Co., Ltd.
Address : Building i, No.2, Lixin Road, Fuyong Street, Bao'an District, 518103,
Shenzhen, Guangdong, China

Report Number : A2404166-C01-R02
Date of Receipt : April 19, 2024
Date of Test : April 19, 2024 - June 13, 2024
Date of Report : June 13, 2024
Version Number : V0
Result : **Pass**

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TEST REPORT DECLARATION

Applicant : Wahoo Fitness LLC
Address : 90 W. Wieuca Road #110 Atlanta, Georgia 30342, United States
Manufacturer : Wahoo Fitness LLC
Address : 90 W. Wieuca Road #110 Atlanta, Georgia 30342, United States
EUT Description : KICKR RUN
(A) Model No. : WF150
(B) Trademark : N/A

Measurement Standard Used:

**FCC Rules and Regulations Part 15 Subpart C Section 15.247,
ANSI C63.10:2013, CISPR 16-1-4:2010**

The device described above is tested by Shenzhen Alpha Product Testing Co., Ltd. to determine the maximum emission levels emanating from the device. The maximum emission levels are compared to the FCC Part 15 Subpart C limits both conducted and radiated emissions. The test results are contained in this test report and Shenzhen Alpha Product Testing Co., Ltd. is assumed of full responsibility for the accuracy and completeness of these tests.

After the test, our opinion is that EUT compliance with the requirement of the above standards.

This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Shenzhen Alpha Product Testing Co., Ltd.

Tested by (name + signature).....: Yannis Wen
Project Engineer

Yannis Wen

Approved by (name + signature).....: Jack Xu
Project Manager

Jack Xu

Date of issue.....: June 13, 2024

Revision History

| Revision | Issue Date | Revisions | Revised By |
|----------|---------------|------------------------|------------|
| V0 | June 13, 2024 | Initial released Issue | Yannis Wen |

1. SUMMARY OF STANDARDS AND RESULTS

1.1. Description of Standards and Results

The EUT have been tested according to the applicable standards as referenced below:

| Test Item | Standards Paragraph | Result |
|---|--|--------|
| Conducted Emission | FCC Part 15: 15.207 ANSI C63.10 :2013 | P |
| 6dB Bandwidth | FCC PART 15:15.247(a)(2) ANSI C63.10 :2013 | P |
| Output Power | FCC Part 15: 15.247(b)(3) ANSI C63.10 :2013 | P |
| Radiated Spurious Emission | FCC Part 15: 15.209 FCC Part 15: 15.247(d) ANSI C63.10 :2013 | P |
| Conducted Spurious & Band Edge Emission | FCC Part 15: 15.247(d) ANSI C63.10 :2013 | P |
| Power Spectral Density | FCC PART 15:15.247(e) ANSI C63.10 :2013 | P |
| Radiated Band Edge Emission | FCC Part 15: 15.247(d) ANSI C63.10 :2013 | P |
| Antenna Requirement | FCC Part 15: 15.203 | P |

Note:

1. P is an abbreviation for Pass.
2. F is an abbreviation for Fail.
3. N/A is an abbreviation for Not Applicable.
4. Decision rules for the conclusion of this test report: decision by actual test data without considering measurement uncertainty.

2. GENERAL INFORMATION

2.1. Description of Device (EUT)

| | | |
|---------------------|---|---|
| Description/PMN | : | KICKR RUN |
| Model Number | : | WF150 |
| Diff. | : | N/A |
| Test Voltage | : | AC 120V/60Hz |
| Radio Technology | : | Bluetooth BLE |
| Operation frequency | : | 2402-2480MHz |
| Channel No. | : | 40 channels |
| Data rate | : | 1Mbps/2Mbps |
| Channel Separation | : | 2MHz |
| Modulation | : | GFSK |
| Antenna Type | : | Internal antenna, Maximum Gain is 5.12dBi. (Antenna information is provided by applicant.) |
| Software Version | : | V1.0 |
| Hardware version | : | V1.0 |

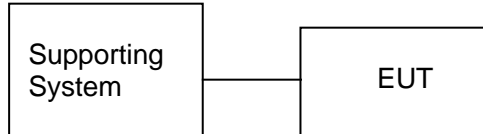
2.2. Accessories of Device (EUT)

Accessories : /
 Manufacturer : /
 Model : /
 Ratings : /

2.3. Tested Supporting System Details

| No. | Description | Manufacturer | Model | Serial Number | Certification or SDOC |
|-----|-------------|--------------|-------|---------------|-----------------------|
| 1. | Notebook | Thinkpad | E14 | N/A | N/A |

2.4. Block Diagram of connection between EUT and simulators



2.5. Test Mode Description

| Tested mode, channel, and data rate information | | |
|---|--------------|-----------------|
| Mode | Channel | Frequency (MHz) |
| GFSK(1Mbps/2Mbps) | Low : CH0 | 2402 |
| | Middle: CH19 | 2440 |
| | High: CH39 | 2480 |

The test software was used to control EUT work in Continuous TX mode, and select test channel, wireless mode.

2.6. Test Conditions

| Items | Required | Actual |
|--------------------|-----------|--------|
| Temperature range: | 15-35°C | 27°C |
| Humidity range: | 25-75% | 56% |
| Pressure range: | 86-106kPa | 98kPa |

2.7. Test Facility

Shenzhen Alpha Product Testing Co., Ltd
 Building i, No.2, Lixin Road, Fuyong Street, Bao'an District, 518103,
 Shenzhen, Guangdong, China

June 21, 2018 File on Federal Communication Commission
 Registration Number: 293961
 Designation Number: CN1236

July 15, 2019 Certificated by IC
 Registration Number: 12135A

2.8. Measurement Uncertainty

(95% confidence levels, k=2)

| Item | Uncertainty |
|--|---------------------------|
| Uncertainty for Power point Conducted Emissions Test | 1.63dB |
| Uncertainty for Radiation Emission test in 3m chamber (below 30MHz) | 3.5dB |
| Uncertainty for Radiation Emission test in 3m chamber (30MHz to 1GHz) | 3.74dB(Polarize: V) |
| | 3.76dB(Polarize: H) |
| Uncertainty for Radiation Emission test in 3m chamber (1GHz to 25GHz) | 3.77dB(Polarize: V) |
| | 3.80dB(Polarize: H) |
| Uncertainty for radio frequency | 5.06×10^{-8} GHz |
| Uncertainty for conducted RF Power | 0.40dB |
| Uncertainty for temperature | 0.2°C |
| Uncertainty for humidity | 1% |
| Uncertainty for DC and low frequency voltages | 0.06% |

2.9. Test Equipment List

| Equipment | Manufacture | Model No. | Firmware version | Serial No. | Last cal. | Cal Interval |
|-----------------------------|---------------|------------------|------------------|----------------------------|------------|--------------|
| 9*6*6 anechoic chamber | CHENYU | 9*6*6 | / | N/A | 2022.05.17 | 3Year |
| Spectrum analyzer | ROHDE&SCHWARZ | FSV40-N | 2.3 | 102137 | 2023.08.16 | 1Year |
| Spectrum analyzer | Agilent | N9020A | A.14.16 | MY499100060 | 2023.08.16 | 1Year |
| Receiver | ROHDE&SCHWARZ | ESR | 2.28 SP1 | 1316.3003K03-10 2082-Wa | 2023.08.16 | 1Year |
| Receiver | R&S | ESCI | 4.42 SP1 | 101165 | 2023.08.16 | 1Year |
| Bilog Antenna | Schwarzbeck | VULB 9168 | / | VULB 9168#627 | 2023.08.28 | 1Year |
| Horn Antenna | SCHWARZBECK | BBHA 9120 D | / | 2106 | 2023.08.19 | 1Year |
| Loop Antenna | SCHWARZBECK | FMZB 1519B | / | 00128 | 2023.08.19 | 1Year |
| RF Cable | Resenberger | Cable 1 | / | RE1 | 2023.08.16 | 1Year |
| RF Cable | Resenberger | Cable 2 | / | RE2 | 2023.08.16 | 1Year |
| RF Cable | Resenberger | Cable 3 | / | CE1 | 2023.08.16 | 1Year |
| Pre-amplifier | HP | HP8347A | / | 2834A00455 | 2023.08.16 | 1Year |
| Pre-amplifier | Agilent | 8449B | / | 3008A02664 | 2023.08.16 | 1Year |
| L.I.S.N.#1 | Schwarzbeck | NSLK8126 | / | 8126-466 | 2023.08.16 | 1Year |
| L.I.S.N.#2 | ROHDE&SCHWARZ | ENV216 | / | 101043 | 2023.08.16 | 1Year |
| Horn Antenna | SCHWARZBECK | BBHA 9170 | / | 00946 | 2023.08.19 | 1Year |
| Preamplifier | SKET | LNPA_1840 -50 | / | SK2018101801 | 2023.08.16 | 1 Year |
| Power Meter | Agilent | E9300A | / | MY41496628 | 2023.08.16 | 1 Year |
| Power Sensor | DARE | RPR3006W | / | 15100041SNO91 | 2023.08.16 | 1 Year |
| Temp. & Humid. Chamber | Teelong | TL-HW408S | / | TL-20191205-01 | 2023.07.25 | 1 Year |
| Switching Mode Power Supply | JUNKE | JK12010S | / | 20140927-6 | 2023.08.16 | 1 Year |
| Adjustable attenuator | MWRFtest | N/A | / | N/A | N/A | N/A |
| 10dB Attenuator | Mini-Circuits | DC-6G | / | N/A | N/A | N/A |

| Software Information | | | |
|----------------------|---------------|--------------|-----------|
| Test Item | Software Name | Manufacturer | Version |
| RE | EZ-EMC | EZ | Alpha-3A1 |
| CE | EZ-EMC | EZ | Alpha-3A1 |
| RF-CE | MTS 8310 | MW | V2.0.0.0 |

3. SPURIOUS EMISSION

3.1. Test Limits

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

15.205 Restricted frequency band

| MHz | MHz | MHz | GHz |
|----------------------------|-----------------------|-----------------|------------------|
| 0.090 - 0.110 | 16.42 - 16.423 | 399.9 - 410 | 4.5 - 5.15 |
| ¹ 0.495 - 0.505 | 16.69475 - 16.69525 | 608 - 614 | 5.35 - 5.46 |
| 2.1735 - 2.1905 | 16.80425 - 16.80475 | 960 - 1240 | 7.25 - 7.75 |
| 4.125 - 4.128 | 25.5 - 25.67 | 1300 - 1427 | 8.025 - 8.5 |
| 4.17725 - 4.17775 | 37.5 - 38.25 | 1435 - 1626.5 | 9.0 - 9.2 |
| 4.20725 - 4.20775 | 73 - 74.6 | 1645.5 - 1646.5 | 9.3 - 9.5 |
| 6.215 - 6.218 | 74.8 - 75.2 | 1660 - 1710 | 10.6 - 12.7 |
| 6.26775 - 6.26825 | 108 - 121.94 | 1718.8 - 1722.2 | 13.25 - 13.4 |
| 6.31175 - 6.31225 | 123 - 138 | 2200 - 2300 | 14.47 - 14.5 |
| 8.291 - 8.294 | 149.9 - 150.05 | 2310 - 2390 | 15.35 - 16.2 |
| 8.362 - 8.366 | 156.52475 - 156.52525 | 2483.5 - 2500 | 17.7 - 21.4 |
| 8.37625 - 8.38675 | 156.7 - 156.9 | 2690 - 2900 | 22.01 - 23.12 |
| 8.41425 - 8.41475 | 162.0125 - 167.17 | 3260 - 3267 | 23.6 - 24.0 |
| 12.29 - 12.293 | 167.72 - 173.2 | 3332 - 3339 | 31.2 - 31.8 |
| 12.51975 - 12.52025 | 240 - 285 | 3345.8 - 3358 | 36.43 - 36.5 |
| 12.57675 - 12.57725 | 322 - 335.4 | 3600 - 4400 | (²) |

15.209 Limit

| FREQUENCY MHz | DISTANCE Meters | FIELD STRENGTHS LIMIT | |
|------------------|--------------------|---|-----------------------------------|
| | | $\mu\text{V}/\text{m}$ | $\text{dB}(\mu\text{V})/\text{m}$ |
| 0.009-0.490 | 300 | 2400/F(KHz) | / |
| 0.490-1.705 | 30 | 24000/F(KHz) | / |
| 1.705-30 | 30 | 30 | 29.5 |
| 30 ~ 88 | 3 | 100 | 40.0 |
| 88 ~ 216 | 3 | 150 | 43.5 |
| 216 ~ 960 | 3 | 200 | 46.0 |
| 960 ~ 1000 | 3 | 500 | 54.0 |
| Above 1000 | 3 | 74.0 dB(μV)/m (Peak) 54.0 dB(μV)/m (Average) | |

Note 1: The peak limit is 20 dB higher than the average limit

Note 2: Peak limit applies (AVG limit + 20 dB) as well as RSS-247 Section 5.5

Harmonic emissions limits comply with below 54 dBuV/m at 3m. Other emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or comply with the radiated emissions limits specified in section 15.209(a) limit in the table below has to be followed.

Table 5 – General field strength limits at frequencies above 30 MHz

| Frequency (MHz) | Field strength ($\mu\text{V}/\text{m}$ at 3 m) |
|-----------------|---|
| 30 – 88 | 100 |
| 88 – 216 | 150 |
| 216 – 960 | 200 |
| Above 960 | 500 |

Table 6 – General field strength limits at frequencies below 30 MHz

| Frequency | Magnetic field strength (H-Field) ($\mu\text{A}/\text{m}$) | Measurement distance (m) |
|-------------------------------|--|--------------------------|
| 9 - 490 kHz ^{Note 1} | $6.37/F$ (F in kHz) | 300 |
| 490 - 1705 kHz | $63.7/F$ (F in kHz) | 30 |
| 1.705 - 30 MHz | 0.08 | 30 |

Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

3.2. Test Procedure

The measuring distance of 3m shall be used for measurements at frequency up to 1GHz and above 1GHz. The EUT was placed on a rotating 0.8 m high above ground for below 1GHz and 1.5m high for above 1GHz testing, The table was rotated 360 degrees to determine the position of the highest radiation.

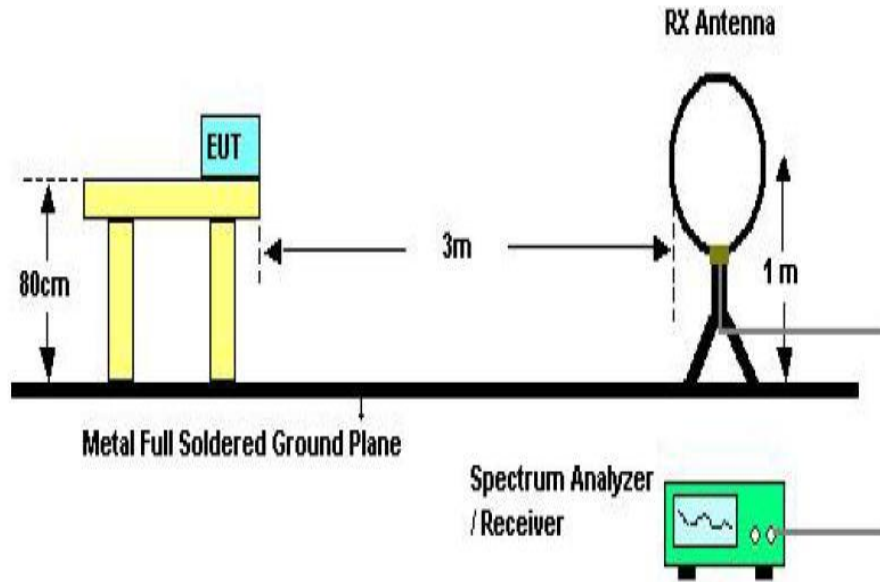
The Test antenna shall vary between 1m and 4m, Both Horizontal and Vertical antenna are set of make measurement.

The initial step in collecting radiated emission data is a spectrum analyzer Peak detector mode pre-scanning the measurement frequency range. Significant Peaks are then marked. and then Quasi Peak Detector mode premeasured.

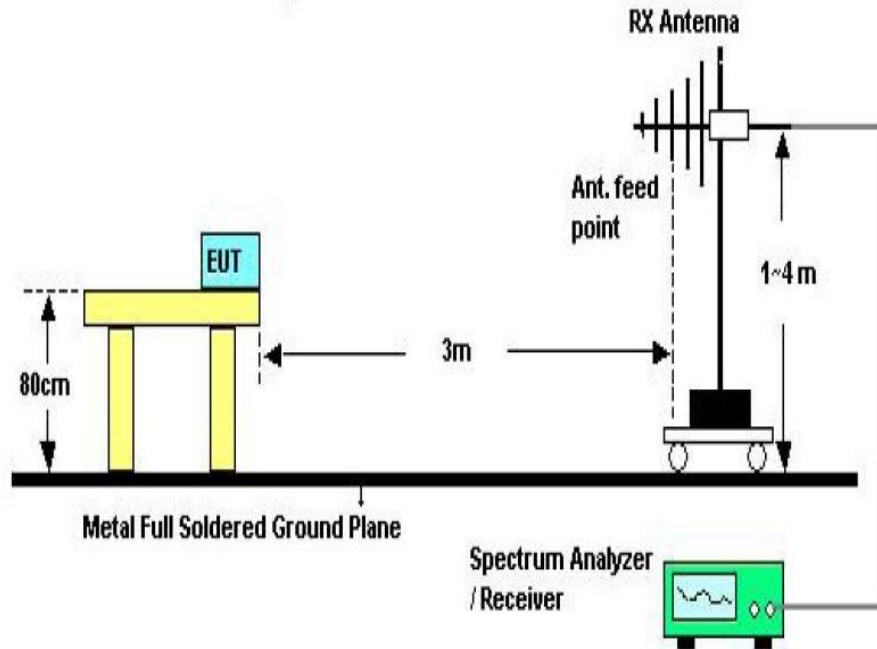
If Peak value comply with QP limit Below 1GHz, the EUT deemed to comply with QP limit. But the Peak value and average value both need to comply with applicable limit above 1GHz.

