**ETSI EN 300 328 V2.2.2 (DTS)**

**TEST REPORT**

*For*

**Bluetooth Module**

**MODEL NUMBER: HM-BT4531**

**REPORT NUMBER: E01A23040015R00601**

**ISSUE DATE: May 13, 2023**

*Prepared for*

## Shenzhen Hope Microelectronics Co., Ltd

## 30th floor of 8th Building, C Zone, Vanke Cloud City, Xili Sub-district, Nanshan, Shenzhen, GD, P.R. China

*Prepared by*

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Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| V0 | May 13, 2023 | Initial Issue | Duke |

## Summary of Test Results

| Summary of Test Results | | | |
|---|---|---|---|
| **Test Item** | **Clause** | **Limit/Requirement** | **Result** |
| NORMAL AND EXTREME CONDITIONS | N/A | Clause 5.1.2 | Pass |
| RF output power | Clause 5.4.2.2.1.2 | Clause 4.3.2.2 | Pass |
| Power Spectral Density | Clause 5.4.3.2.1 | Clause 4.3.2.3 | Pass |
| Duty Cycle, Tx-sequence, Tx-gap | Clause 5.4.2.2.1.3 | Clause 4.3.2.4 | N/A |
| Medium Utilization (MU) factor | Clause 5.4.2.2.1.4 | Clause 4.3.2.5 | N/A |
| Adaptivity (non-FHSS) | Clause 5.4.6.2.1 | Clause 4.3.2.6 | N/A |
| Occupied Channel Bandwidth | Clause 5.4.7.2.1 | Clause 4.3.2.7 | Pass |
| Transmitter unwanted emissions in the out-of-band domain | Clause 5.4.8.2.1 | Clause 4.3.2.8 | Pass |
| Transmitter unwanted emissions in the spurious domain | Clause 5.4.9.2.1& Clause 5.4.9.2.2 | Clause 4.3.2.9 | Pass |
| Receiver spurious emissions | Clause 5.4.10.2.1& Clause 5.4.10.2.2 | Clause 4.3.2.10 | Pass |
| Receiver Blocking | Clause 5.4.11.2.1 | Clause 4.3.2.11 | Pass |
| Geo-location capability | N/A | Clause 4.3.2.12 | N/A |

Note:
1. N/A: In this whole report not applicable.

*This test report is only published to and used by the applicant, and it is not for evidence purpose in China.
*The measurement result for the sample received is <Pass> according to <ETSI EN 300 328 V2.2.2 (DTS)> when <Accuracy Method> decision rule is applied.

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# 1. ATTESTATION OF TEST RESULTS

**Applicant Information**

| | |
|---|---|
| Company Name: | Shenzhen Hope Microelectronics Co., Ltd |
| Address: | 30th floor of 8th Building, C Zone, Vanke Cloud City, Xili Sub-district, Nanshan, Shenzhen, GD, P.R. China |

**Manufacturer Information**

| | |
|---|---|
| Company Name: | Shenzhen Hope Microelectronics Co., Ltd |
| Address: | 30th floor of 8th Building, C Zone, Vanke Cloud City, Xili Sub-district, Nanshan, Shenzhen, GD, P.R. China |

**EUT Information**

| | |
|---|---|
| EUT Name: | Bluetooth Module |
| Model: | HM-BT4531 |
| Serial model: | N/A |
| Brand: | N/A |
| Sample Received Date: | April 20, 2023 |
| Sample Status: | Normal |
| Sample ID: | A23040015 006 |
| Date of Tested: | April 20, 2023 to May 05, 2023 |

| APPLICABLE STANDARDS | |
|---|---|
| **STANDARD** | **TEST RESULTS** |
| **ETSI EN 300 328 V2.2.2 (DTS)** | **Pass** |

Prepared By:

Duke

Project Engineer

Checked By:

Dyson

Project Engineer

Approved By:

Tiger Xu

Laboratory Supervisor

## 2. TEST METHODOLOGY

All tests were performed in accordance with the standard ETSI EN 300 328 V2.2.2 (DTS)

## 3. FACILITIES AND ACCREDITATION

Site Description

| | | |
|---|---|---|
| Name of Firm | : | Dong Guan Anci Electronic Technology Co., Ltd. |
| Site Location | : | 1-2 Floor, Building A, No.11, Headquarters 2 Road, Songshan, Lake Hi-tech Industrial Development Zone, Dongguan City,evelopment Zone, Dongguan City, Guangdong Pr., China. |

# 4. CALIBRATION AND UNCERTAINTY

## 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations and is traceable to recognized national standards.

## 4.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| Test Case | Description | Limit | Uncertainties |
|---|---|---|---|
| 5.3.2.2.1.1 | RF Output Power | ±1.5 dB | 1.15 |
| 5.3.2.2.1.2 | Duty Cycle | ±5 % | 0.03 |
| | Tx Sequence | ±5 % | 0.03 |
| | Tx Gap | ±5 % | 0.03 |
| 5.3.2.2.1.3 | Medium Utilisation | ±5 % | 0.10 |
| 5.3.3.2.1 | Power Spectral Density | ±3 dB | 1.21 |
| 5.3.4.2.1 | Accumulated Dwell Time | ±5 % | 0.05 |
| | Minimum Frequency Occupation Time | ±5 % | 0.15 |
| 5.3.5.2.1 | Hopping Frequency Separation | - | 0.24 |
| 5.3.8.2.1 | Occupied Channel Bandwidth | ±5 % | 1.71 |
| 5.3.9..2.1 | Out-of-band emissions | ±3 dB | 1.39 |
| 5.3.10.2.1 | Transmitter unwanted emissions in the spurious domain | | |
| | 30 MHz to 1 GHz | ±3 dB | 0.64 |
| | 1 GHz to 12.75GHz | ±3 dB | 1.68 |
| 5.3.11.2.1 | Receiver Spurious emission | | |
| | 30 MHz to 1 GHz | ±3 dB | 0.64 |
| | 1 GHz to 12.75GHz | ±3 dB | 1.68 |

| Test Item | Uncertainty |
|---|---|
| Uncertainty for Radiation Emission test | 4.62 dB (30 MHz-1 GHz) |
| | 3.50 dB (1 GHz-18 GHz) |
| Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of k=2. | |

# 5. EQUIPMENT UNDER TEST

## 5.1. DESCRIPTION OF EUT

| | | |
|---|---|---|
| EUT Name | | Bluetooth Module |
| Model | | HM-BT4531 |
| EUT Classification | | Class B |
| Internal Frequency | | 2500MHz |
| Hardware Version | | V1.0 |
| Ratings | | DC 1.8V-3.6V |
| PC | DC | 3.3V |

| | |
|---|---|
| Frequency Band: | 2400 MHz to 2483.5 MHz |
| Frequency Range: | 2402 MHz to 2480 MHz |
| Bluetooth Version: | Bluetooth Ver.5.1 BLE |
| Bluetooth Mode: | Bluetooth LE |
| Geo-location Capability: | Not Support |
| Type of Modulation: | GFSK, π/4-DQPSK |
| Number of Channels: | 40 |
| Channel Separation: | 2 MHz |
| Maximum EIRP: | 8.19 dBm |
| Antenna Type: | Internal PCB antenna |
| Antenna Gain: | 0 dBi |
| Normal Test Voltage: | 3.3 Vdc |
| Extreme Test Temperature: | Portable: -10 °C to +50 °C |

## 5.2. RECEIVER CATEGORY

| EUT belong to | Receiver category | Relevant receiver clauses |
|---|---|---|
| ☐ | 1 | Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p. |
| ☒ | 2 | Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or adaptive equipment with a maximum RF output power of 10 dBm e.i.r.p. |
| ☐ | 3 | Non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % or adaptive equipment with a maximum RF output power of 0 dBm e.i.r.p. |

## 5.3. CHANNEL LIST

| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---|---|---|---|---|---|---|---|
| 0 | **2402** | 11 | 2424 | 22 | 2446 | 33 | 2468 |
| 1 | 2404 | 12 | 2426 | 23 | 2448 | 34 | 2470 |
| 2 | 2406 | 13 | 2428 | 24 | 2450 | 35 | 2472 |
| 3 | 2408 | 14 | 2430 | 25 | 2452 | 36 | 2474 |
| 4 | 2410 | 15 | 2432 | 26 | 2454 | 37 | 2476 |
| 5 | 2412 | 16 | 2434 | 27 | 2456 | 38 | 2478 |
| 6 | 2414 | 17 | 2436 | 28 | 2458 | 39 | **2480** |
| 7 | 2416 | 18 | 2438 | 29 | 2460 | / | / |
| 8 | 2418 | 19 | **2440** | 30 | 2462 | / | / |
| 9 | 2420 | 20 | 2442 | 31 | 2464 | / | / |
| 10 | 2422 | 21 | 2444 | 32 | 2468 | / | / |

## 5.4. MAXIMUM AVERAGE EIRP

| Test Mode | Frequency (MHz) | Channel Number | Max AVG EIRP (dBm) |
|---|---|---|---|
| GFSK(1Mbps), π/4-DQPSK(2Mbps) | 2402 ~ 2480 | 0-39[40] | 8.19 |

## 5.5. TEST CHANNEL CONFIGURATION

| Test Mode | Test Channel | Frequency |
|---|---|---|
| LE 1M, LE 2M | CH 0(Low Channel), CH 19(MID Channel), CH 39(High Channel) | 2402 MHz, 2440 MHz, 2480 MHz |

## 5.6. THE WORSE CASE POWER SETTING PARAMETER

| The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band | | | | |
|---|---|---|---|---|
| Test Software Version | | nrfconnect-setup-4.0.1-ia32.exe | | |
| Modulation Type | Transmit Antenna Number | Test Software setting value | | |
| | | CH 0 | CH 19 | CH 39 |
| GFSK(1Mbps), π/4-DQPSK (2Mbps) | 1 | Max | Max | Max |

## 5.7. DESCRIPTION OF AVAILABLE ANTENNAS

| Antenna | Frequency (MHz) | Antenna Type | MAX Antenna Gain (dBi) |
|---|---|---|---|
| 1 | 2402-2480 | External Antenna | 0 |

| Test Mode | Transmit and Receive Mode | Description |
|---|---|---|
| GFSK(1Mbps), π/4-DQPSK (2Mbps) | 1TX, 1RX | Chain 1 can be used as transmitting/receiving antenna. |

Note: The value of the antenna gain was declared by customer.