For the actual test configuration, please see the test setup photo.

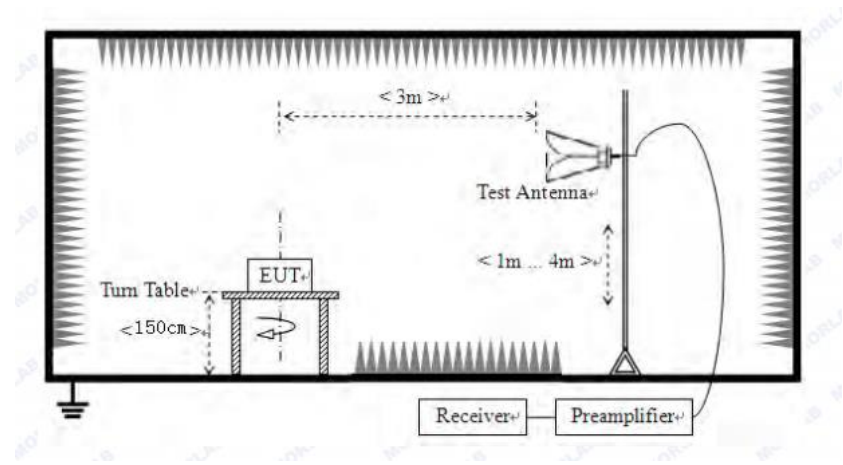
3.3. Test Setup



Below 30MHz Test Setup



Above 30MHz Test Setup



Above 1GHz Test Setup

3.4. Test Results

Test Condition

Continual Transmitting in maximum power.

| | | |
|--------------|-----------|------------|
| 9KHz~150KHz | RBW200Hz | VBW1KHz |
| 150KHz~30MHz | RBW9KHz | VBW 30KHz |
| 30MHz~1GHz | RBW120KHz | VBW 300KHz |
| Above1GHz | RBW1MHz | VBW 3MHz |

We have scanned from 9 kHz to the 10th harmonic of the EUT.

Detailed information please see the following page.

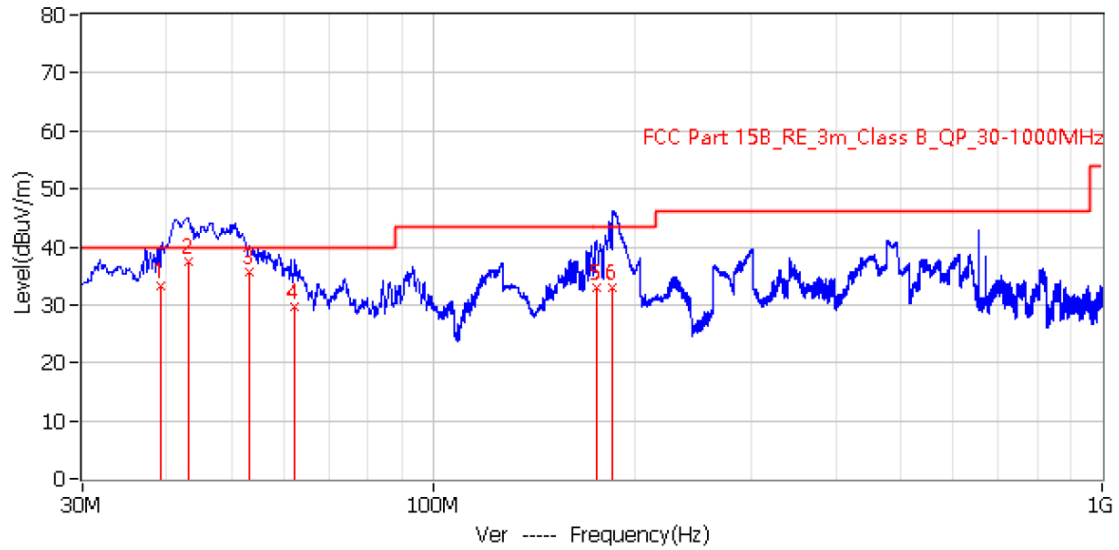
From 9KHz to 30MHz: Conclusion: Pass

Note: 1.The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

2.Only show the test data of the worst Channel in this report.

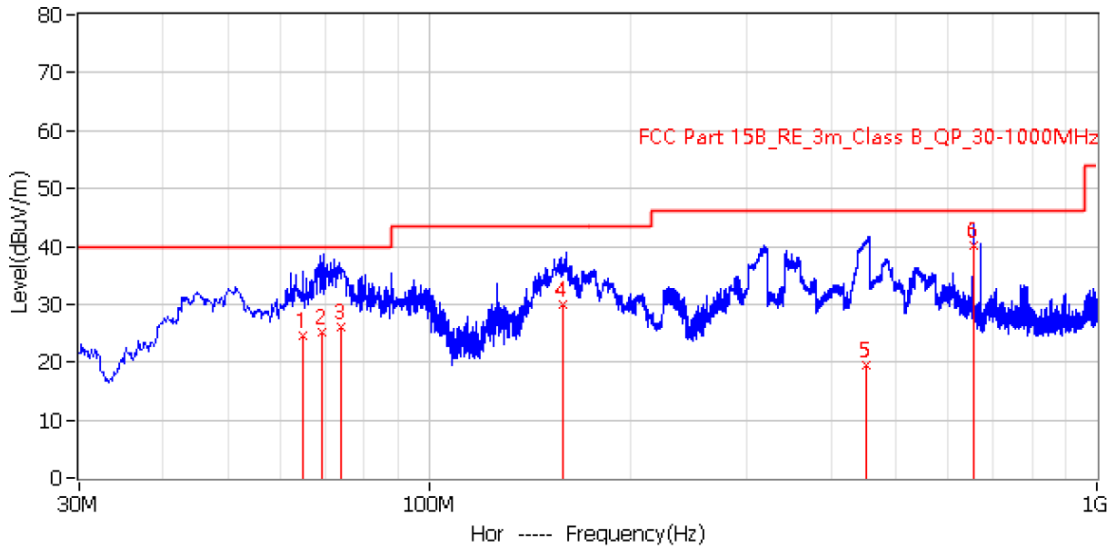
From 30MHz to 1000MHz: Conclusion: Pass

Vertical:



| No. | Frequency | Limit dBuV/m | Level dBuV/m | Margin dB | Factor dB/m | Detector | Height cm | Height cm | Angle deg |
|-----|------------|--------------|--------------|-----------|-------------|----------|-----------|-----------|-----------|
| 1 | 39.161MHz | 40.0 | 33.3 | -6.7 | 16.3 | QP | Ver | 100.0 | 205.0 |
| 2 | 43.222MHz | 40.0 | 37.6 | -2.4 | 17.6 | QP | Ver | 100.0 | 145.0 |
| 3 | 53.272MHz | 40.0 | 35.6 | -4.4 | 18.1 | QP | Ver | 100.0 | 220.0 |
| 4 | 62.258MHz | 40.0 | 29.6 | -10.4 | 17.2 | QP | Ver | 100.0 | 220.0 |
| 5 | 176.288MHz | 43.5 | 32.9 | -10.6 | 14.7 | QP | Ver | 100.0 | 121.0 |
| 6 | 185.677MHz | 43.5 | 33.1 | -10.4 | 13.5 | QP | Ver | 100.0 | 121.0 |

Horizontal:



| No. | Frequency | Limit dBuV/m | Level dBuV/m | Margin dB | Factor dB/m | Detector | Height cm | Height cm | Angle deg |
|-----|------------|--------------|--------------|-----------|-------------|----------|-----------|-----------|-----------|
| 1 | 64.921MHz | 40.0 | 24.6 | -15.4 | 16.8 | QP | Hor | 100.0 | 319.0 |
| 2 | 69.111MHz | 40.0 | 25.1 | -14.9 | 13.6 | QP | Hor | 100.0 | 299.0 |
| 3 | 74.139MHz | 40.0 | 26.2 | -13.8 | 13.6 | QP | Hor | 100.0 | 299.0 |
| 4 | 158.973MHz | 43.5 | 30.1 | -13.4 | 16.0 | QP | Hor | 100.0 | 0.0 |
| 5 | 451.473MHz | 46.0 | 19.4 | -26.6 | 19.3 | QP | Hor | 100.0 | 108.0 |
| 6 | 652.953MHz | 46.0 | 40.2 | -5.8 | 23.3 | QP | Hor | 100.0 | 186.0 |

Notes: Above is below 1GHz test data. This report only shall the worst case mode for TX 2440MHz.(1Mbps)

From 1G-25GHz(1Mbps):

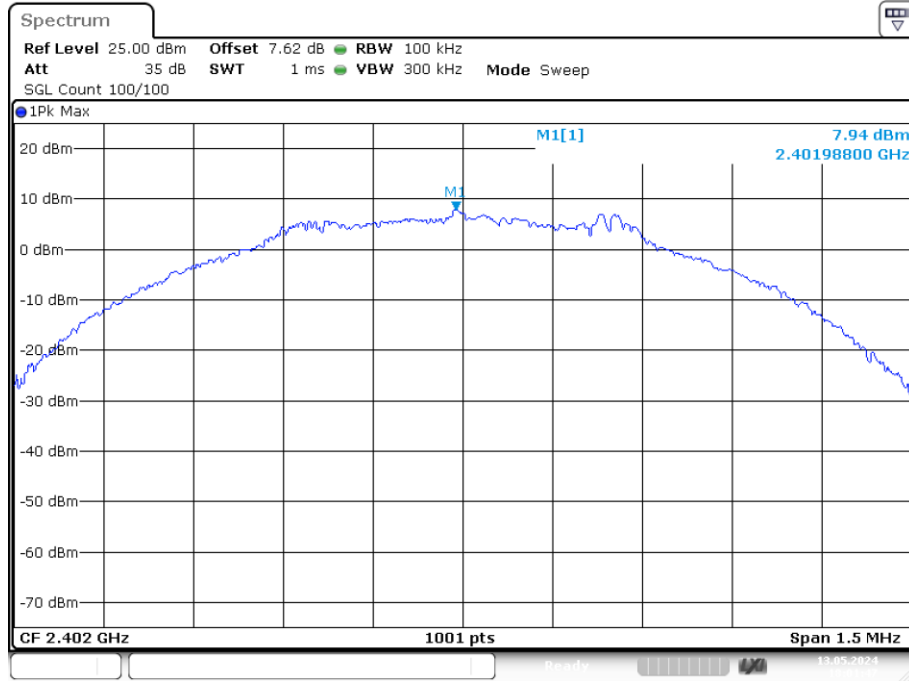
| Test Mode: TX Low | | | | | | | | | |
|---|---------------------|-------------|-----------------------|----------------|-----------------|-----------------|----------------|-------------|--------|
| Freq (MHz) | Read Level (dBuV/m) | Polar (H/V) | Antenna Factor (dB/m) | Cable loss(dB) | Amp Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
| 4804 | 45.22 | V | 33.95 | 10.18 | 34.26 | 55.09 | 74 | -18.91 | PK |
| 4804 | 38.56 | V | 33.95 | 10.18 | 34.26 | 48.43 | 54 | -5.57 | AV |
| 7206 | / | / | / | / | / | / | / | / | / |
| 9608 | / | / | / | / | / | / | / | / | / |
| 4804 | 43.05 | H | 33.95 | 10.18 | 34.26 | 52.92 | 74 | -21.08 | PK |
| 4804 | 35.95 | H | 33.95 | 10.18 | 34.26 | 45.82 | 54 | -8.18 | AV |
| 7206 | / | / | / | / | / | / | / | / | / |
| 9608 | / | / | / | / | / | / | / | / | / |
| Test Mode: TX Mid | | | | | | | | | |
| 4880 | 44.27 | V | 33.93 | 10.2 | 34.29 | 54.11 | 74 | -19.89 | PK |
| 4880 | 34.75 | V | 33.93 | 10.2 | 34.29 | 44.59 | 54 | -9.41 | AV |
| 7320 | / | / | / | / | / | / | / | / | / |
| 9760 | / | / | / | / | / | / | / | / | / |
| 4880 | 45.05 | H | 33.93 | 10.2 | 34.29 | 54.89 | 74 | -19.11 | PK |
| 4880 | 33.56 | H | 33.93 | 10.2 | 34.29 | 43.40 | 54 | -10.60 | AV |
| 7320 | / | / | / | / | / | / | / | / | / |
| 9760 | / | / | / | / | / | / | / | / | / |
| Test Mode: TX High | | | | | | | | | |
| 4960 | 44.27 | V | 33.98 | 10.22 | 34.25 | 54.22 | 74 | -19.78 | PK |
| 4960 | 33.91 | V | 33.98 | 10.22 | 34.25 | 43.86 | 54 | -10.14 | AV |
| 7440 | / | / | / | / | / | / | / | / | / |
| 9920 | / | / | / | / | / | / | / | / | / |
| 4960 | 44.78 | H | 33.98 | 10.22 | 34.25 | 54.73 | 74 | -19.27 | PK |
| 4960 | 32.43 | H | 33.98 | 10.22 | 34.25 | 42.38 | 54 | -11.62 | AV |
| 7440 | / | / | / | / | / | / | / | / | / |
| 9920 | / | / | / | / | / | / | / | / | / |
| Note: | | | | | | | | | |
| 1, Result = Read level + Antenna factor + cable loss-Amp factor | | | | | | | | | |
| 2, All the other emissions not reported were too low to read and deemed to comply with FCC limit. | | | | | | | | | |

From 1G-25GHz(2Mbps):

| Test Mode: TX Low | | | | | | | | | |
|---|---------------------|-------------|-----------------------|----------------|-----------------|-----------------|----------------|-------------|--------|
| Freq (MHz) | Read Level (dBuV/m) | Polar (H/V) | Antenna Factor (dB/m) | Cable loss(dB) | Amp Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
| 4804 | 46.72 | V | 33.95 | 10.18 | 34.26 | 56.59 | 74 | -17.41 | PK |
| 4804 | 36.75 | V | 33.95 | 10.18 | 34.26 | 46.62 | 54 | -7.38 | AV |
| 7206 | / | / | / | / | / | / | / | / | / |
| 9608 | / | / | / | / | / | / | / | / | / |
| 4804 | 44.96 | H | 33.95 | 10.18 | 34.26 | 54.83 | 74 | -19.17 | PK |
| 4804 | 36.48 | H | 33.95 | 10.18 | 34.26 | 46.35 | 54 | -7.65 | AV |
| 7206 | / | / | / | / | / | / | / | / | / |
| 9608 | / | / | / | / | / | / | / | / | / |
| Test Mode: TX Mid | | | | | | | | | |
| 4880 | 43.99 | V | 33.93 | 10.2 | 34.29 | 53.83 | 74 | -20.17 | PK |
| 4880 | 35.83 | V | 33.93 | 10.2 | 34.29 | 45.67 | 54 | -8.33 | AV |
| 7320 | / | / | / | / | / | / | / | / | / |
| 9760 | / | / | / | / | / | / | / | / | / |
| 4880 | 46.29 | H | 33.93 | 10.2 | 34.29 | 56.13 | 74 | -17.87 | PK |
| 4880 | 34.38 | H | 33.93 | 10.2 | 34.29 | 44.22 | 54 | -9.78 | AV |
| 7320 | / | / | / | / | / | / | / | / | / |
| 9760 | / | / | / | / | / | / | / | / | / |
| Test Mode: TX High | | | | | | | | | |
| 4960 | 46.11 | V | 33.98 | 10.22 | 34.25 | 56.06 | 74 | -17.94 | PK |
| 4960 | 36.87 | V | 33.98 | 10.22 | 34.25 | 46.82 | 54 | -7.18 | AV |
| 7440 | / | / | / | / | / | / | / | / | / |
| 9920 | / | / | / | / | / | / | / | / | / |
| 4960 | 44.34 | H | 33.98 | 10.22 | 34.25 | 54.29 | 74 | -19.71 | PK |
| 4960 | 34.89 | H | 33.98 | 10.22 | 34.25 | 44.84 | 54 | -9.16 | AV |
| 7440 | / | / | / | / | / | / | / | / | / |
| 9920 | / | / | / | / | / | / | / | / | / |
| Note: | | | | | | | | | |
| 1, Result = Read level + Antenna factor + cable loss-Amp factor | | | | | | | | | |
| 2, All the other emissions not reported were too low to read and deemed to comply with FCC limit. | | | | | | | | | |