## 5.8. ENVIROMENTAL CONDITIONS FOR TESTING

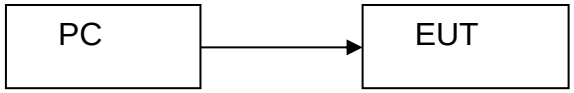
| Environment Parameter | Selected Values During Tests | | |
|---|---|---|---|
| Test Condition | Ambient | | |
| | Temperature (°C) | Voltage | Relative Humidity (%) |
| TN/VN | +15 to +35 | 3.3 V | 20 to 75 (Except Electrostatic Discharge is 30% to 60%) |
| TH/VN | 40 | 3.3 V | 20 to 75 |
| TL/VN | -10 | 3.3 V | 20 to 75 |
| Remark:<br>1) NV: Normal Voltage; NT: Normal Temperature | | | |

## 5.9. SUPPORT UNITS FOR SYSTEM TEST

The EUT has been tested as an independent unit

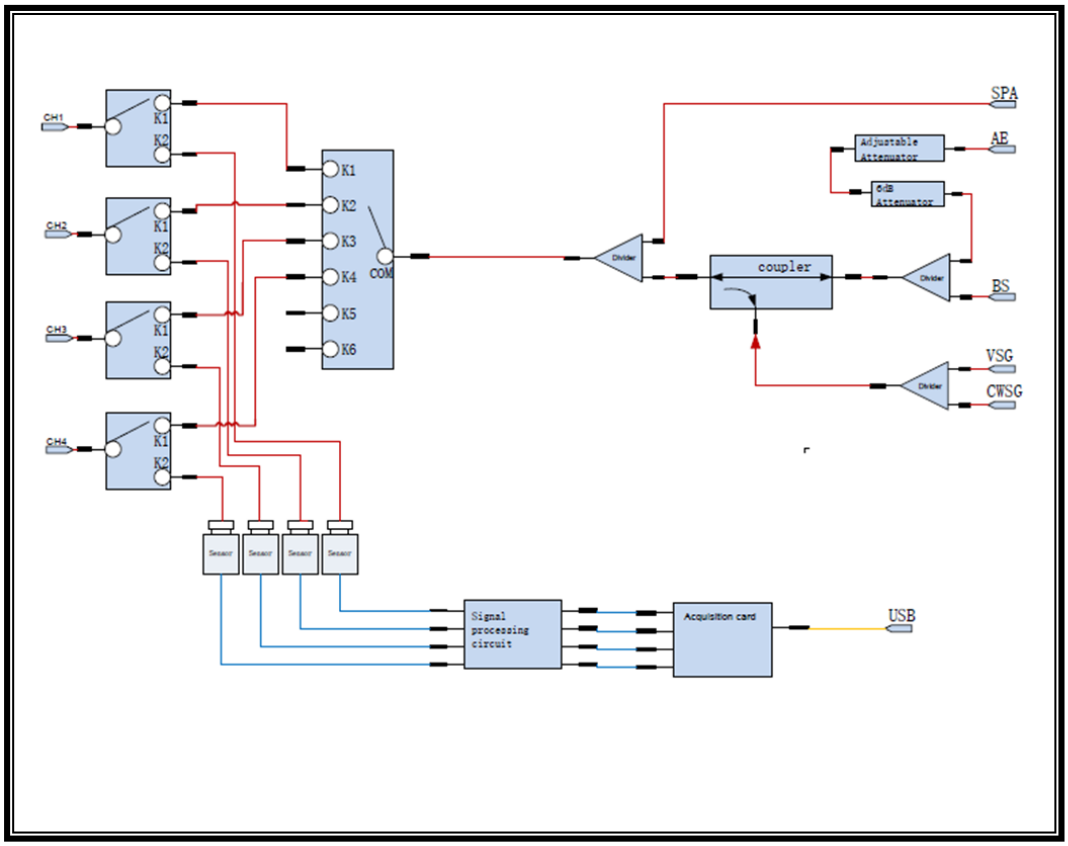
| **Equipment** | **Manufacturer** | **Model No.** |
|---|---|---|
| PC | Lenovo | T430 |

## 5.10. SETUP DIAGRAM



## 5.11. TEST SYSTEM CONFIGURATION

Tonsend SRD Test System




## 5.12. DESCRIPTION OF THE EQUIPMENT UNDER TESTED

(INFORMATION AS REQUIRED BY EN 300 328 V2.2.2, CLAUSE 5.4.1)

| | | | |
|---|---|---|---|
| **a)** | Modulation Type | | |
| | ☐ FHSS | | |
| | ☒ non-FHSS | | |
| **b)** | FHSS Equipment Description | | |
| | The Number of Hopping Frequencies | The Maximum | / |
| | | The Minimum | / |
| | The (average) dwell time | / | |
| **c)** | **Adaptive / Non-adaptive Equipment** | | |
| | ☐ Non-adaptive Equipment | | |
| | ☒ Adaptive Equipment Without the Possibility to Switch to A Non-adaptive Mode | | |
| | ☐ Adaptive Equipment Which can also operate in A Non-adaptive Mode | | |
| **d)** | **Adaptive Equipment Description** | | |
| | The maximum Channel Occupancy Time implemented by the equipment | / | |
| | ☒ The equipment has implemented an LBT mechanism | | |
| | ☐ The equipment has implemented a DAA mechanism | | |
| | ☐ The equipment can operate in more than one adaptive mode | | |
| **e)** | **The different transmit operating modes** | | |
| | ☒ Equipment with only one antenna | | |

| | | |
|---|---|---|
| | ☒ Operating mode 1 (single antenna) | ☐ Equipment with two diversity antennas but only one antenna active at any moment in time |
| | | ☐ Smart Antenna Systems with two or more antennas, but operating in a (legacy) mode where only one antenna is used (e.g. IEEE 802.11™ legacy mode in smart antenna systems) |
| | ☐ Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming | ☐ Single spatial stream/Standard throughput/(e.g. IEEE 802.11™ legacy mode) |
| | | ☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1 |
| | | ☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2 |
| | ☐ Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming | ☐ Single spatial stream/Standard throughput (e.g. IEEE 802.11™ legacy mode) |
| | | ☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1 |
| | | ☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2 |

| | | |
|---|---|---|
| **f)** | **In case of Smart Antenna Systems** | |
| | The number of Receive chains | 1 |
| | The number of Transmit chains | 1 |
| | In case of beam forming, the maximum (additional) beam forming gain: | / |
| **g)** | **Operating Frequency Range(s) of the equipment** | |
| | Operating Frequency Range | 2402 MHz to 2480 MHz |
| **h)** | **Nominal Channel Bandwidth(s)** | |
| | Occupied Channel Bandwidth | 1.063MHz |

| | | | | | | |
|---|---|---|---|---|---|---|
| **i)** | **Type of Equipment** | | | | | |
| | ☒Stand-Alone | | | | | |
| | ☐ Plug-in radio Equipment | | | | | |
| | ☐ Combined Equipment | | | | | |
| **j)** | **The extreme operating conditions that apply to the equipment** | | | | | |
| | Operating temperature range | -10°C to 50 °C | | | | |
| **k)** | **The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels** | | | | | |
| | Antenna Type | ☐ Integral Antenna | Antenna Gain | | | |
| | | ☒ Dedicated Antennas (equipment with antenna connector) | ☒Single power level with corresponding antenna(s) | Gain | ANT1 | 0 dBi |
| | | | | | | |
| | | | | | | |
| | | | ☐Multiple power settings and corresponding antenna(s) | Power Level 1 | | |
| | | | | Power Level 2 | | |
| | | | | Power Level 3 | | |
| **l)** | **The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices:** | | | | | |
| | Details provided are for the | ☒ Testing of stand-alone equipment | | | | |
| | | ☐ Combined equipment | | | | |
| | | ☐ Test jig | | | | |
| | Supply Voltage | ☐ AC mains | State AC voltage | | | |

| | | | | | |
|---|---|---|---|---|---|
| | | ☒ DC | State DC voltage | ☐ Internal Power Supply | |
| | | | | ☐ External Power Supply or AC/DC adapter | |
| | | | | ☒ PC | 3.3 V |
| | | | | ☐Other | |
| **m)** | **The equipment type** | | | | |
| | ☒ Bluetooth® | | | | |
| | ☐ IEEE 802.11™ [i.3] | | | | |
| | ☐ Proprietary | | | | |
| **n)** | **Geo-location capability supported by the equipment** | | ☐ Yes<br>☐ The geographical location determined by the equipment as defined in clause 4.3.1.13.2 or clause 4.3.2.12.2 is not accessible to the user. | | |
| | | | ☒ No | | |

# 6. MEASURING EQUIPMENT AND SOFTWARE USED

**or Spurious Emissions Test**

| Equipment Type | Manufacturer | Model No. | Serial Number | Calibrated until |
|---|---|---|---|---|
| EMI Test Receiver | Rohde & Schwarz | ESPI | 100502 | 2023-10-07 |
| EMI Test Receiver | Rohde & Schwarz | FSV40 | 102257 | 2023-10-07 |
| Pre-Amplifier | HP | 8447D | 2727A06172 | 2023-05-12 |
| Pre-Amplifier | A-INFO | LA1018N4009 | J1013130524001 | 2023-05-12 |
| Bilog Antenna | Schwarzbeck | VULB9163 | VULB9163-588 | 2023-05-12 |
| Horn Antenna | A-INFO | LB-10180-SF | J2031090612123 | 2023-05-12 |
| Cable | N/A | N/A | 6# | 2023-05-12 |
| Cable | N/A | N/A | 1-1# | 2023-05-12 |
| Cable | N/A | N/A | 1-2# | 2023-05-12 |
| Cable | N/A | N/A | 7# | 2023-05-12 |
| 3m Semi-anechoic Chamber | chengyu | 9m*6m*6m | N/A | 2023-05-12 |
| Test Software | Farad | EZ-EMC Ver:ANCI-3A1 | N/A | N/A |

**For Other Test Items:**

| Equipment Type | Manufacturer | Model No. | Serial Number | Calibrated until |
|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSV40 | 102257 | 2023-10-07 |
| WIDEBAND RADIO COMMUNICATION | Rohde & Schwarz | CMW500 | 157423 | 2023-10-07 |
| Vector Signal Generator | Agilent | 5182A | MY50140563 | 2023-10-07 |
| ESG SERIES SIGNAL GENERATOR | Agilent | E4421B | 40050971 | 2023-10-07 |
| USB RF Power sensor | RadiPower | RPR3006W | 17I00015SNO88 | 2023-10-07 |
| RF Test Software | MAIWEI | MTS 8310 | N/A | N/A |
| Humidity Chamber | GAOXIN | GX-3000-150LHT | 1801027 | 2023-05-12 |
| Dc source | RUIYUAN | WYK-6030K | 180828026030 | 2023-05-12 |

# 7. TEST PROCEDURES AND RESULTS

## 7.1. RF OUTPUT POWER

**LIMITS**

| RF OUTPUT POWER | |
|---|---|
| Condition | Limit |
| ☐ Non-adaptive non-FHSS Equipment | For non-adaptive non-FHSS equipment, where the manufacturer has declared an RF output power of less than 20 dBm e.i.r.p., the RF output power shall be equal to or less than that declared value. |
| ☒ Adaptive non-FHSS Equipment | non-FHSS equipment shall be equal to or less than 20 dBm. |

**TEST PROCEDURE**

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.2

The power sensor was used for power measurement, and it use a fast power sensor with a minimum sensitivity of -40 dBm and capable of minimum 1 MS/s.

The test software was used to control the power detector and the sampling unit.

For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) are captured.

| Measurement | |
|---|---|
| ☒Conducted measurement | ☐Radiated measurement |

**CALCULATIONS**

Add the (stated) antenna assembly gain G in dBi of the individual antenna.
• In case of smart antenna systems operating in mode with beamforming (see clause 5.3.2.2.4), add the additional beamforming gain Y in dB.
• If more than one antenna assembly is intended for this power setting, the maximum overall antenna gain (G or G + Y) shall be used.
• The RF Output Power (Pout) shall be calculated using the formula below:

$$P_{out} = A + G + Y$$

**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 24℃ | Relative Humidity | 50% |
| Atmosphere Pressure | 101kPa | | |

**TEST RESULTS**

Please refer to section "Test Data" - Appendix A**POWER SPECTRAL DENSITY**

**LIMITS**

| Power Spectral Density |
|---|

| Condition | Limit |
|---|---|
| All types of non-FHSS equipment | 10 dBm/MHz |

**TEST PROCEDURE**

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.3

R&S EMC32 software is used to control the spectrum analyzer to use the following settings:

| | |
|---|---|
| Start Frequency | 2400MHz |
| Stop Frequency | 2483.5MHz |
| Detector | RMS |
| Sweep Point | > 8 350; for spectrum analysers not supporting this number of sweep points, the frequency band may be segmented |
| RBW | 10KHz |
| VBW | 30KHz |
| Trace Mode | Max Hold |
| Sweep Time | For non-continuous transmissions: 2 × Channel Occupancy Time × number of sweep points<br>For non-adaptive equipment use the maximum TX-sequence time in the formula above instead of the Channel Occupancy Time<br>For continuous transmissions: 10 s; the sweep time may be increased further until a value where the sweep time has no further impact anymore on the RMS value of the signal |

The test software acquires the trace data and calculate the Spectral Density in 1MHz.

**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 24℃ | Relative Humidity | 50% |
| Atmosphere Pressure | 101kPa | | |

**TEST RESULTS**

Please refer to section "Test Data" - Appendix **OCCUPIED CHANNEL BANDWIDTH**

**LIMITS**

| OCCUPIED CHANNEL BANDWIDTH | | |
|---|---|---|
| Condition | | Limit |
| All types of equipment | | Each hopping frequency shall be within the 2400 to 2483.5 MHz band |
| Additional requirement | For non-adaptive non-FHSS equipment with e.i.r.p. greater than 10 dBm | Each hopping frequency shall be equal to or less than 20 MHz |

**TEST PROCEDURE**

Refer to ETSI EN 300 328 V2.2.2 (2019-07) clause 5.4.7

| Measurement | |
|---|---|
| ☒Conducted measurement | ☐Radiated measurement |

Connect the UUT to the spectrum analyser and use the following settings:

| | |
|---|---|
| Center Frequency | The center frequency of the channel under test |
| Frequency Span | 2 × Nominal Channel Bandwidth |
| Detector | RMS |
| RBW | ~ 1 % of the span without going below 1 % |
| VBW | 3 × RBW |
| Trace | Max hold |
| Sweep Time | 1s |

**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 24℃ | Relative Humidity | 50% |
| Atmosphere Pressure | 101kPa | | |

**TEST RESULTS**

Please refer to section "Test Data" - Appendix **TRANSMITTER UNWANTED EMISSIONS IN THE OUT-OF-BAND DOMAIN**

**LIMITS**

| Transmitter Unwanted Emissions in The Out-Of-Band Domain | |
|---|---|
| Condition | Limit |
| Under Normal Test Condition | The transmitter unwanted emissions in the out-of-band domain shall not exceed the values provided by the mask in figure 3. |

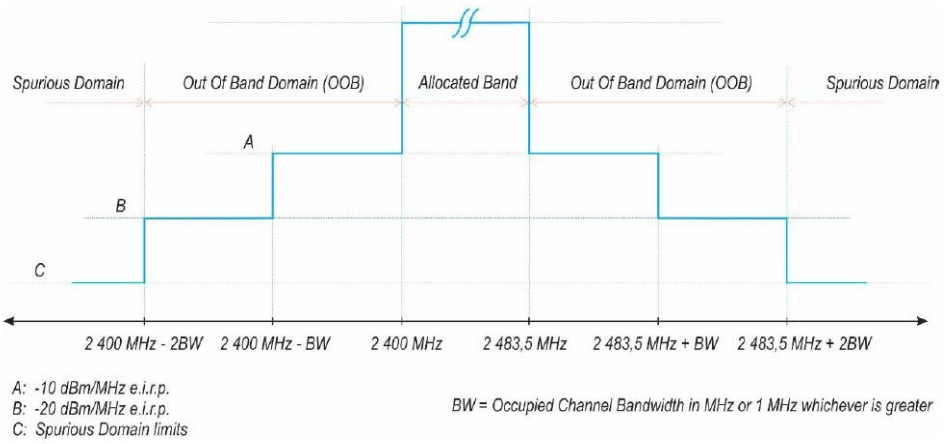



**Figure 3: Transmit mask**

**TEST PROCEDURE**

Refer to ETSI EN 300 328 V2.2.2 (2019-07) clause 5.4.8

| Measurement | |
|---|---|
| ☒Conducted measurement | ☐Radiated measurement |

Connect the UUT to the spectrum analyser and use the following settings:

| | |
|---|---|
| Span | Zero Span |
| Filter Mode | Channel Filter |
| Trace Mode | Max Hold |
| Trigger Mode | Video |
| Detector | RMS |
| Sweep Points | Sweep time [µs] / (1 µs) with a maximum of 30 000 |
| RBW / VBW | 1MHz / 3MHz |
| Measurement Mode | Time Domain Power |
| Sweep Time | > 120 % of the duration of the longest burst detected during the measurement of the RF Output Power |

**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 24℃ | Relative Humidity | 50% |
| Atmosphere Pressure | 101kPa | | |

**TEST RESULTS**

Please refer to section "Test Data" - Appendix **TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN**

**LIMITS**

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 12.
In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and as e.i.r.p. for emissions above 1 GHz.

**Table 12: Transmitter limits for spurious emissions**

| Frequency range | Maximum power | Bandwidth |
|---|---|---|
| 30 MHz to 47 MHz | -36 dBm | 100 kHz |
| 47 MHz to 74 MHz | -54 dBm | 100 kHz |
| 74 MHz to 87,5 MHz | -36 dBm | 100 kHz |
| 87,5 MHz to 118 MHz | -54 dBm | 100 kHz |
| 118 MHz to 174 MHz | -36 dBm | 100 kHz |
| 174 MHz to 230 MHz | -54 dBm | 100 kHz |
| 230 MHz to 470 MHz | -36 dBm | 100 kHz |
| 470 MHz to 694 MHz | -54 dBm | 100 kHz |
| 694 MHz to 1 GHz | -36 dBm | 100 kHz |
| 1 GHz to 12,75 GHz | -30 dBm | 1 MHz |

**TEST PROCEDURE**

Refer to Refer to ETSI EN 300 328 V2.2.2 (2019-07) clause 5.4.9

| Measurement | |
|---|---|
| ☒Conducted measurement | ☐Radiated measurement |

Spectrum analyser settings for pre-scan:

| | |
|---|---|
| RBW | 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz) |
| VBW | 300 kHz (< 1 GHz) / 3 MHz (> 1 GHz) |
| Detector Mode | Peak |
| Filter type | 3 dB (Gaussian) |
| Trace Mode | Max hold |
| Sweep Points | ⩾ 19 400 (< 1 GHz); ⩾ 23 500 (> 1 GHz); for spectrum analysers not supporting this high number of sweep points, the frequency band may be segmented. |
| Sweep Time | For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 100 kHz frequency step, the measurement time is greater than two transmissions of the UUT, on any channel.<br>For FHSS equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies.<br>The above sweep time setting may result in long measuring times in case of FHSS equipment. To avoid such long measuring times, an FFT analyser may be used. |