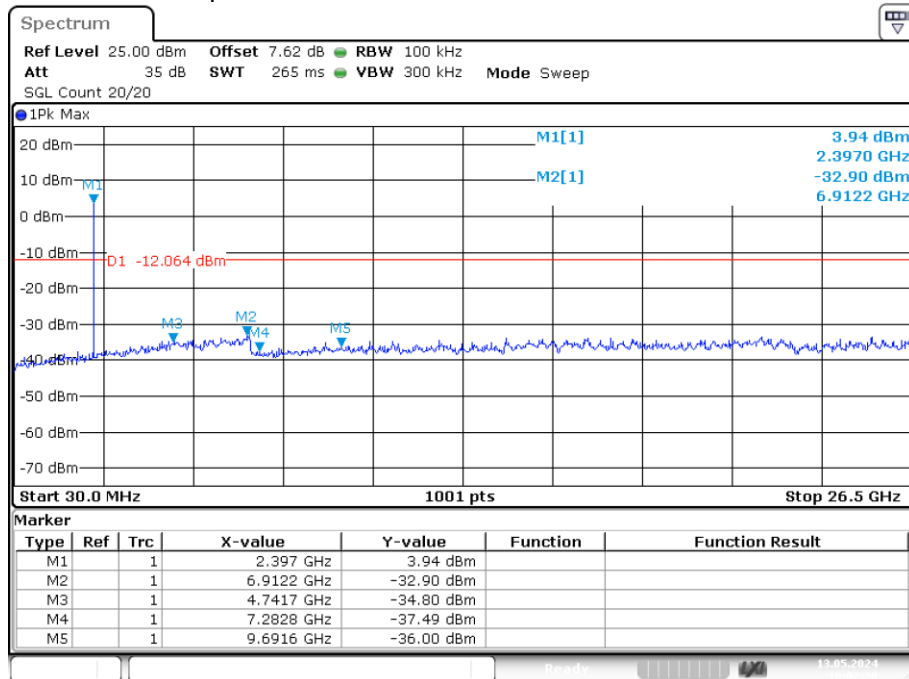
Conducted RF Spurious Emission

Tx. Spurious NVNT BLE 1M 2402MHz Ant1 Ref



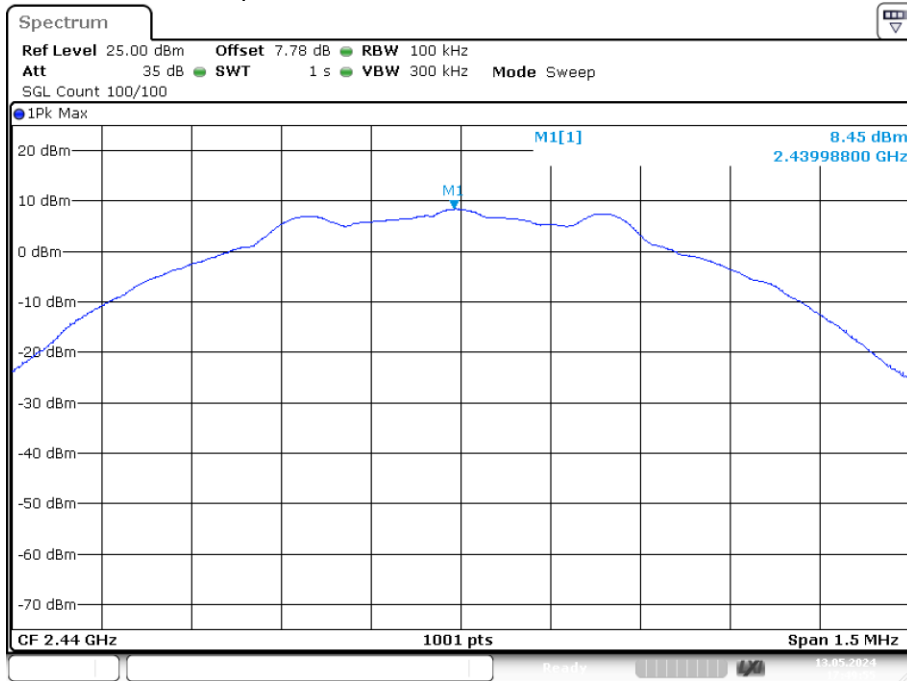
Date: 13.MAY.2024 18:01:47

Tx. Spurious NVNT BLE 1M 2402MHz Ant1 Emission



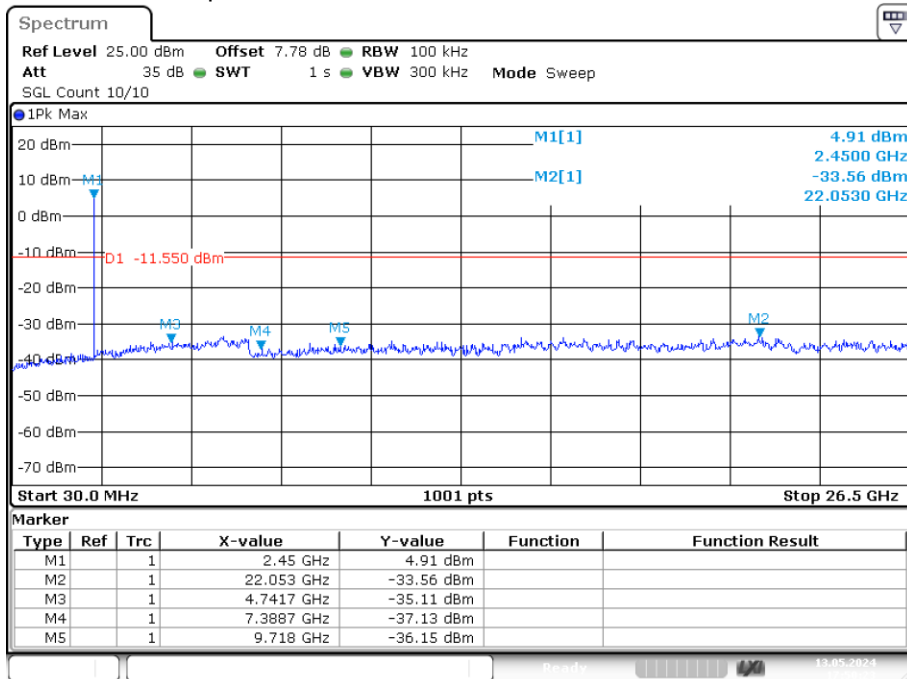
Date: 13.MAY.2024 18:02:20

Tx. Spurious NVNT BLE 1M 2440MHz Ant1 Ref



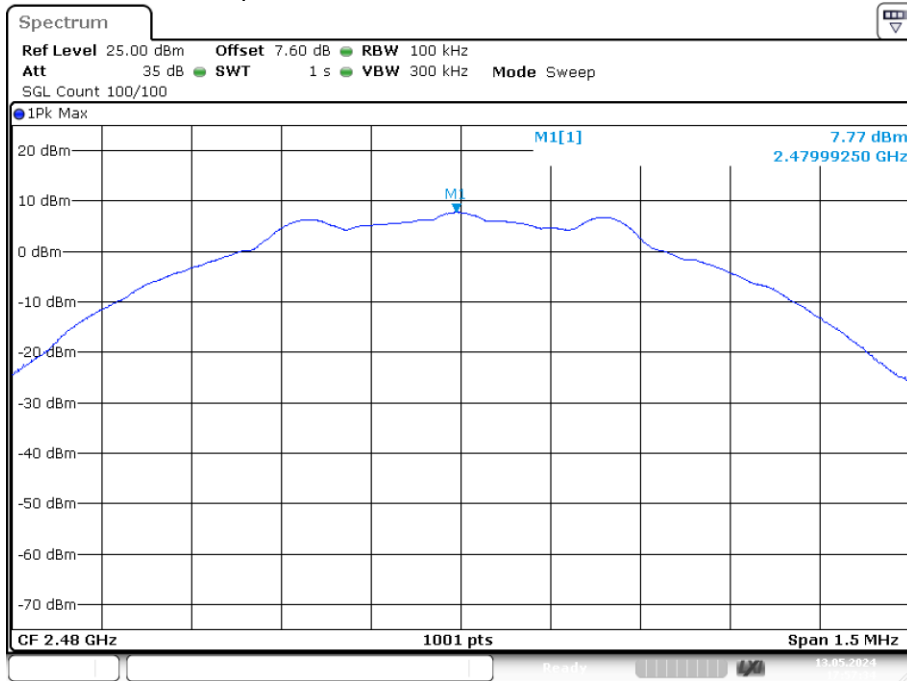
Date: 13.MAY.2024 17:49:55

Tx. Spurious NVNT BLE 1M 2440MHz Ant1 Emission



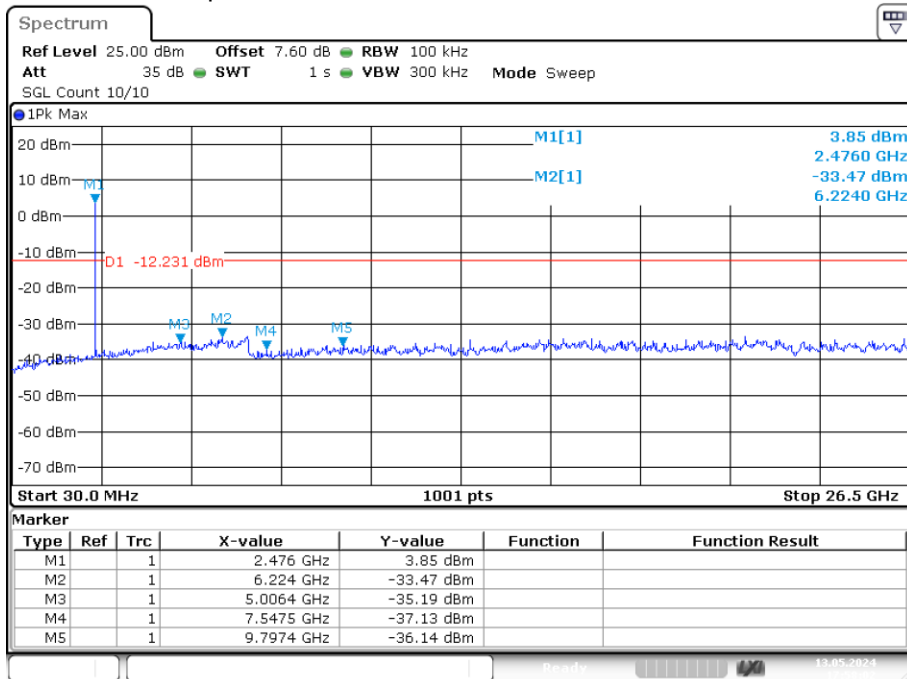
Date: 13.MAY.2024 17:50:22

Tx. Spurious NVNT BLE 1M 2480MHz Ant1 Ref



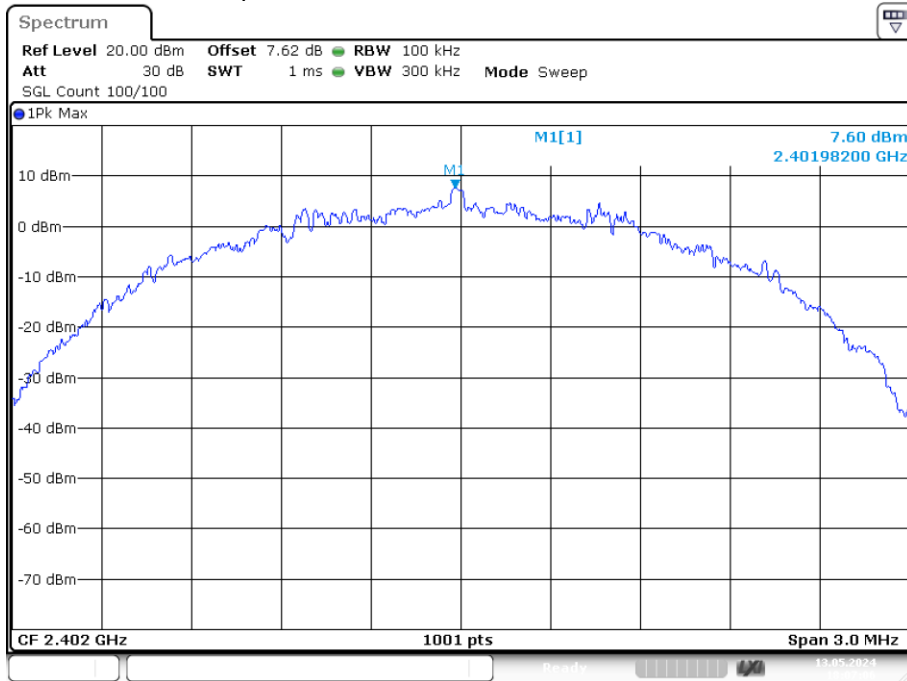
Date: 13.MAY.2024 17:57:34

Tx. Spurious NVNT BLE 1M 2480MHz Ant1 Emission



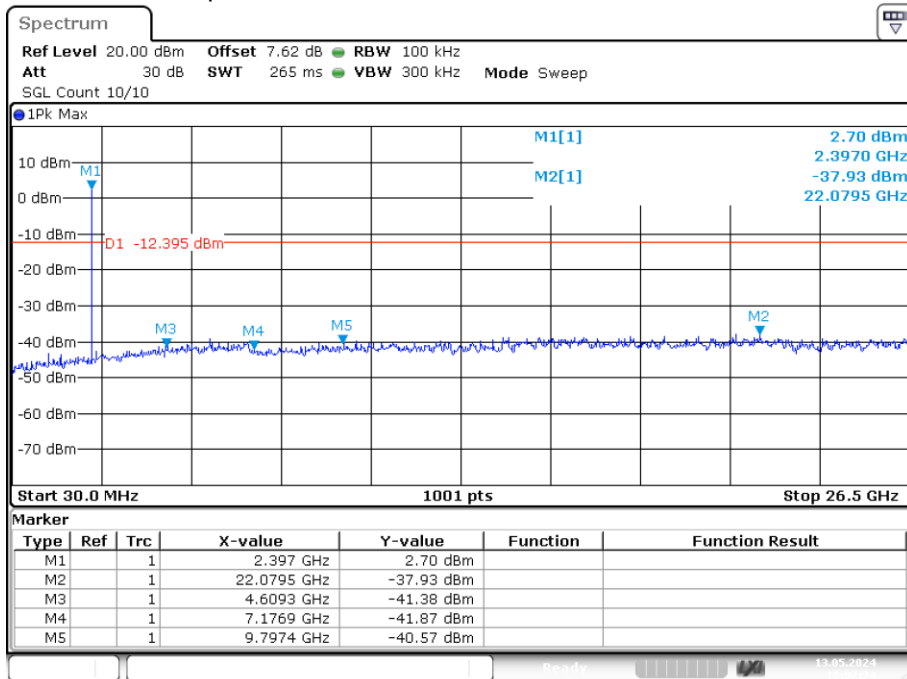
Date: 13.MAY.2024 17:58:01

Tx. Spurious NVNT BLE 2M 2402MHz Ant1 Ref



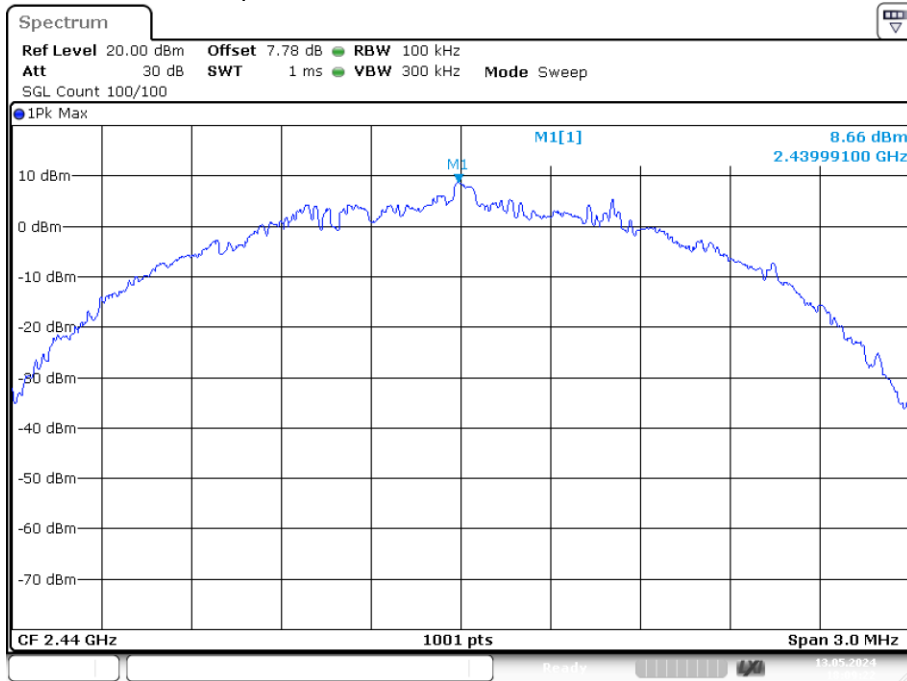
Date: 13.MAY.2024 18:07:06

Tx. Spurious NVNT BLE 2M 2402MHz Ant1 Emission



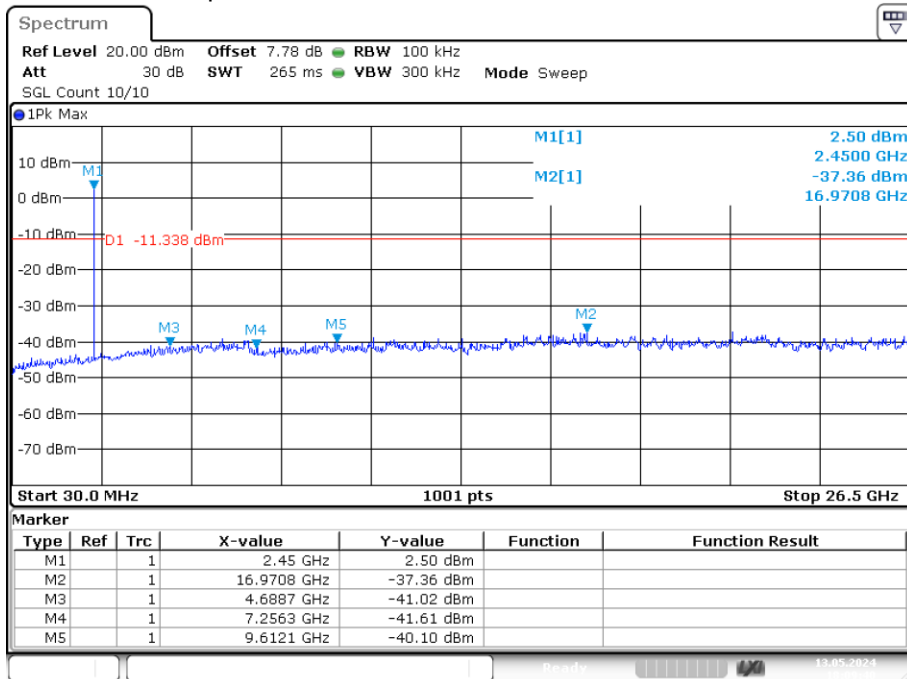
Date: 13.MAY.2024 18:07:24

Tx. Spurious NVNT BLE 2M 2440MHz Ant1 Ref



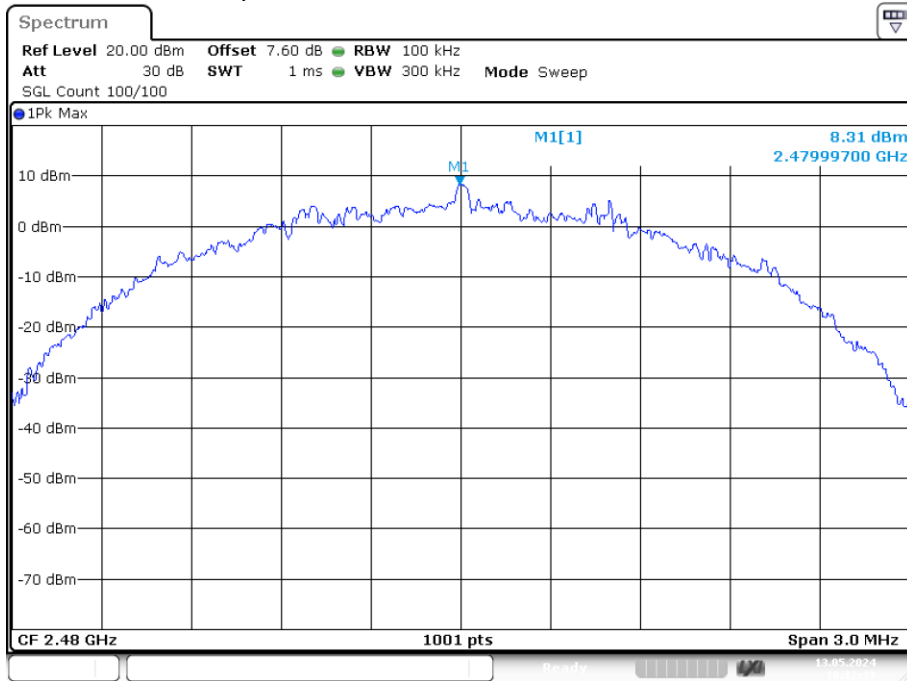
Date: 13.MAY.2024 18:09:23

Tx. Spurious NVNT BLE 2M 2440MHz Ant1 Emission



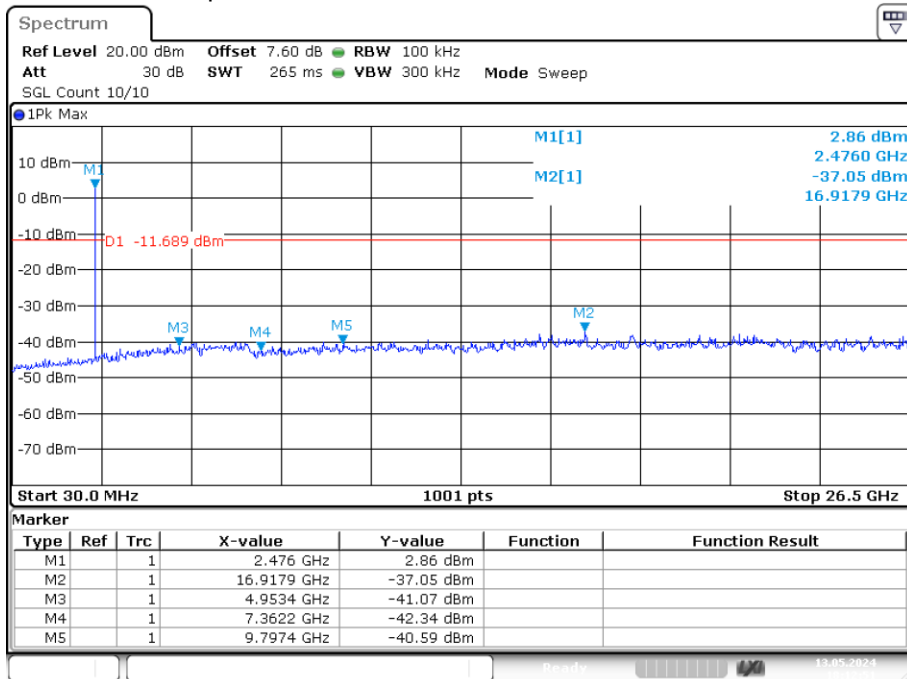
Date: 13.MAY.2024 18:09:41

Tx. Spurious NVNT BLE 2M 2480MHz Ant1 Ref



Date: 13.MAY.2024 18:12:33

Tx. Spurious NVNT BLE 2M 2480MHz Ant1 Emission



Date: 13.MAY.2024 18:12:51

4. POWER LINE CONDUCTED EMISSION

4.1. Test Limits

| Frequency MHz | Limits dB(μ V) | |
|------------------|---------------------|---------------|
| | Quasi-peak Level | Average Level |
| 0.15 -0.50 | 66 -56* | 56 - 46* |
| 0.50 -5.00 | 56 | 46 |
| 5.00 -30.00 | 60 | 50 |

Notes: 1. *Decreasing linearly with logarithm of frequency.

2. The lower limit shall apply at the transition frequencies.

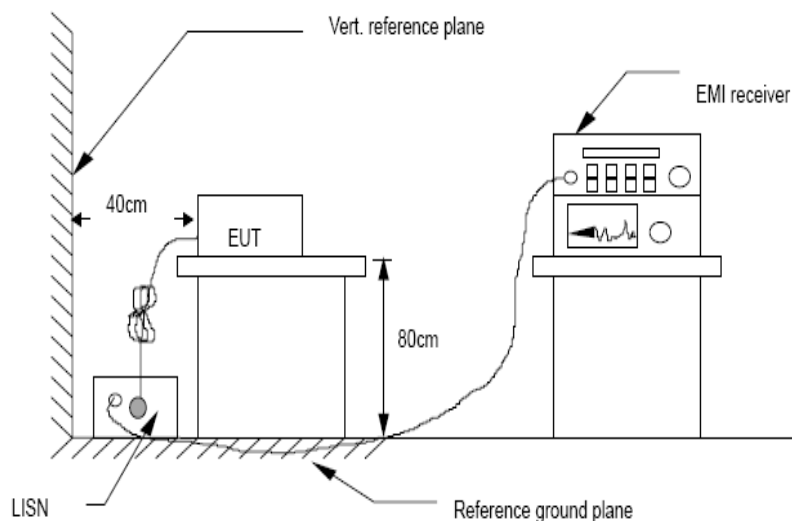
3. The limit decreases in line with the logarithm of the frequency in rang of 0.15 to 0.50 MHz.

4.2. Test Procedure

The EUT is put on the plane 0.8m high above the ground by insulating support and is connected to the power mains through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm coupling impedance for the EUT system. Please refer the block diagram of the test setup and photographs. Both sides of AC lines are checked to find out the maximum conducted emission. In order to find the maximum emission levels, the relative positions of equipment and all of the interface cables shall be changed according to ANSI C63.10:2013 on Conducted Emission Measurement.

The bandwidth of test receiver is set at 9 kHz.

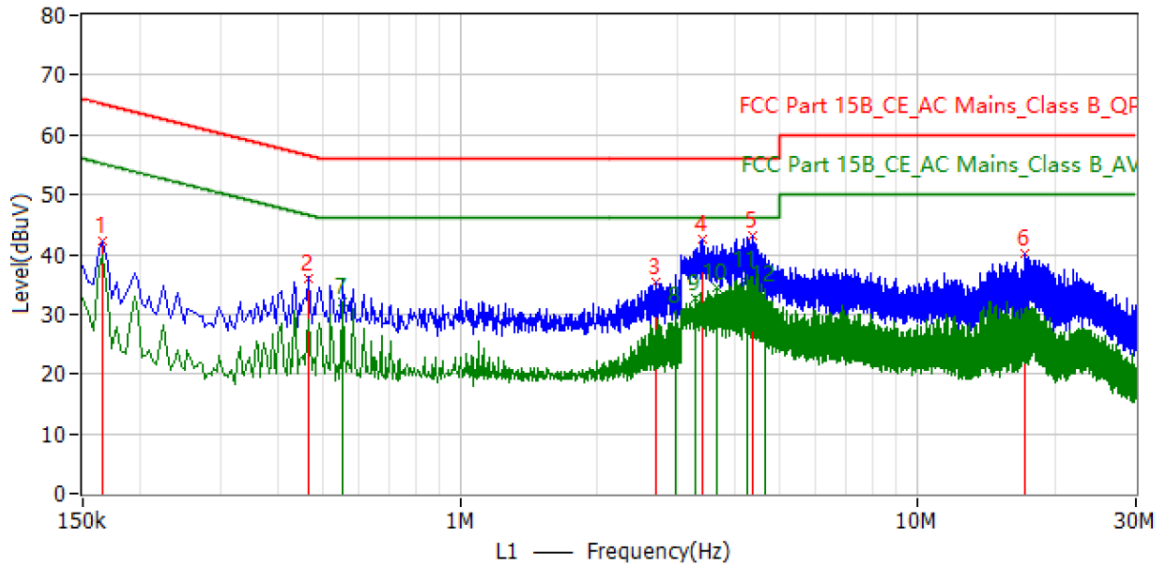
4.3. Test Setup



4.4. Test Results

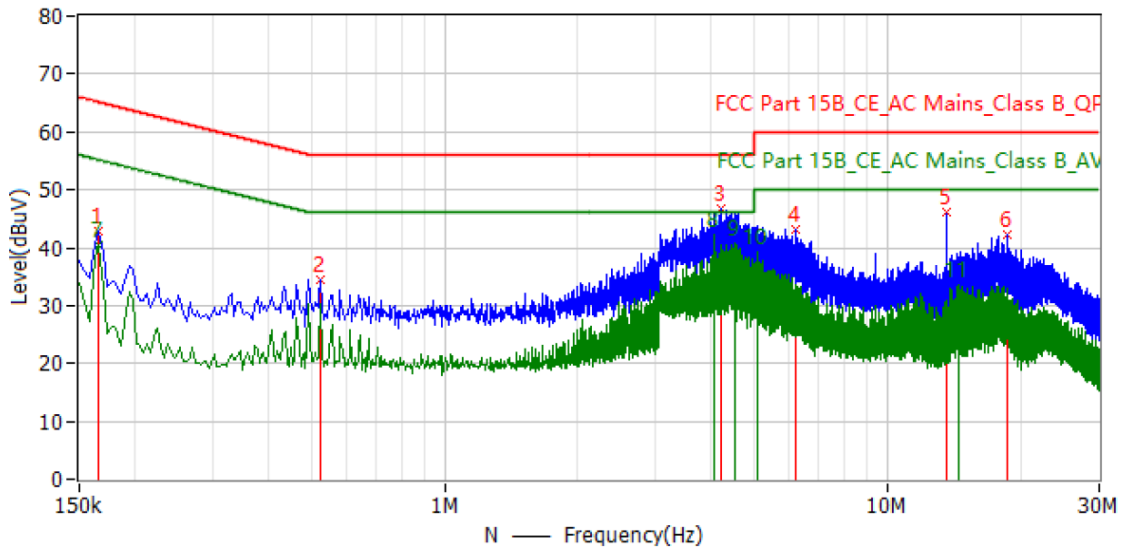
Pass

Line:



| No. | Frequency | Limit dBuV | Level dBuV | Delta dB | Factor dB | Detector | Polar |
|-----|-------------|------------|------------|----------|-----------|----------|-------|
| 1* | 166.000 kHz | 65.2 | 42.1 | -23.0 | 15.5 | PK | L1 |
| 2* | 466.000 kHz | 56.6 | 36.1 | -20.5 | 13.8 | PK | L1 |