Spectrum analyser settings for the emissions identified during the pre-scan:

| | |
|---|---|
| Measurement Mode | Time Domain Power |
| Centre Frequency | Frequency of the emission identified during the pre-scan |
| RBW | 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz) |

| | |
|---|---|
| VBW | 300 kHz (< 1 GHz) / 3 MHz (> 1 GHz) |
| Frequency Span | Zero Span |
| Sweep Mode | Single Sweep |
| Detector Mode | RMS |
| Trace Mode | Max hold |
| Trigger Mode | Video (burst signals) or Manual (continuous signals) |
| Sweep Points | Sweep time [µs] / (1 µs) with a maximum of 30 000 |
| Sweep Time | > 120 % of the duration of the longest burst detected during the measurement of the<br>RF Output Power |

**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 24℃ | Relative Humidity | 50% |
| Atmosphere Pressure | 101kPa | | |

**TEST RESULTS**

Please refer to section "Test Data" - Appendix **RECEIVER SPURIOUS EMISSIONS**

**LIMITS**

The spurious emissions of the receiver shall not exceed the values given in table 13.
In case of non-FHSS equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or for emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

**Table 13: Spurious emission limits for receivers**

| Frequency range | Maximum power | Bandwidth |
|---|---|---|
| 30 MHz to 1 GHz | -57 dBm | 100 kHz |
| 1 GHz to 12,75 GHz | -47 dBm | 1 MHz |

**TEST PROCEDURE**

Please refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.10

| Measurement | |
|---|---|
| ☒Conducted measurement | ☐Radiated measurement |

Please refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.10

Spectrum analyser settings for pre-scan:

| | |
|---|---|
| RBW | 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz) |

| | |
|---|---|
| VBW | 300 kHz (< 1 GHz) / 3 MHz (> 1 GHz) |
| Detector Mode | Peak |
| Filter type | 3 dB (Gaussian) |
| Trace Mode | Max hold |
| Sweep Points | ≥ 19 400 (< 1 GHz); ≥ 23 500 (> 1 GHz); for spectrum analysers not supporting this high number of sweep points, the frequency band may be segmented. |
| Sweep Time | Auto |

Spectrum analyser settings for the emissions identified during the pre-scan:

| | |
|---|---|
| Measurement Mode | Time Domain Power |
| Centre Frequency | Frequency of the emission identified during the pre-scan |
| RBW | 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz) |
| VBW | 300 kHz (< 1 GHz) / 3 MHz (> 1 GHz) |
| Frequency Span | Zero Span |
| Sweep Mode | Single Sweep |
| Detector Mode | RMS |
| Trace Mode | Max hold |
| Trigger Mode | Video (burst signals) or Manual (continuous signals) |
| Sweep Points | ≥ 30 000 |
| Sweep Time | 30 ms |

**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 24℃ | Relative Humidity | 50% |
| Atmosphere Pressure | 101kPa | | |

**TEST RESULTS**

Please refer to section "Test Data" - Appendix **RECEIVER BLOCKING**

**LIMITS**

Performance Criteria

For equipment that supports a PER or FER test to be performed, the minimum performance criterion shall be a PER or FER less than or equal to 10 %.
For equipment that does not support a PER or a FER test to be performed, the minimum performance criterion shall be no loss of the wireless transmission function needed for the intended use of the equipment.

While maintaining the minimum performance criteria as defined in clause 4.3.2.11.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in table 14, table 15 or table 16.

☒ Receiver Category 1

**Table 14: Receiver Blocking parameters for Receiver Category 1 equipment**

| Wanted signal mean power from companion device (dBm) (see notes 1 and 4) | Blocking signal frequency (MHz) | Blocking signal power (dBm) (see note 4) | Type of blocking signal |
|---|---|---|---|
| (-133 dBm + 10 × $\log_{10}$(OCBW)) or -68 dBm whichever is less (see note 2) | 2 380<br>2 504 | -34 | CW |
| (-139 dBm + 10 × $\log_{10}$(OCBW)) or -74 dBm whichever is less (see note 3) | 2 300<br>2 330<br>2 360<br>2 524<br>2 584<br>2 674 | | |

NOTE 1: OCBW is in Hz.
NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to $P_{min}$ + 26 dB where $P_{min}$ is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.
NOTE 3: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to $P_{min}$ + 20 dB where $P_{min}$ is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.
NOTE 4: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.

☐ Receiver Category 2

**Table 15: Receiver Blocking parameters receiver Category 2 equipment**

| Wanted signal mean power from companion device (dBm) (see notes 1 and 3) | Blocking signal frequency (MHz) | Blocking signal power (dBm) (see note 3) | Type of blocking signal |
|---|---|---|---|
| (-139 dBm + 10 × $\log_{10}$(OCBW) + 10 dB) or (-74 dBm + 10 dB) whichever is less (see note 2) | 2 380<br>2 504<br>2 300<br>2 584 | -34 | CW |
| NOTE 1: OCBW is in Hz.<br>NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to $P_{min}$ + 26 dB where $P_{min}$ is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.<br>NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2. | | | |

☐ Receiver Category 3

**Table 16: Receiver Blocking parameters receiver Category 3 equipment**

| Wanted signal mean power from companion device (dBm) (see notes 1 and 3) | Blocking signal frequency (MHz) | Blocking signal power (dBm) (see note 3) | Type of blocking signal |
|---|---|---|---|
| (-139 dBm + 10 × $\log_{10}$(OCBW) + 20 dB) or (-74 dBm + 20 dB) whichever is less (see note 2) | 2 380<br>2 504<br>2 300<br>2 584 | -34 | CW |
| NOTE 1: OCBW is in Hz.<br>NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to $P_{min}$ + 30 dB where $P_{min}$ is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.<br>NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2. | | | |

**TEST PROCEDURE**

Please refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.11

| Measurement | |
|---|---|
| ☒Conducted measurement | ☐Radiated measurement |

Step 1:
• For non-FHSS equipment, the UUT shall be set to the lowest operating channel on which the blocking test has to be performed (see clause 5.4.11.1).
Step 2:
• The blocking signal generator is set to the first frequency as defined in the appropriate table corresponding to the receiver category and type of equipment.
Step 3:
• With the blocking signal generator switched off, a communication link is established between the UUT and the associated companion device using the test setup shown in figure 6.
• Unless the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, the level of the wanted signal shall be set to the value provided in the table corresponding to the receiver category and type of equipment. The test procedure defined in clause 5.4.2, and more in particular clause 5.4.2.2.1.2, can be used to measure the (conducted) level of the wanted signal however no correction shall be made for antenna gain of the companion device (step 6 in clause 5.4.2.2.1.2 shall be ignored). This level may be measured directly at the output of the companion device and a correction is made for the coupling loss into the UUT. The actual level for the wanted signal shall be recorded in the test report.
• When the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, the attenuation of the variable attenuator shall be increased in 1 dB steps to a value at which the minimum performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still met. The resulting level for the wanted signal at the input of the UUT is Pmin. This signal level (Pmin) is increased by the value provided in note 2 of the applicable table corresponding to the receiver category and type of equipment.
Step 4:
• The blocking signal at the UUT is set to the level provided in the table corresponding to the receiver category and type of equipment.
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 are met then proceed to step 6.
Step 5:
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been increased with a value equal to the Occupied Channel Bandwidth except:
- For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by 3 dB.
- For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by 3 dB.
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been decreased with a value equal to the Occupied Channel Bandwidth except:
- For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by 3 dB.
- For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by 3 dB.
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still not met, the UUT fails to comply with the Receiver Blocking requirement and step 6 and step 7 are no longer required.

• It shall be recorded in the test report whether the shift of blocking frequencies as described in the present step was used.
Step 6:
• Repeat step 4 and step 5 for each remaining combination of frequency and level for the blocking signal as provided in the table corresponding to the receiver category and type of equipment.
Step 7:
• For non-FHSS equipment, repeat step 2 to step 6 with the UUT operating at the highest operating channel on which the blocking test has to be performed (see clause 5.4.11.1).
Step 8:
• It shall be assessed and recorded in the test report whether the UUT complies with the Receiver Blocking requirement.

**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 24℃ | Relative Humidity | 50% |
| Atmosphere Pressure | 101kPa | | |

**TEST RESULTS**

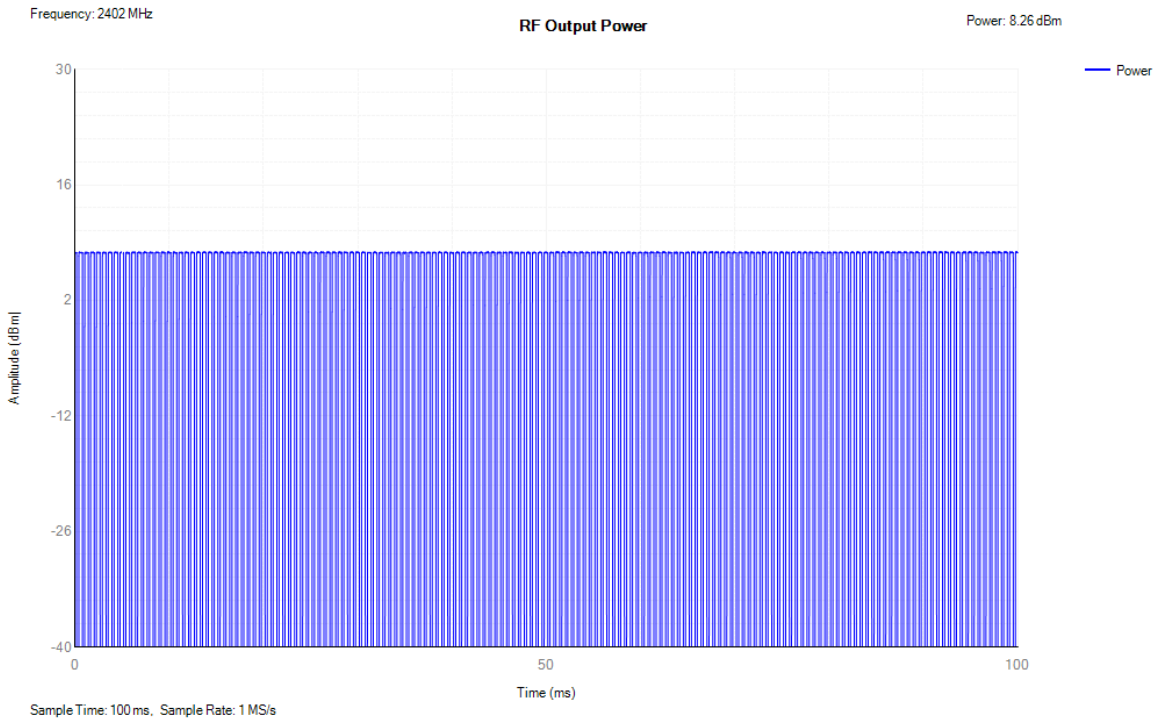
Please refer to section "Test Data" - Appendix **TEST DATA**

**RF Output Power**

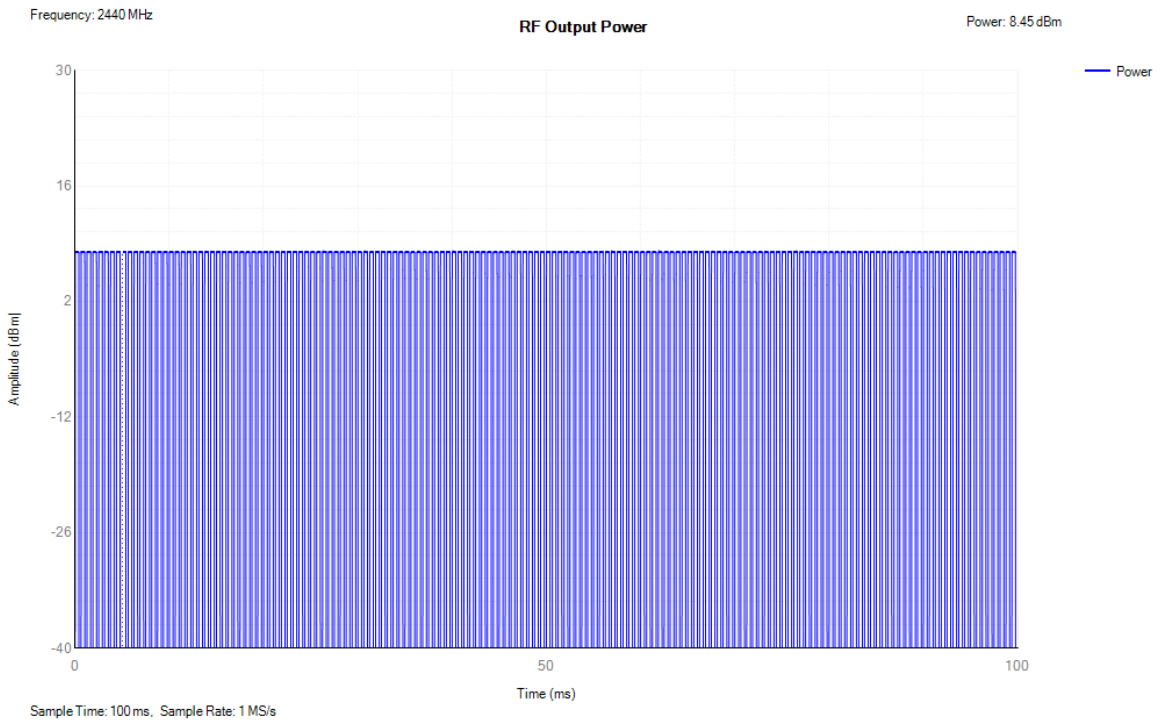
| Condition | Mode | Frequency (MHz) | Antenna | Max Burst RMS Power (dBm) | Burst Number | Gain (dB) | Max EIRP (dBm) | Limit (dBm) | Verdict |
|---|---|---|---|---|---|---|---|---|---|
| NVNT | BLE 1M | 2402 | Ant1 | 7.76 | 161 | 0 | 7.76 | 20 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 7.95 | 160 | 0 | 7.95 | 20 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 8.17 | 161 | 0 | 8.17 | 20 | Pass |
| NVLT | BLE 1M | 2402 | Ant1 | 7.83 | 160 | 0 | 7.83 | 20 | Pass |
| NVLT | BLE 1M | 2440 | Ant1 | 7.97 | 161 | 0 | 7.97 | 20 | Pass |
| NVLT | BLE 1M | 2480 | Ant1 | 8.19 | 161 | 0 | 8.19 | 20 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 7.85 | 160 | 0 | 7.85 | 20 | Pass |
| NVHT | BLE 1M | 2440 | Ant1 | 7.98 | 160 | 0 | 7.98 | 20 | Pass |
| NVHT | BLE 1M | 2480 | Ant1 | 8.19 | 161 | 0 | 8.19 | 20 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 7.86 | 161 | 0 | 7.86 | 20 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 8 | 161 | 0 | 8 | 20 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 8.15 | 160 | 0 | 8.15 | 20 | Pass |
| NVLT | BLE 2M | 2402 | Ant1 | 7.87 | 161 | 0 | 7.87 | 20 | Pass |
| NVLT | BLE 2M | 2440 | Ant1 | 7.99 | 161 | 0 | 7.99 | 20 | Pass |
| NVLT | BLE 2M | 2480 | Ant1 | 8.18 | 160 | 0 | 8.18 | 20 | Pass |
| NVHT | BLE 2M | 2402 | Ant1 | 7.87 | 161 | 0 | 7.87 | 20 | Pass |
| NVHT | BLE 2M | 2440 | Ant1 | 8 | 160 | 0 | 8 | 20 | Pass |
| NVHT | BLE 2M | 2480 | Ant1 | 8.17 | 160 | 0 | 8.17 | 20 | Pass |