| 3* | 2.670 MHz | 56.0 | 35.4 | -20.6 | 13.9 | PK | L1 |
| 4* | 3.374 MHz | 56.0 | 42.6 | -13.4 | 13.9 | PK | L1 |
| 5* | 4.350 MHz | 56.0 | 43.1 | -12.9 | 13.9 | PK | L1 |
| 6* | 17.206 MHz | 60.0 | 40.1 | -19.9 | 14.1 | PK | L1 |
| 7* | 554.000 kHz | 46.0 | 32.0 | -14.0 | 13.8 | AV | L1 |
| 8* | 2.954 MHz | 46.0 | 30.7 | -15.3 | 13.9 | AV | L1 |
| 9* | 3.270 MHz | 46.0 | 32.8 | -13.2 | 13.9 | AV | L1 |
| 10* | 3.630 MHz | 46.0 | 34.5 | -11.5 | 13.9 | AV | L1 |
| 11* | 4.230 MHz | 46.0 | 36.5 | -9.5 | 13.9 | AV | L1 |
| 12* | 4.634 MHz | 46.0 | 34.1 | -11.9 | 13.9 | AV | L1 |

Neutral:



| No. | Frequency | Limit dBuV | Level dBuV | Delta dB | Factor dB | Detector | Polar |
|-----|-------------|------------|------------|----------|-----------|----------|-------|
| 1* | 166.000 kHz | 65.2 | 42.8 | -22.4 | 15.5 | PK | N |
| 2* | 526.000 kHz | 56.0 | 34.5 | -21.5 | 13.7 | PK | N |
| 3* | 4.214 MHz | 56.0 | 46.6 | -9.4 | 13.9 | PK | N |
| 4* | 6.194 MHz | 60.0 | 43.2 | -16.8 | 13.9 | PK | N |
| 5* | 13.554 MHz | 60.0 | 46.0 | -14.0 | 14.0 | PK | N |
| 6* | 18.630 MHz | 60.0 | 42.2 | -17.8 | 14.0 | PK | N |
| 7* | 166.000 kHz | 55.2 | 40.5 | -14.6 | 15.5 | AV | N |
| 8* | 4.050 MHz | 46.0 | 42.1 | -3.9 | 13.9 | AV | N |
| 9* | 4.530 MHz | 46.0 | 40.7 | -5.3 | 13.9 | AV | N |
| 10* | 5.070 MHz | 50.0 | 39.2 | -10.8 | 13.9 | AV | N |
| 11* | 14.506 MHz | 50.0 | 33.6 | -16.4 | 14.0 | AV | N |

Note: This report shows the worst-case testing mode, with TX 2440MHz being the worst-case mode. (1Mbps)

5. CONDUCTED MAXIMUM OUTPUT POWER

5.1. Test limits

Please refer section 15.247.

5.2. Test Procedure

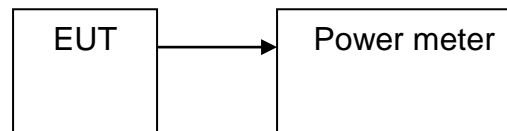
Details see the KDB558074 D01 Meas Guidance v05r02

5.2.1 Place the EUT on the table and set it in transmitting mode.

5.2.2 Measure out each mode and each bands peak output power of EUT.

Note: The cable loss and attenuator loss were offset into measure device as amplitude offset.

5.3. Test Setup



5.4. Test Results

| Mode | Frequency (MHz) | Antenna | Conducted Power (dBm) | Limit (dBm) | Verdict |
|--------|-----------------|---------|-----------------------|-------------|---------|
| BLE 1M | 2402 | Ant1 | 6.159 | 30 | Pass |
| BLE 1M | 2440 | Ant1 | 6.623 | 30 | Pass |
| BLE 1M | 2480 | Ant1 | 5.669 | 30 | Pass |

| Mode | Frequency (MHz) | Antenna | Conducted Power (dBm) | Limit (dBm) | Verdict |
|--------|-----------------|---------|-----------------------|-------------|---------|
| BLE 2M | 2402 | Ant1 | 6.345 | 30 | Pass |
| BLE 2M | 2440 | Ant1 | 6.559 | 30 | Pass |
| BLE 2M | 2480 | Ant1 | 6.406 | 30 | Pass |

6. PEAK POWER SPECTRAL DENSITY

6.1. Test limits

6.1.1 Please refer section 15.247.

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

6.1.3 The direct sequence operating of the hybrid system, with the frequency hopping operation turned off, shall comply with the power density requirements of paragraph (d) of this section.