Test Graphs

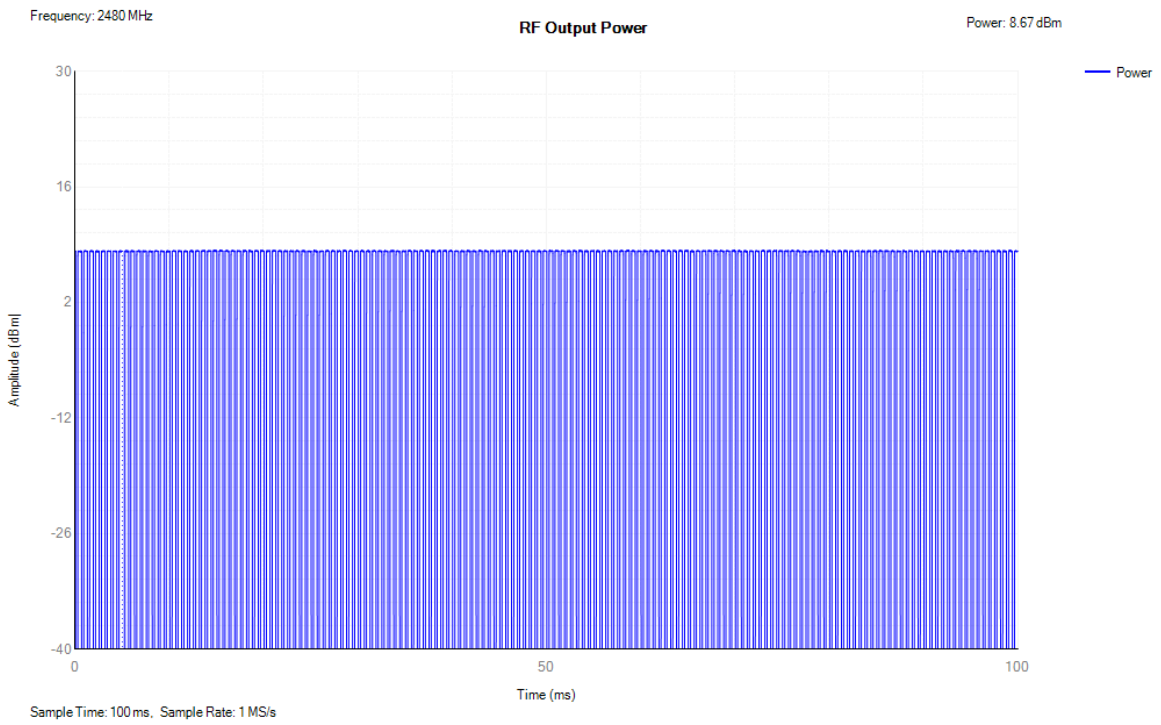
Power NVNT BLE 1M 2402MHz Ant1



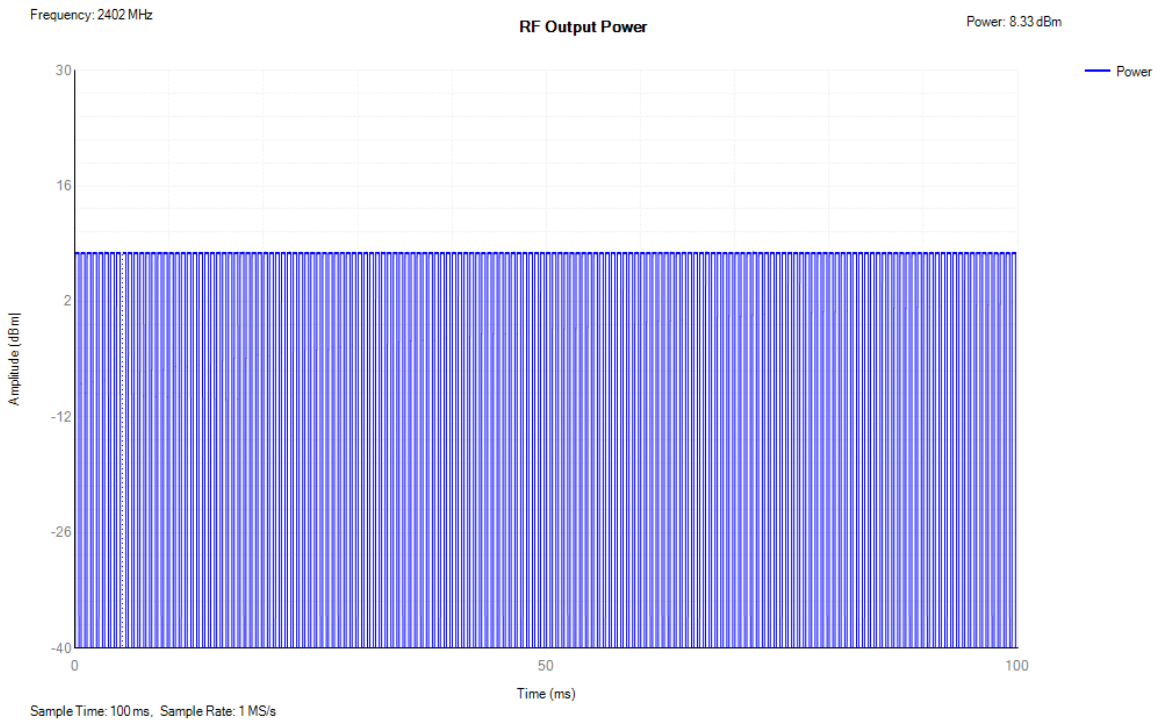

Power NVNT BLE 1M 2440MHz Ant1



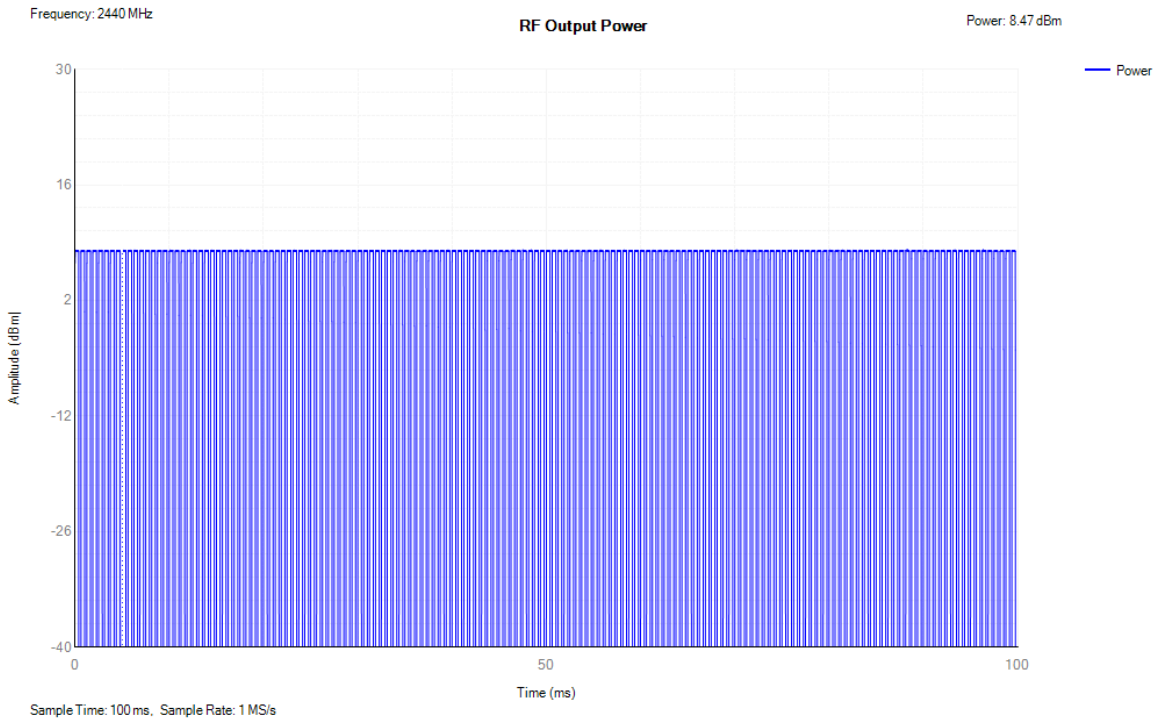
Power NVNT BLE 1M 2480MHz Ant1



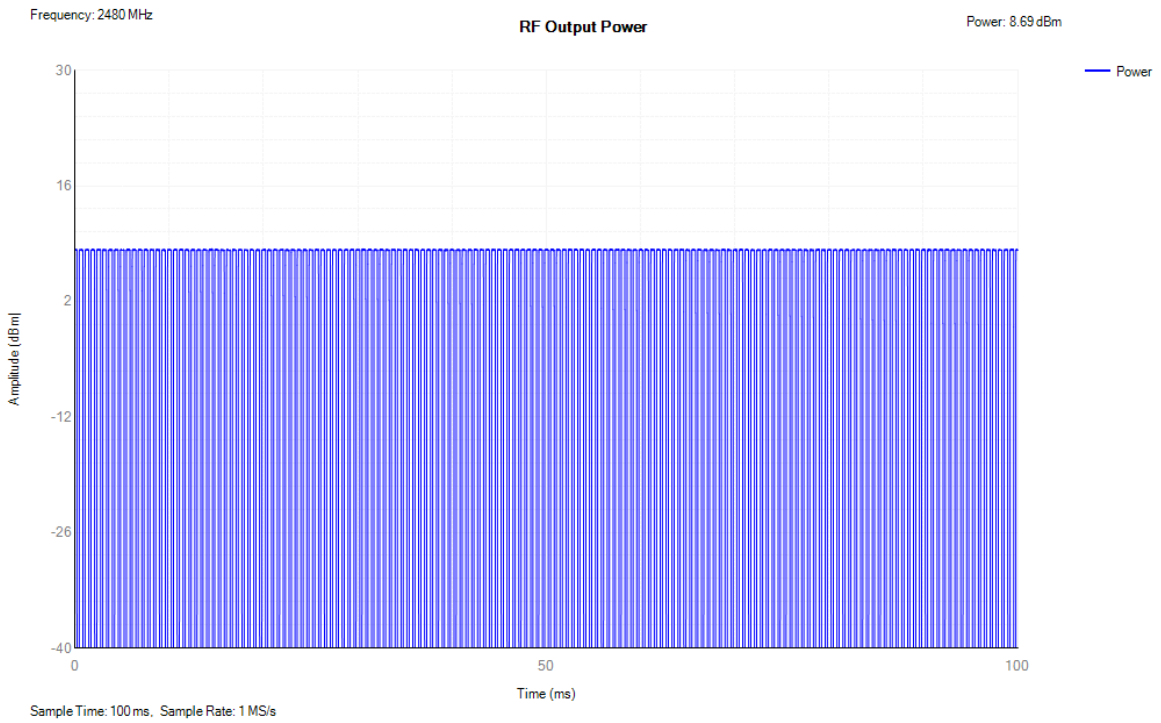

Power NVLT BLE 1M 2402MHz Ant1



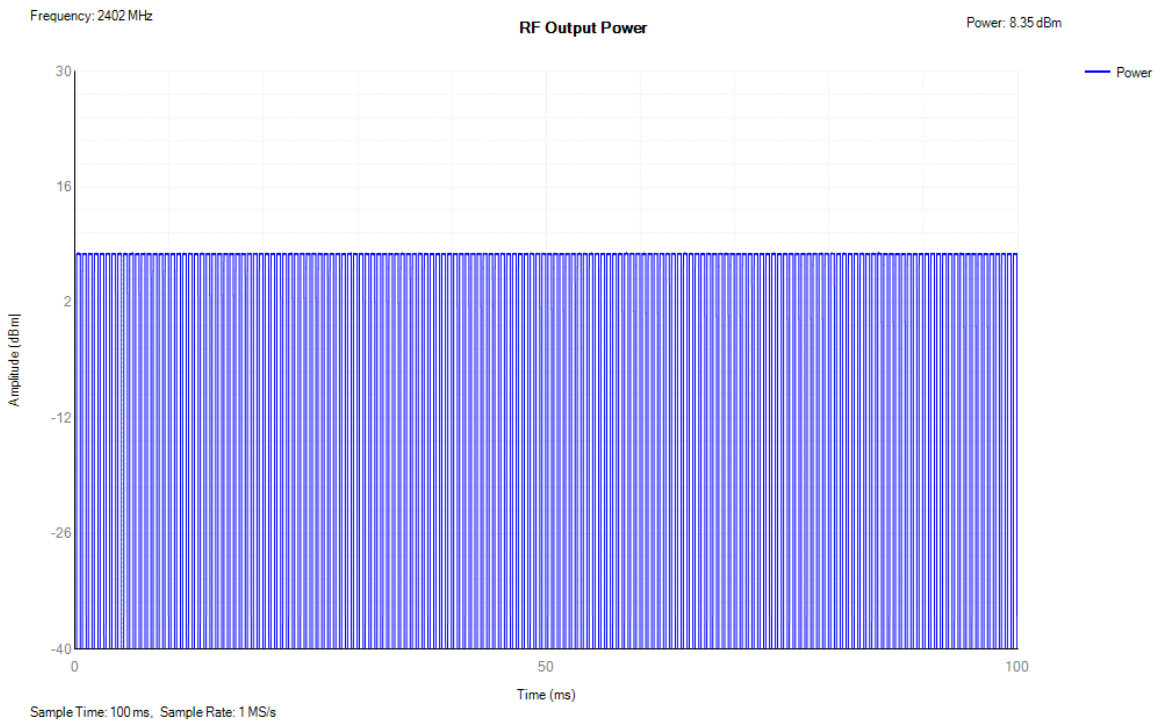
Power NVLT BLE 1M 2440MHz Ant1



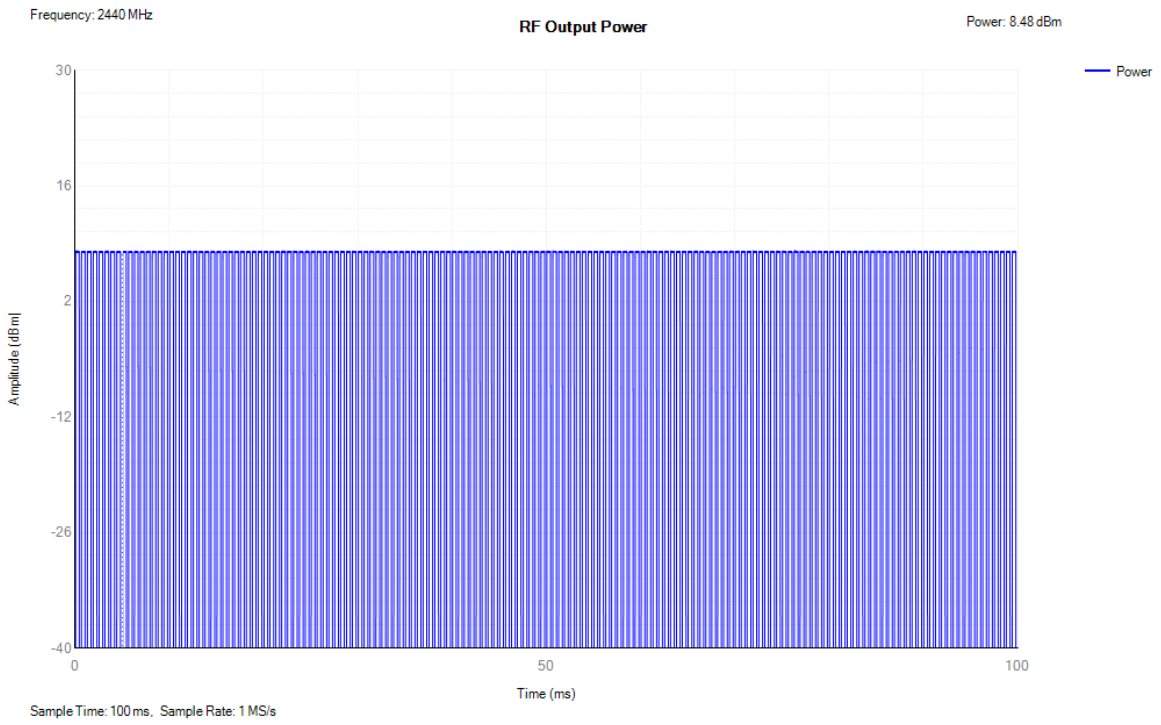

Power NVLT BLE 1M 2480MHz Ant1



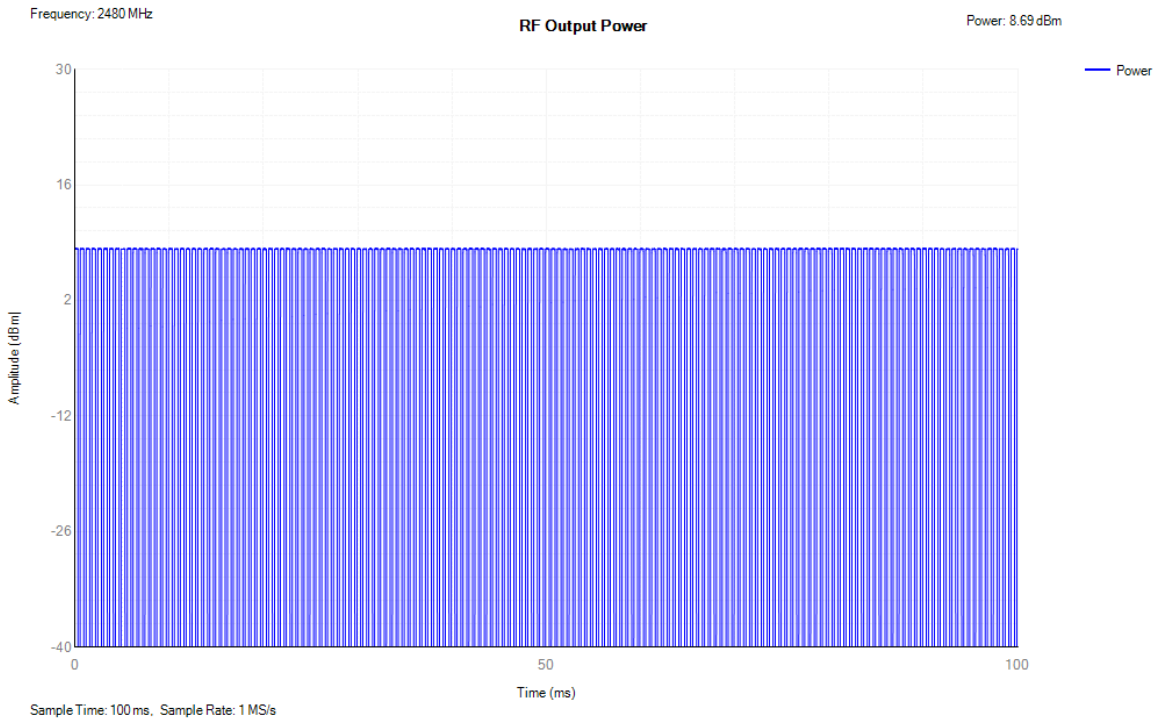
Power NVHT BLE 1M 2402MHz Ant1



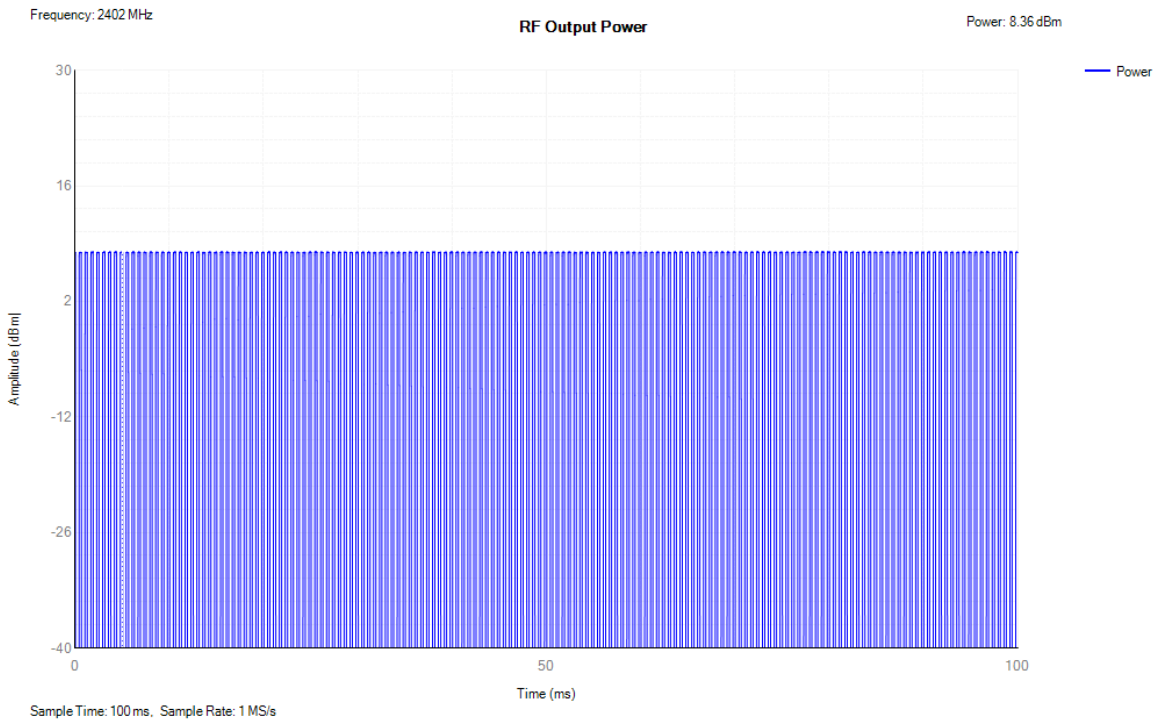

Power NVHT BLE 1M 2440MHz Ant1