6.2. Test Procedure

Details see the KDB558074 D01 Meas Guidance v05r02

6.2.1 Place the EUT on the table and set it in transmitting mode.

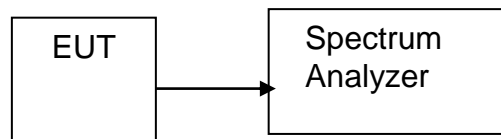
6.2.2 Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

6.2.3 Set the spectrum analyzer as RBW = 3kHz(Set the RBW to: $3\text{ kHz} \leq \text{RBW} \leq 100\text{ kHz}$.), VBW = 10kHz(Set the VBW $\geq 3 \times \text{RBW}$), span $\geq 1.5 \times \text{DTS bandwidth}$., detail see the test plot.

6.2.4 Record the max reading.

6.2.5 Repeat the above procedure until the measurements for all frequencies are completed.

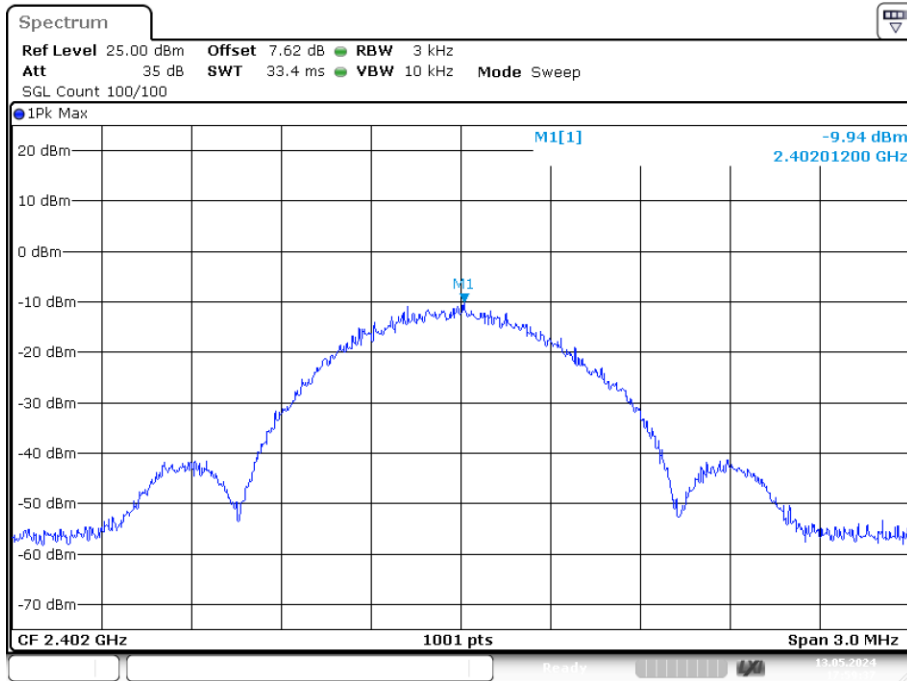
6.3. Test Setup



6.4. Test Results

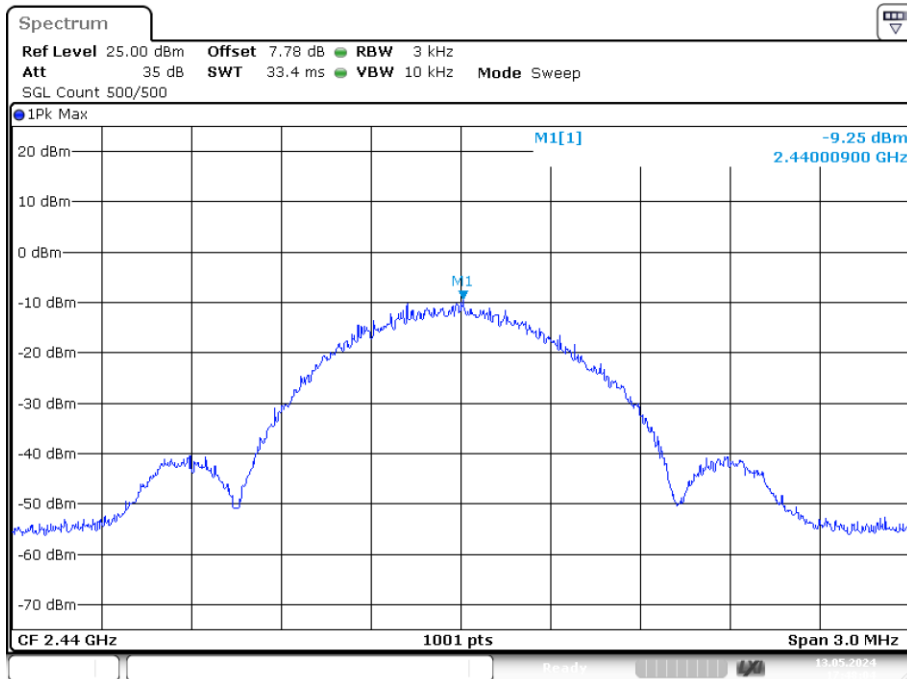
| Condition | Mode | Frequency (MHz) | Antenna | Max PSD (dBm) | Limit (dBm) | Verdict |
|-----------|------|-----------------|---------|---------------|-------------|---------|
| NVNT | 1M | 2402 | Ant1 | -9.941 | 8 | Pass |
| NVNT | 1M | 2440 | Ant1 | -9.253 | 8 | Pass |
| NVNT | 1M | 2480 | Ant1 | -10.076 | 8 | Pass |

PSD NVNT BLE 1M 2402MHz Ant1



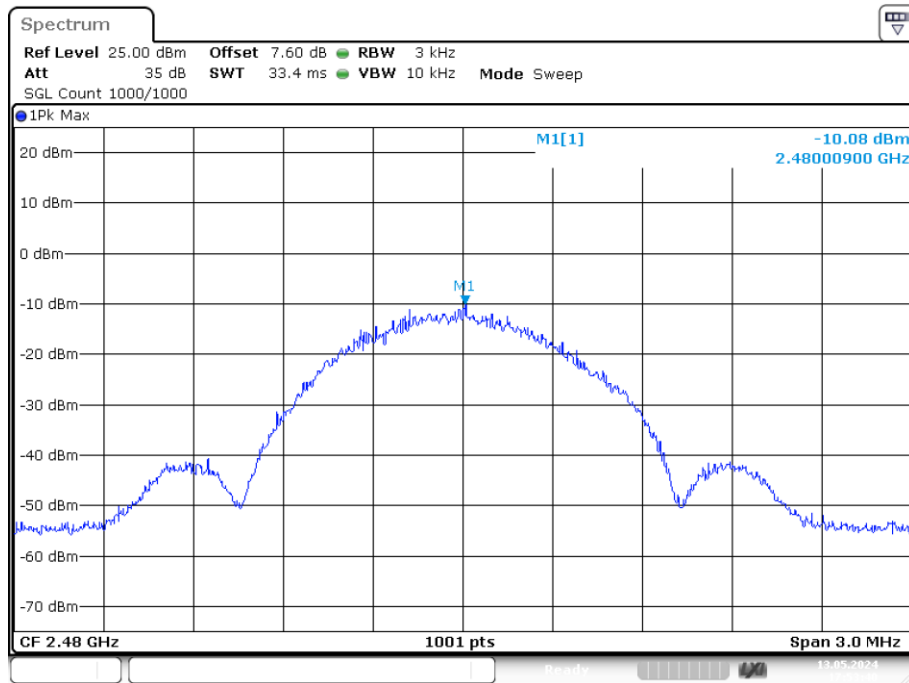
Date: 13.MAY.2024 17:59:36

PSD NVNT BLE 1M 2440MHz Ant1



Date: 13.MAY.2024 17:48:03

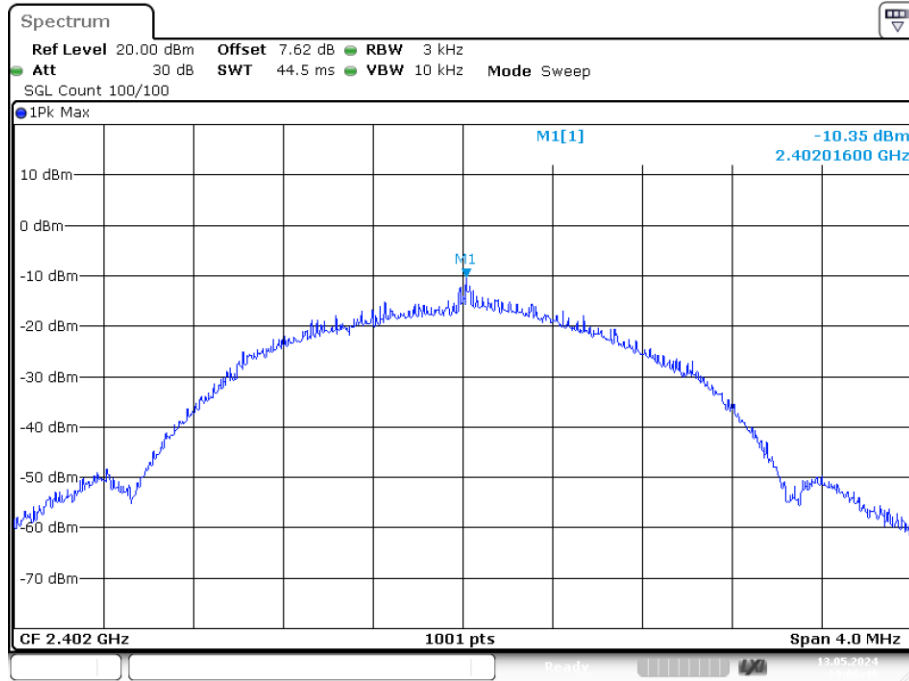
PSD NVNT BLE 1M 2480MHz Ant1



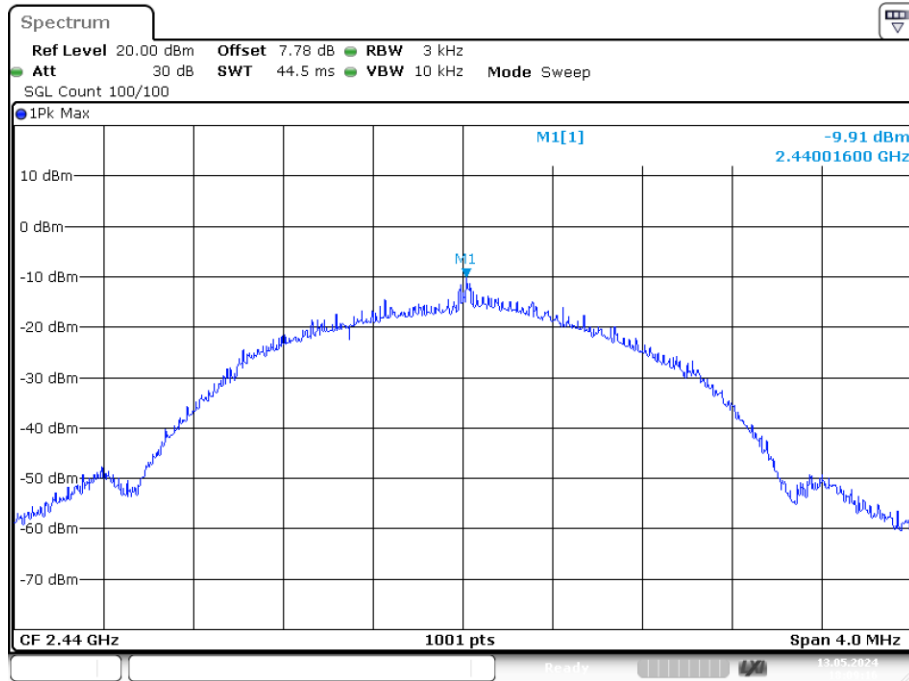
Date: 13.MAY.2024 17:53:40

| Condition | Mode | Frequency (MHz) | Antenna | Max PSD (dBm) | Limit (dBm) | Verdict |
|-----------|--------|-----------------|---------|---------------|-------------|---------|
| NVNT | BLE 2M | 2402 | Ant1 | -10.349 | 8 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | -9.913 | 8 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | -10.369 | 8 | Pass |

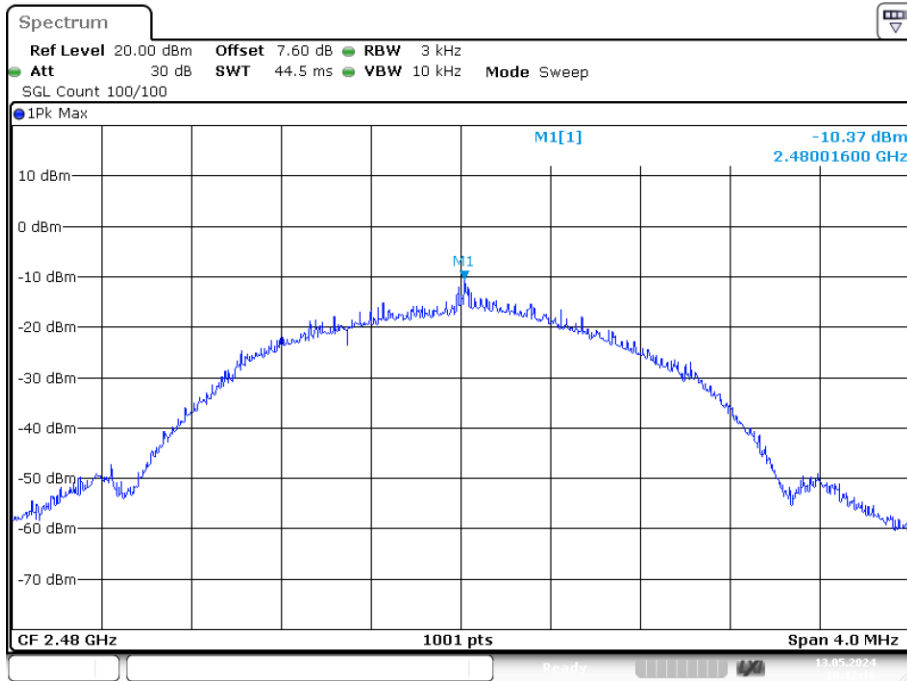
PSD NVNT BLE 2M 2402MHz Ant1



PSD NVNT BLE 2M 2440MHz Ant1



PSD NVNT BLE 2M 2480MHz Ant1



Date: 13.MAY.2024 18:12:16

7. BANDWIDTH

7.1. Test limits

Please refer section 15.247

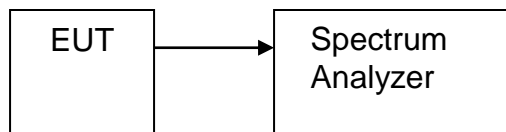
For direct sequence systems, the minimum 6dB bandwidth shall be at least 500 kHz.

7.2. Test Procedure

Details see the KDB558074 D01 Meas Guidance v05r02

- a) The bandwidth is measured at an amplitude level reduced 6dB from the reference level. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.
- b) The test receiver set $RBW = 1-5\%BW$, $VBW \geq 3*RBW$, Sweep time set auto, detail see the test plot for 99% Bandwidth.
- c) The test receiver set $RBW = 100kHz$, $VBW \geq 3*RBW = 300kHz$, Sweep time set auto, detail see the test plot for 6dB Bandwidth.

7.3. Test Setup

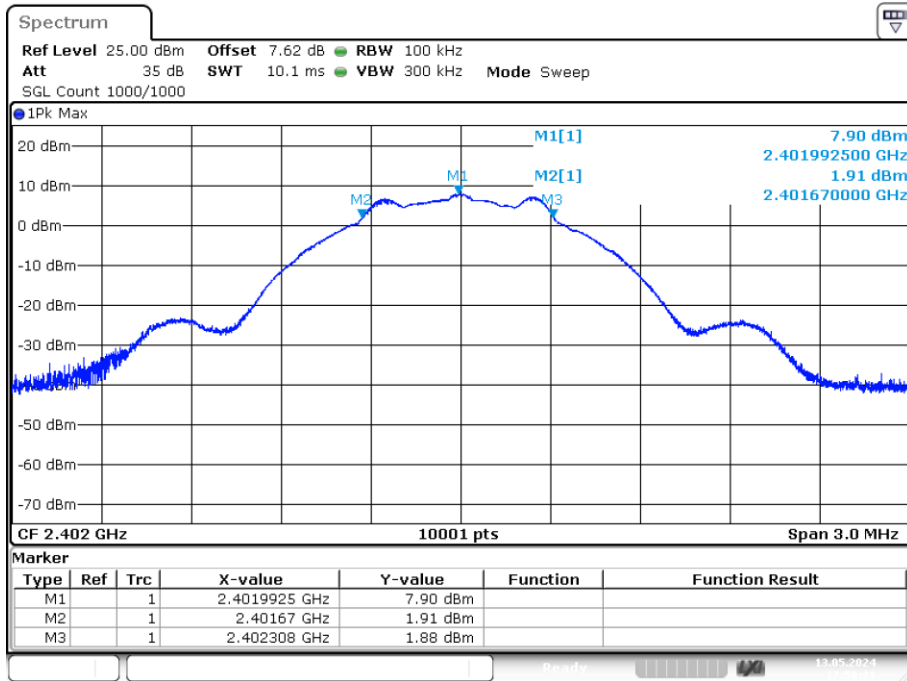


7.4. Test Results

-6dB Bandwidth

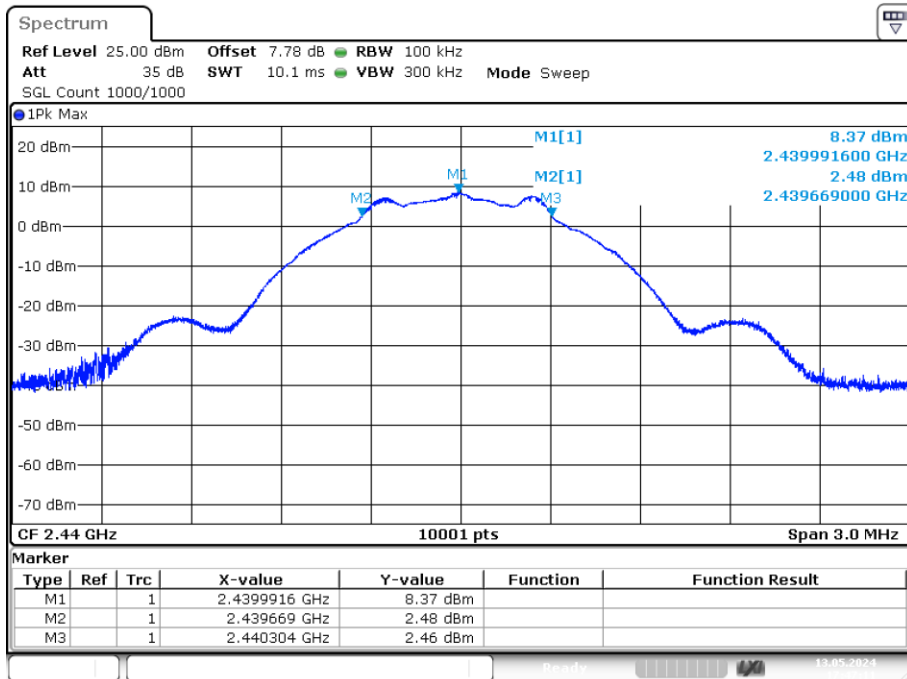
| Condition | Mode | Frequency (MHz) | Antenna | -6 dB Bandwidth (MHz) | Limit -6 dB Bandwidth (MHz) | Verdict |
|-----------|------|-----------------|---------|-----------------------|-----------------------------|---------|
| NVNT | 1M | 2402 | Ant1 | 0.638 | 0.5 | Pass |
| NVNT | 1M | 2440 | Ant1 | 0.636 | 0.5 | Pass |
| NVNT | 1M | 2480 | Ant1 | 0.636 | 0.5 | Pass |

-6dB Bandwidth NVNT BLE 1M 2402MHz Ant1



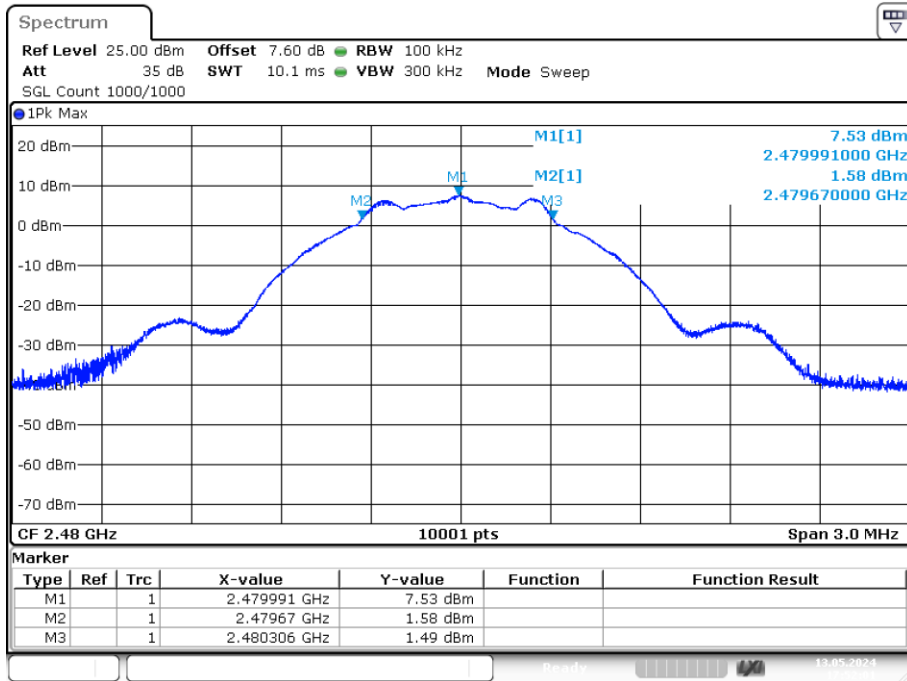
Date: 13.MAY.2024 17:59:20

-6dB Bandwidth NVNT BLE 1M 2440MHz Ant1



Date: 13.MAY.2024 17:47:11

-6dB Bandwidth NVNT BLE 1M 2480MHz Ant1

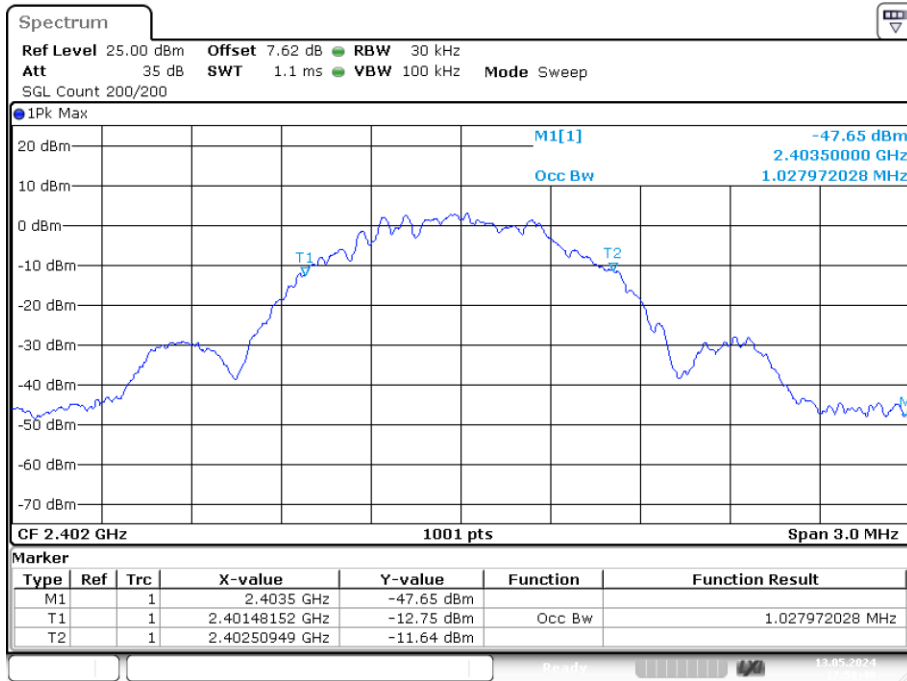


Date: 13.MAY.2024 17:52:00

Occupied Channel Bandwidth

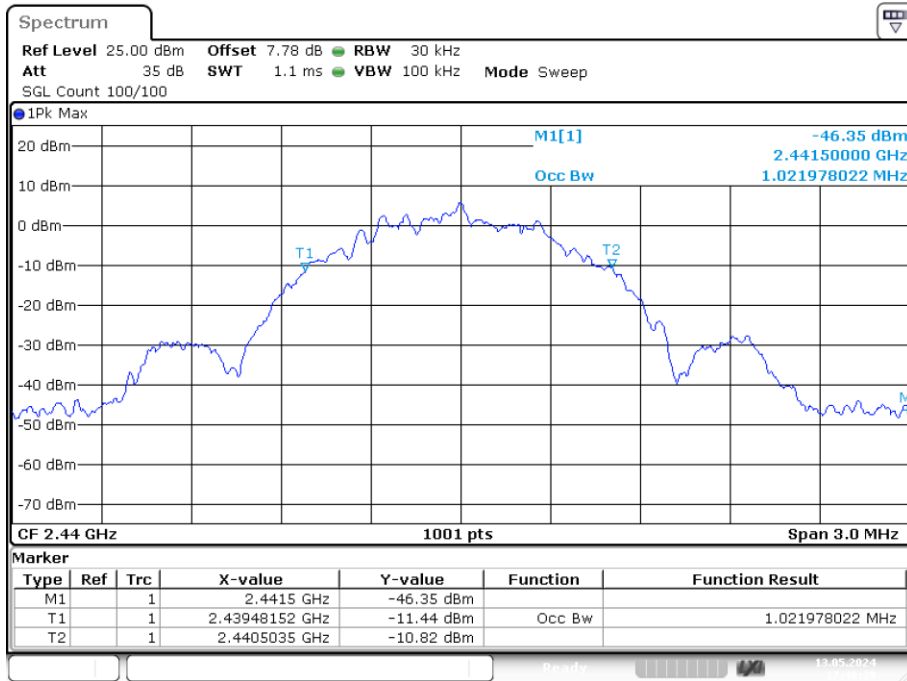
| Condition | Mode | Frequency (MHz) | Antenna | 99% OBW (MHz) |
|-----------|--------|-----------------|---------|---------------|
| NVNT | BLE 1M | 2402 | Ant1 | 1.028 |
| NVNT | BLE 1M | 2440 | Ant1 | 1.022 |
| NVNT | BLE 1M | 2480 | Ant1 | 1.013 |

OBW NVNT BLE 1M 2402MHz Ant1



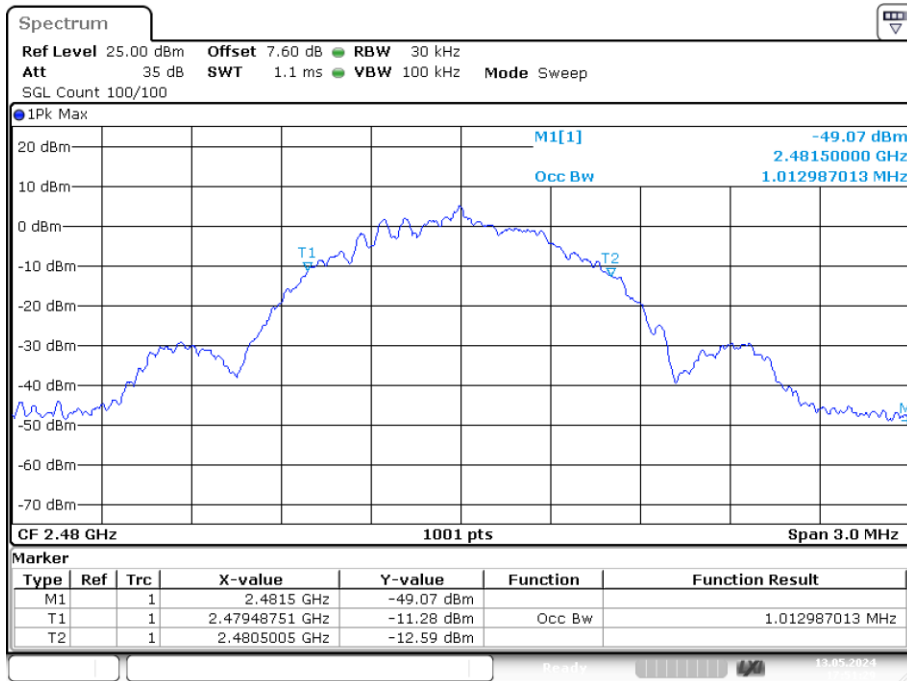
Date: 13.MAY.2024 17:58:48

OBW NVNT BLE 1M 2440MHz Ant1



Date: 13.MAY.2024 17:46:39

OBW NVNT BLE 1M 2480MHz Ant1

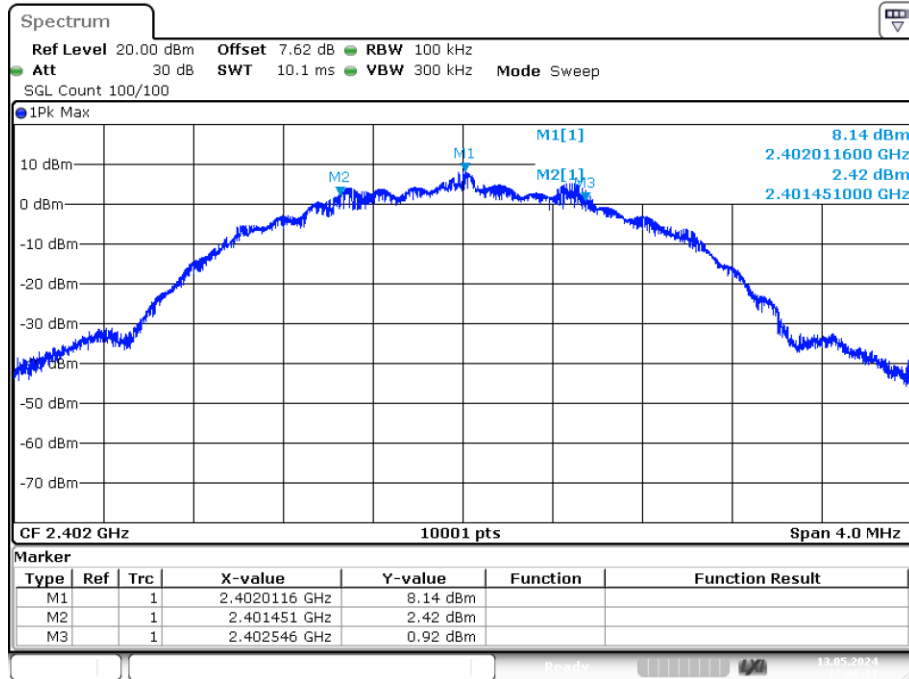


Date: 13.MAY.2024 17:51:29

-6dB Bandwidth

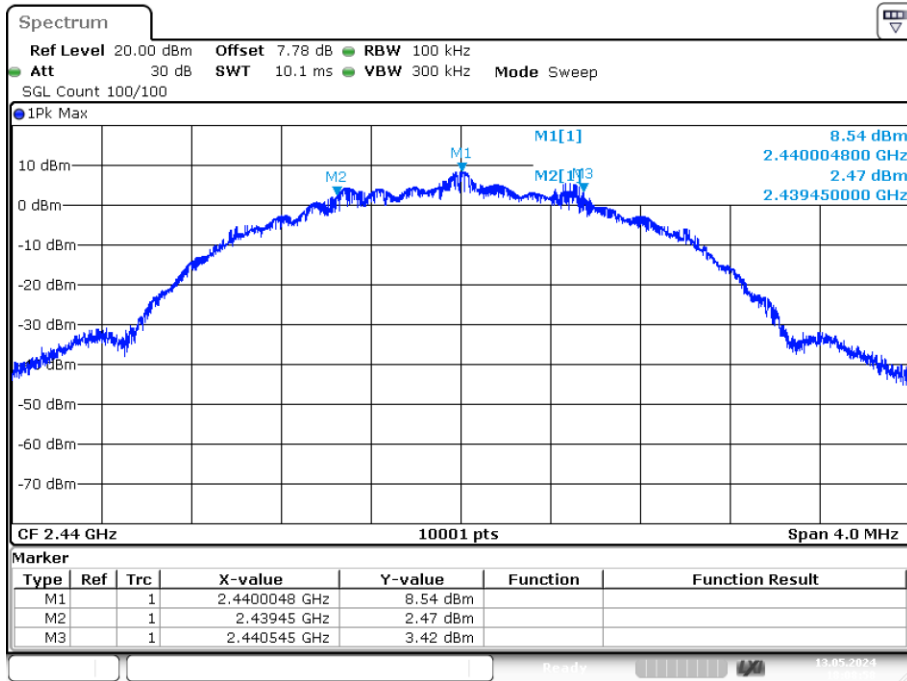
| Condition | Mode | Frequency (MHz) | Antenna | -6 dB Bandwidth (MHz) | Limit -6 dB Bandwidth (MHz) | Verdict |
|-----------|--------|-----------------|---------|-----------------------|-----------------------------|---------|
| NVNT | BLE 2M | 2402 | Ant1 | 1.095 | 0.5 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 1.095 | 0.5 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 1.106 | 0.5 | Pass |

-6dB Bandwidth NVNT BLE 2M 2402MHz Ant1



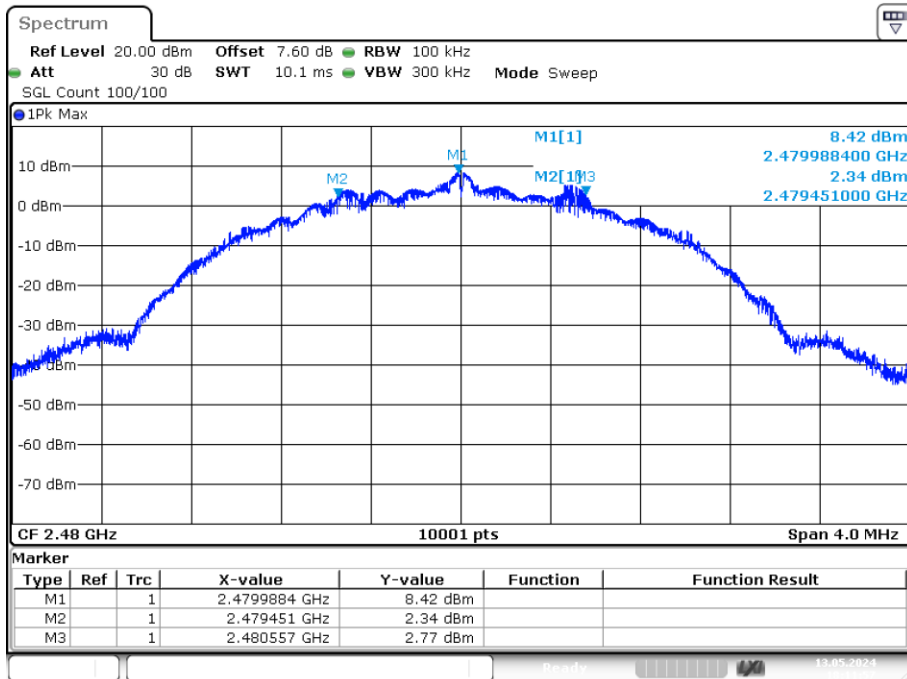
Date: 13.MAY.2024 18:06:31

-6dB Bandwidth NVNT BLE 2M 2440MHz Ant1



Date: 13.MAY.2024 18:08:58

-6dB Bandwidth NVNT BLE 2M 2480MHz Ant1

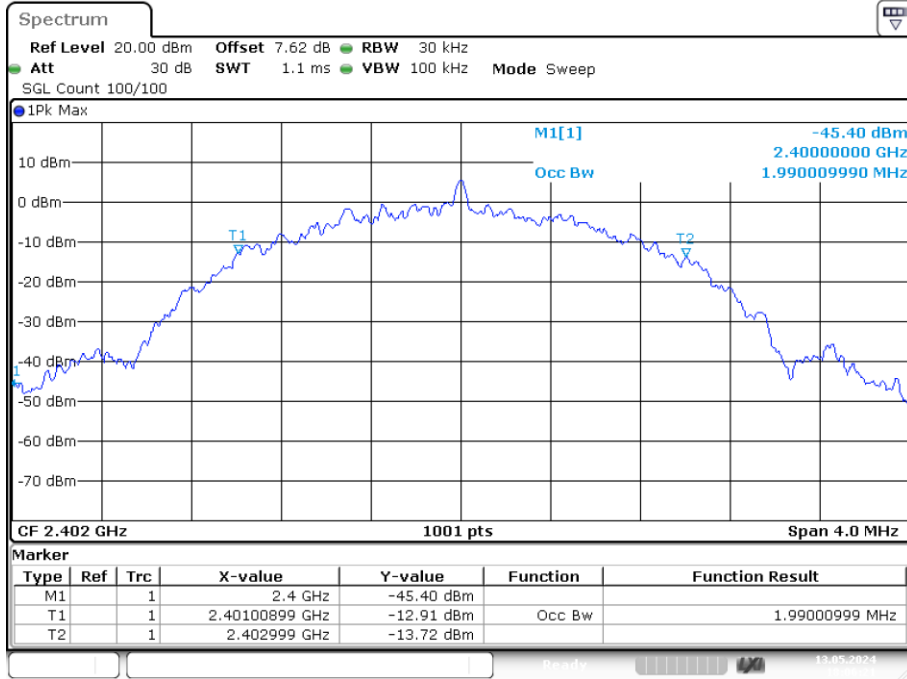


Date: 13.MAY.2024 18:11:58

Occupied Channel Bandwidth

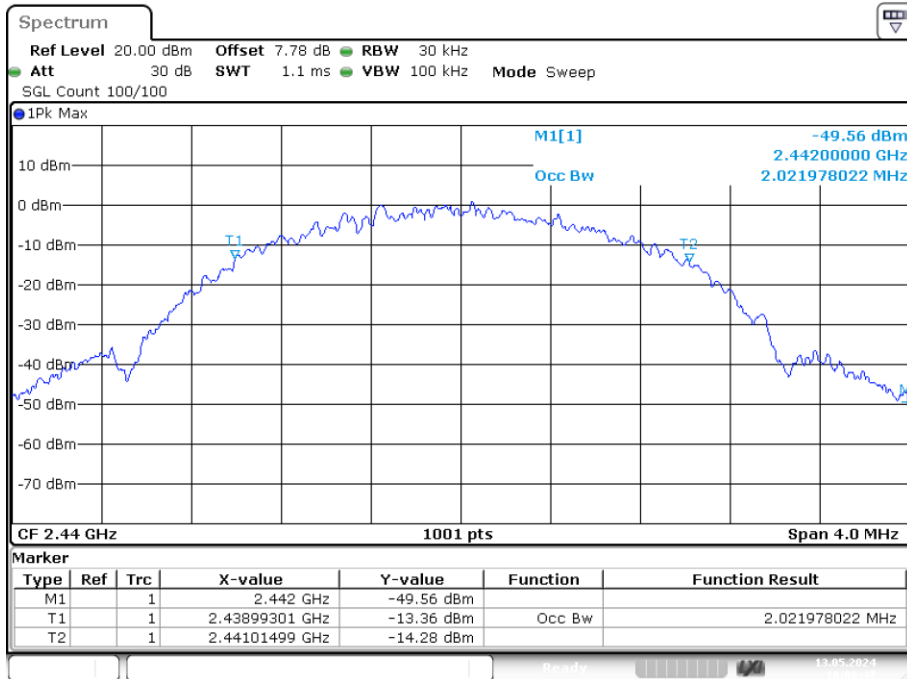
| Condition | Mode | Frequency (MHz) | Antenna | 99% OBW (MHz) |
|-----------|--------|-----------------|---------|---------------|
| NVNT | BLE 2M | 2402 | Ant1 | 1.99 |
| NVNT | BLE 2M | 2440 | Ant1 | 2.022 |
| NVNT | BLE 2M | 2480 | Ant1 | 2.006 |

OBW NVNT BLE 2M 2402MHz Ant1



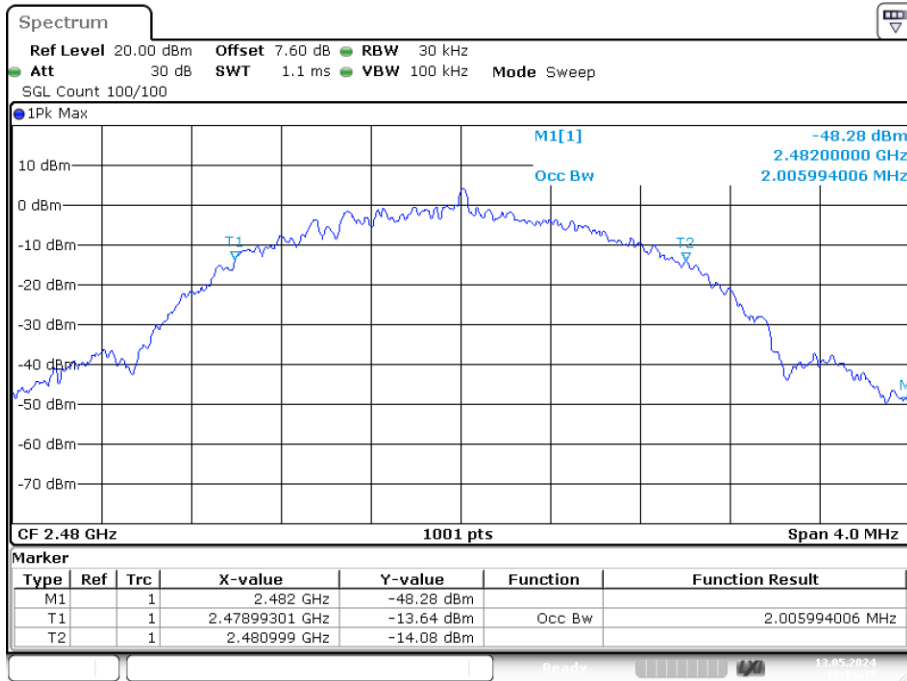
Date: 13.MAY.2024 18:06:20

OBW NVNT BLE 2M 2440MHz Ant1



Date: 13.MAY.2024 18:08:47

OBW NVNT BLE 2M 2480MHz Ant1



Date: 13.MAY.2024 18:11:48

8. BAND EDGE CHECK

8.1. Test limits

Please refer section 15.247.

8.2. Test Procedure

Details see the KDB558074 D01 Meas Guidance v05r02

8.2.1 Put the EUT on a 1.5m high table, power on the EUT. Emissions were scanned and measured rotating the EUT to 360 degrees, Find the maximum Emission

8.2.2 Check the spurious emissions out of band.

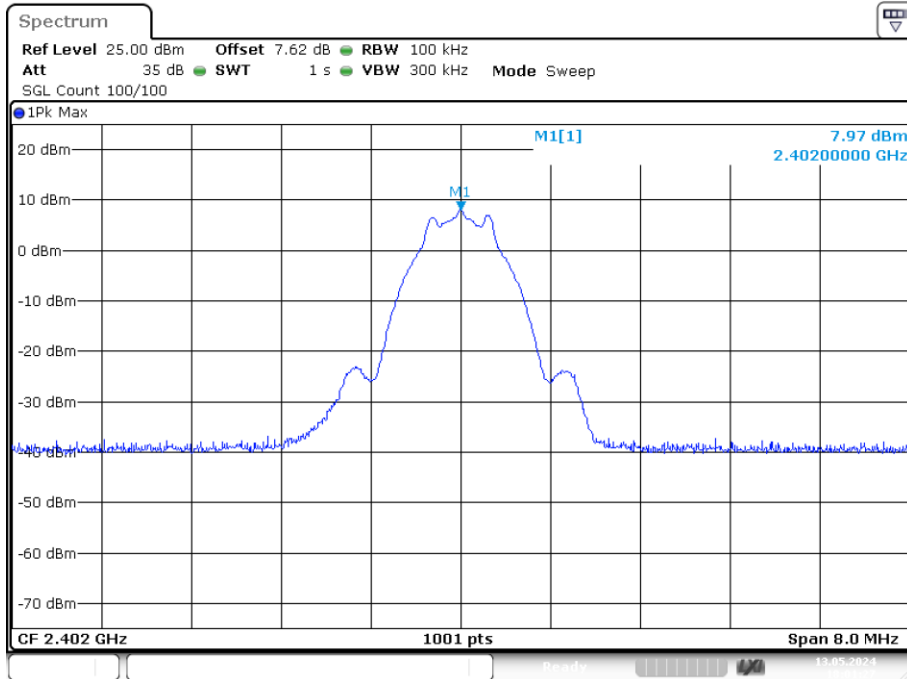
8.2.3 RBW 1MHz ,VBW 3MHz ,peak detector for peak value , RBW 1MHz ,VBW 3MHz ,RMS detector for AV value.

8.3. Test Setup

Same as 3.3 above 1GHz.

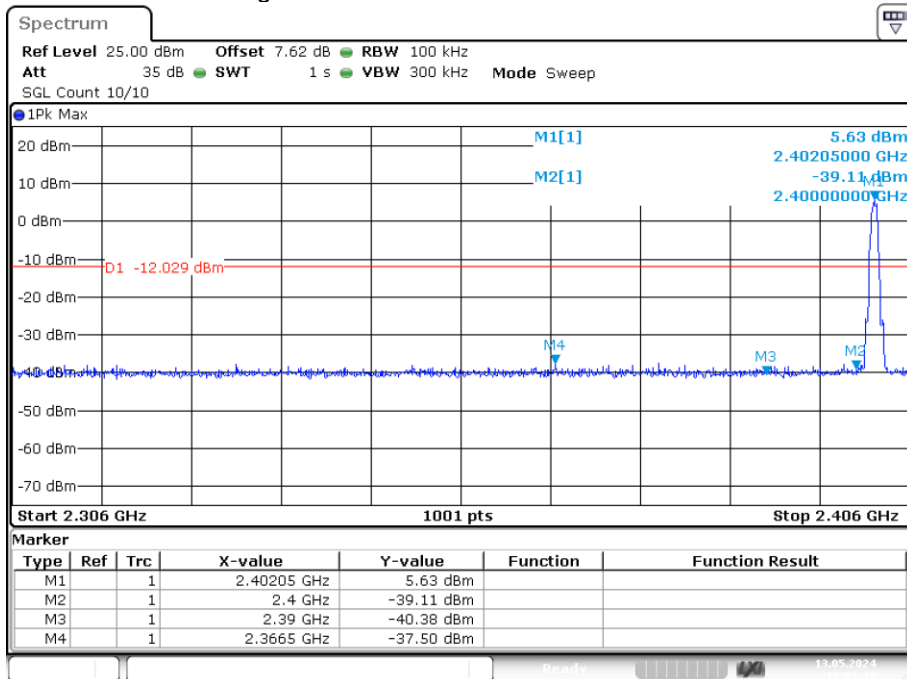
8.4. Test Results

Band Edge NVNT BLE 1M 2402MHz Ant1 Ref



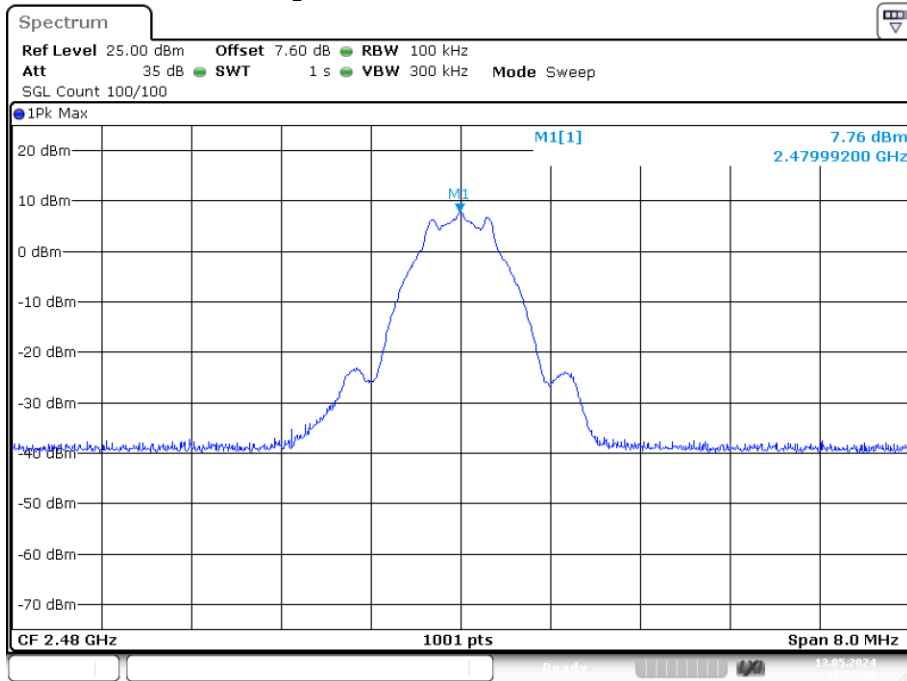
Date: 13.MAY.2024 18:01:27

Band Edge NVNT BLE 1M 2402MHz Ant1 Emission



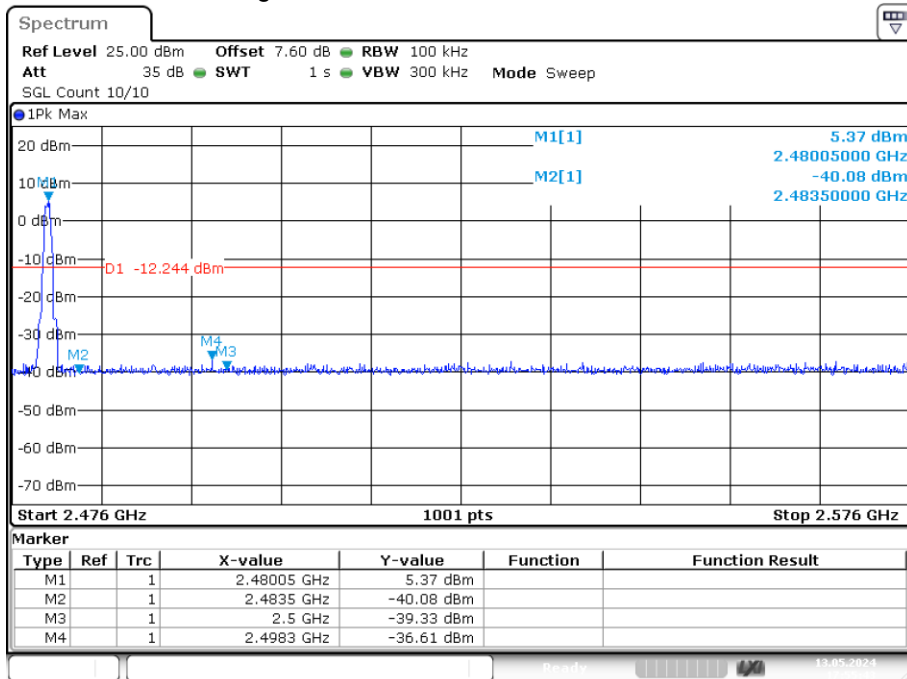
Date: 13.MAY.2024 18:01:40

Band Edge NVNT BLE 1M 2480MHz Ant1 Ref



Date: 13.MAY.2024 17:55:30

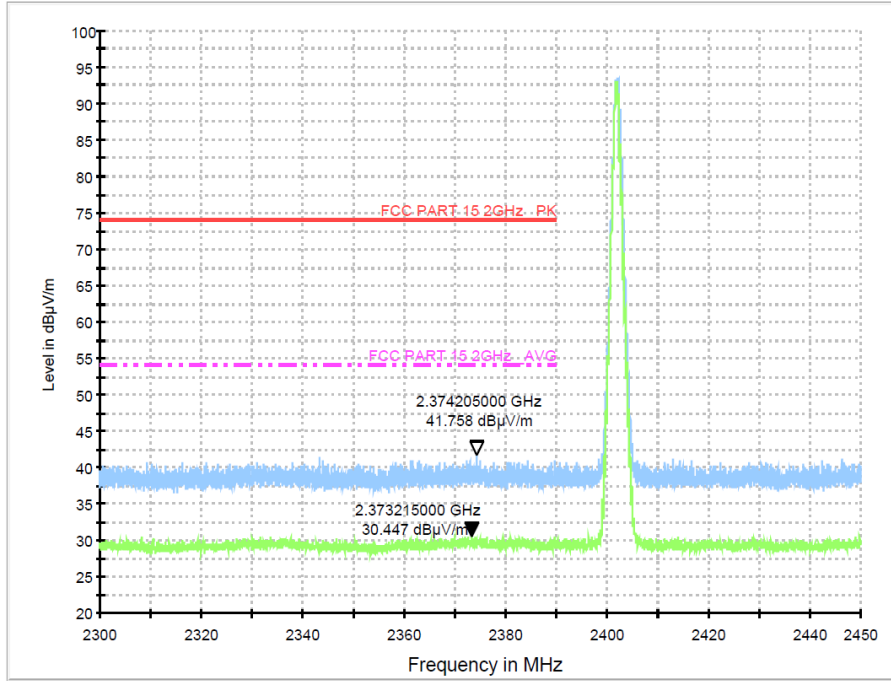
Band Edge NVNT BLE 1M 2480MHz Ant1 Emission



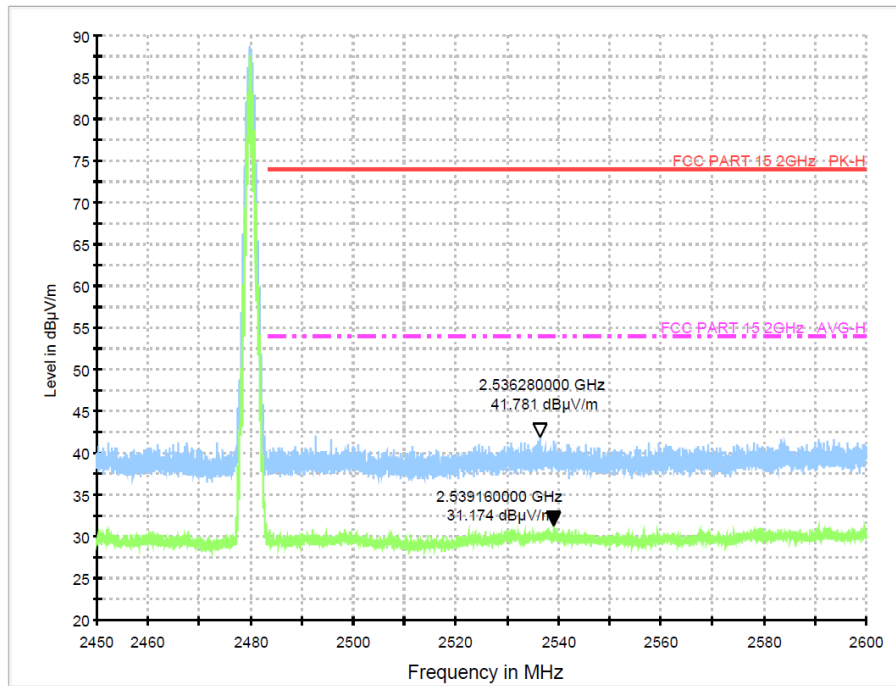
Date: 13.MAY.2024 17:55:43

GFSK 1M Mode:

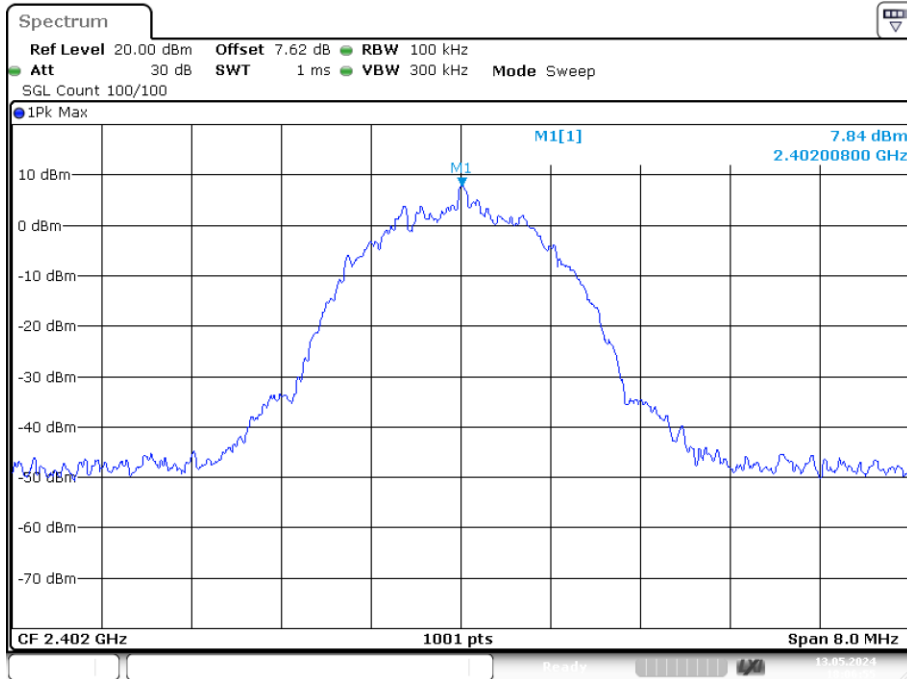
Test channel: Lowest channel



Test channel: Highest channel

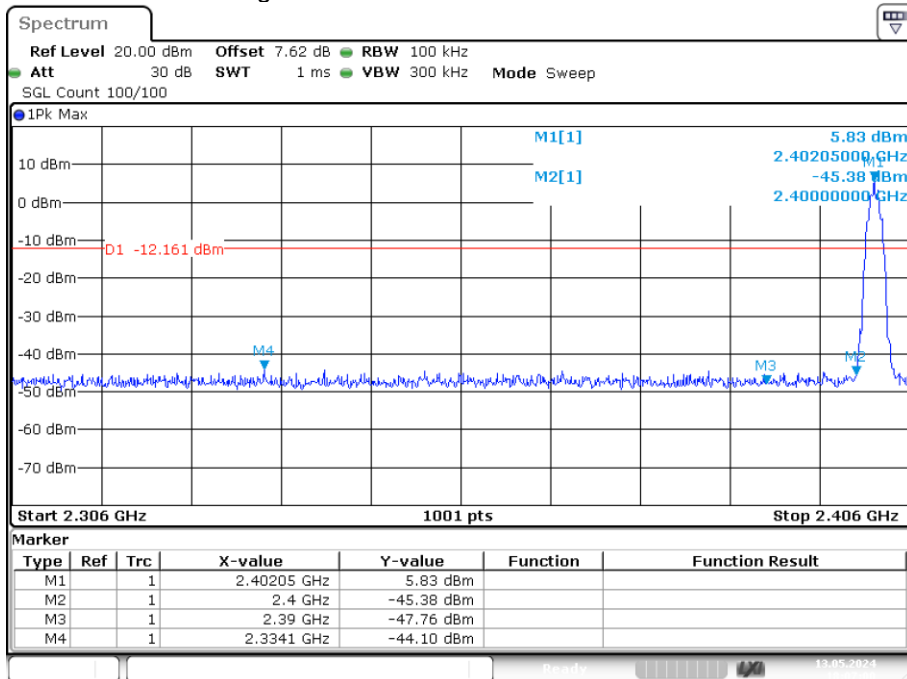


Band Edge NVNT BLE 2M 2402MHz Ant1 Ref



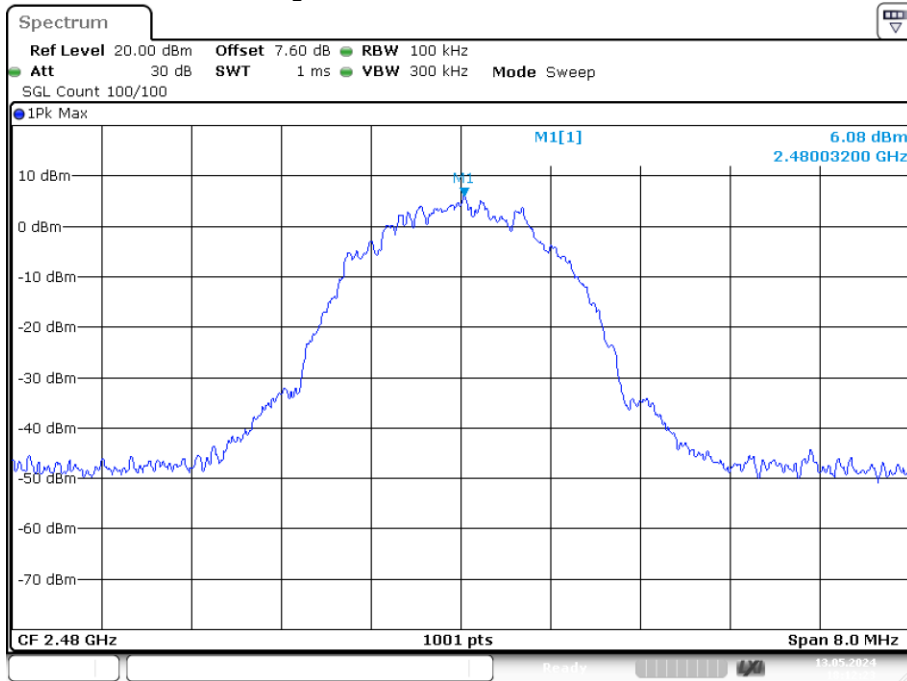
Date: 13.MAY.2024 18:06:55

Band Edge NVNT BLE 2M 2402MHz Ant1 Emission



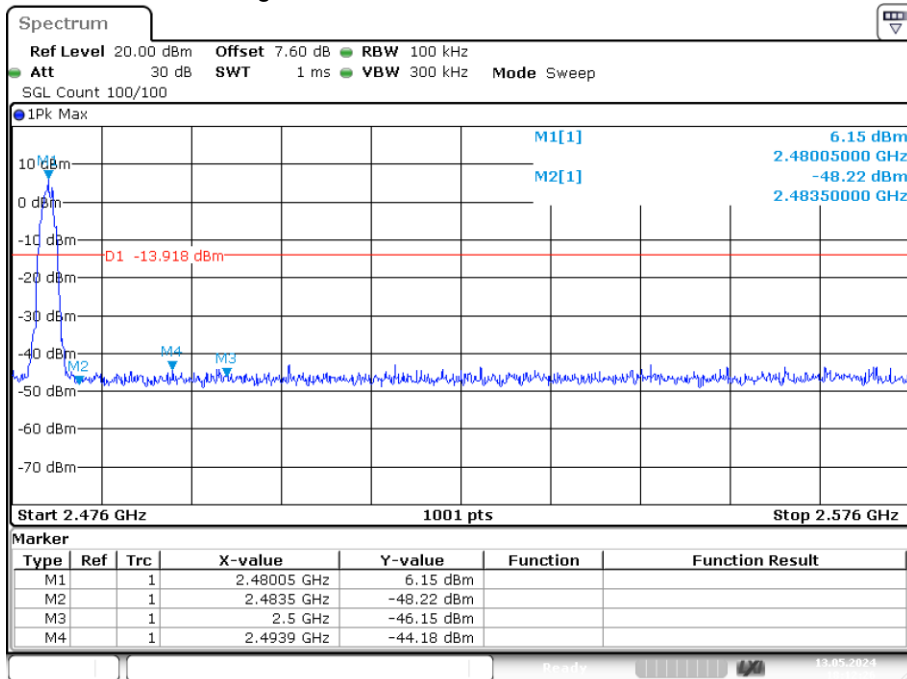
Date: 13.MAY.2024 18:06:59

Band Edge NVNT BLE 2M 2480MHz Ant1 Ref



Date: 13.MAY.2024 18:12:23

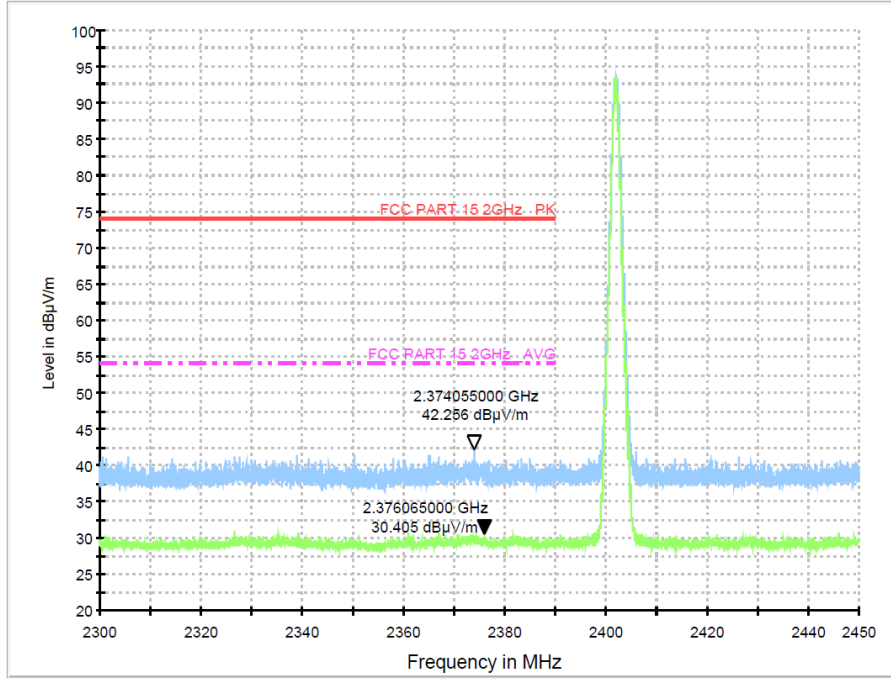
Band Edge NVNT BLE 2M 2480MHz Ant1 Emission



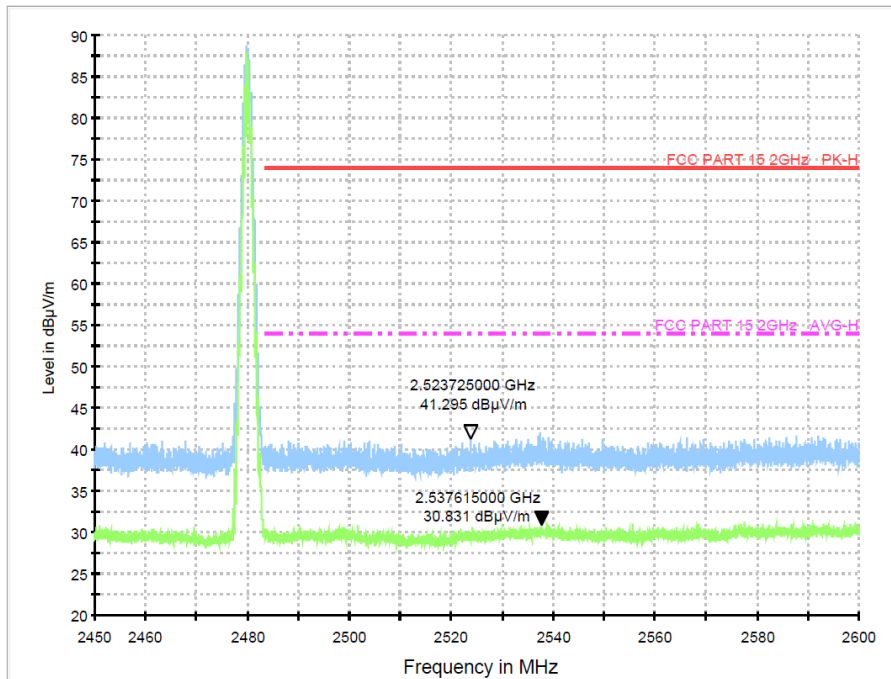
Date: 13.MAY.2024 18:12:26

GFSK 2M Mode:

Test channel: Lowest channel



Test channel: Highest channel



9. ANTENNA REQUIREMENT

9.1. 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 shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

9.2. Antenna Connected Construction

The antenna is Internal antenna and no consideration of replacement. Please see EUT photo for details.

9.3. Results

The EUT antenna is Internal Antenna. It comply with the standard requirement.

-----END OF REPORT-----