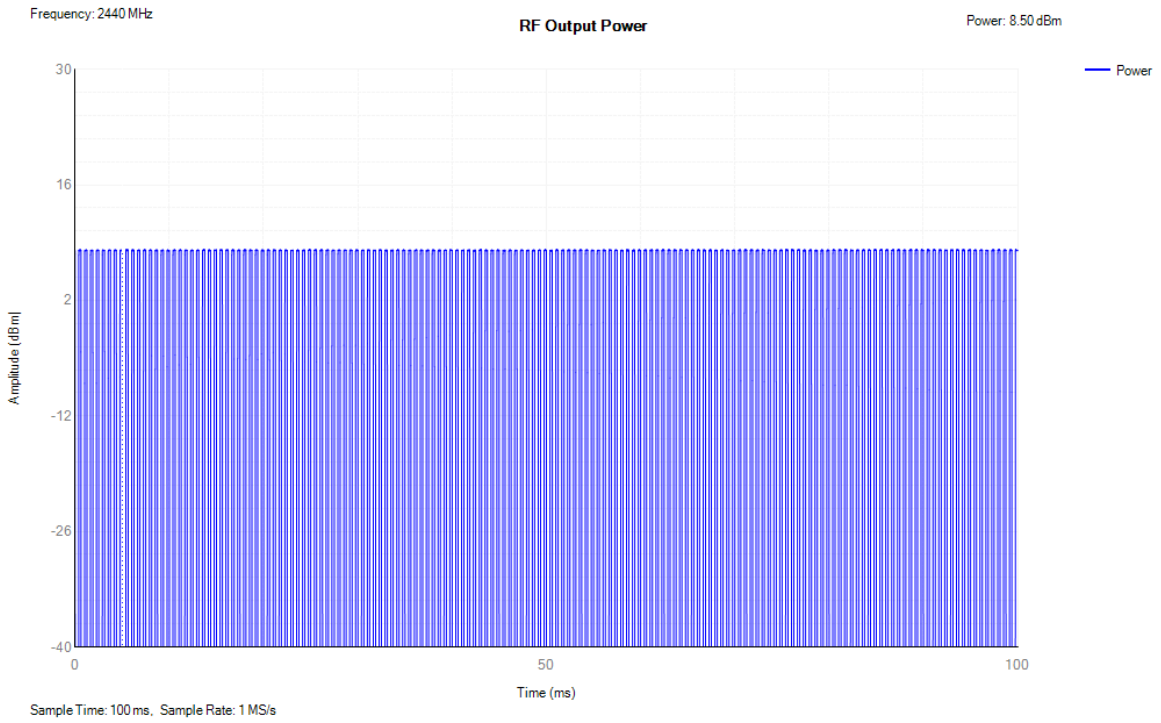
Power NVHT BLE 1M 2480MHz Ant1



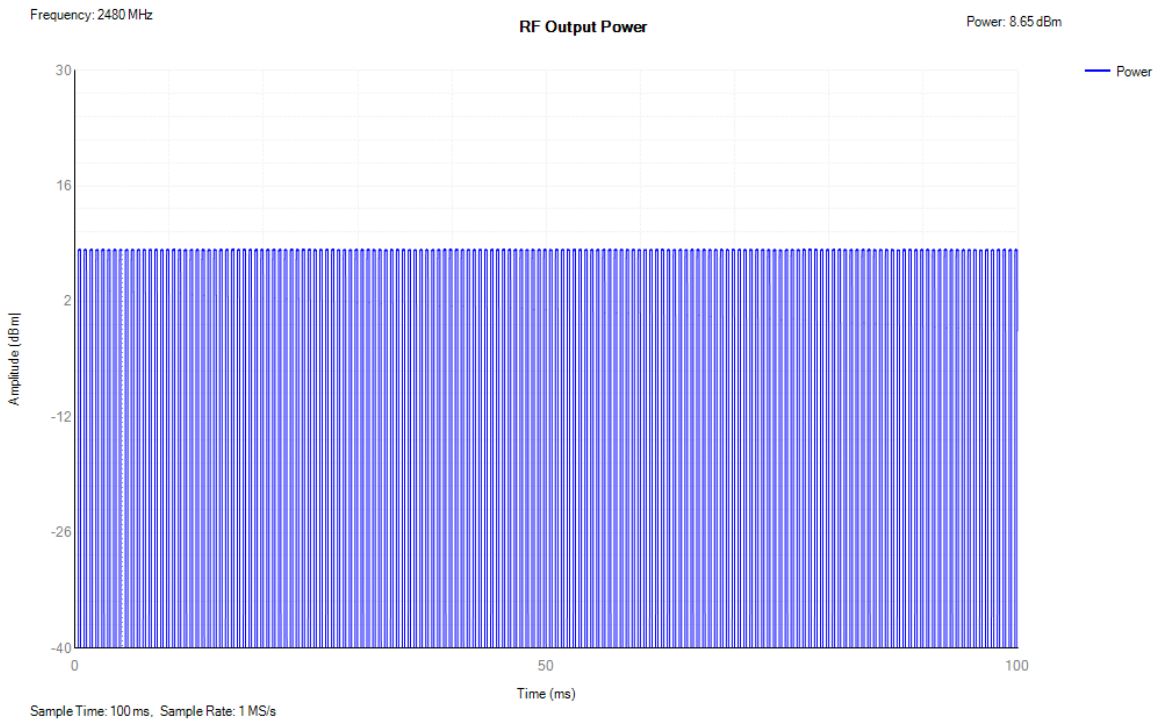

Power NVNT BLE 2M 2402MHz Ant1



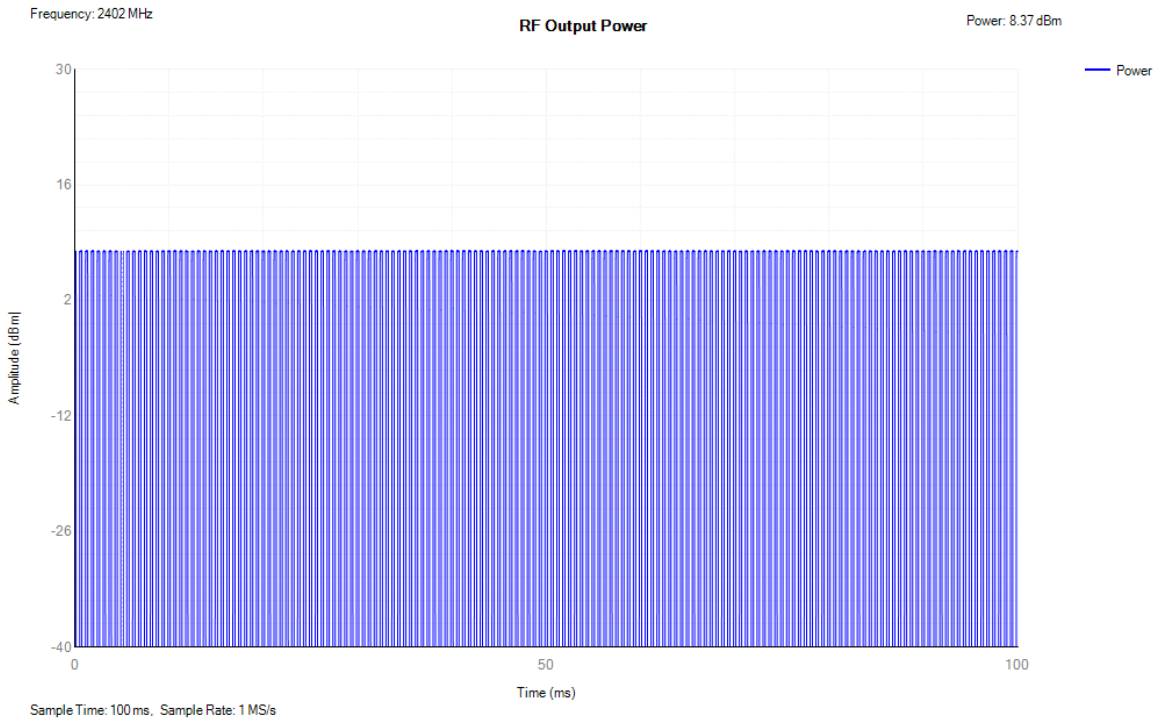
Power NVNT BLE 2M 2440MHz Ant1



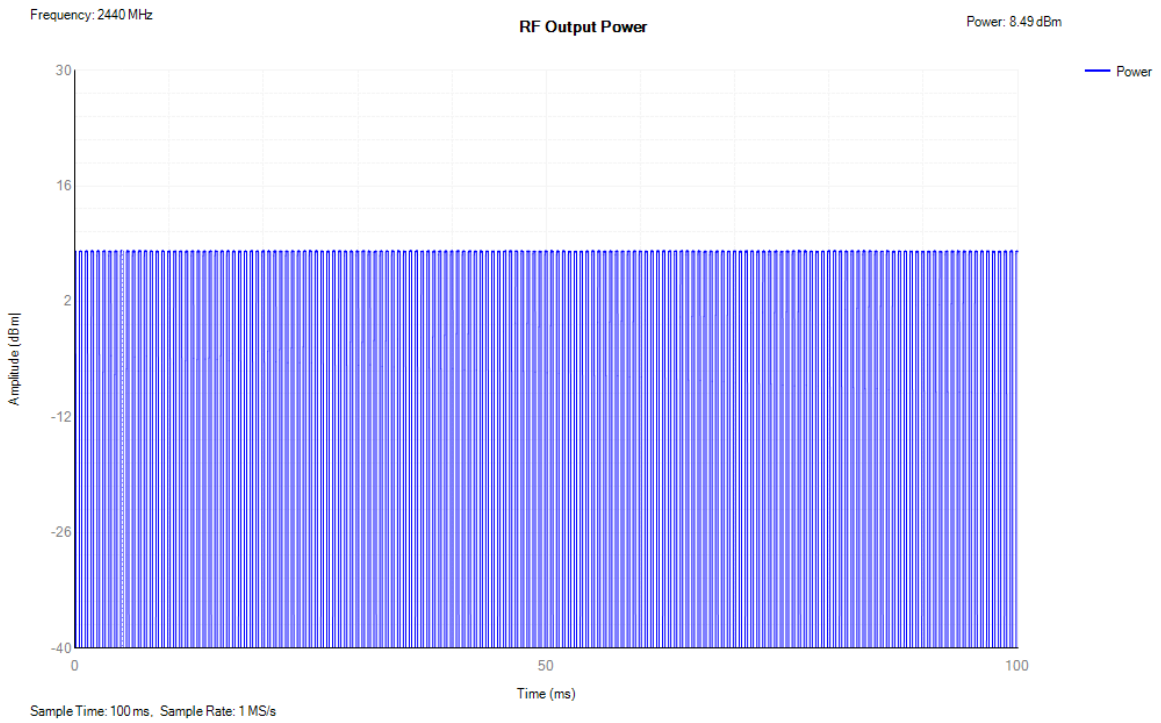

Power NVNT BLE 2M 2480MHz Ant1



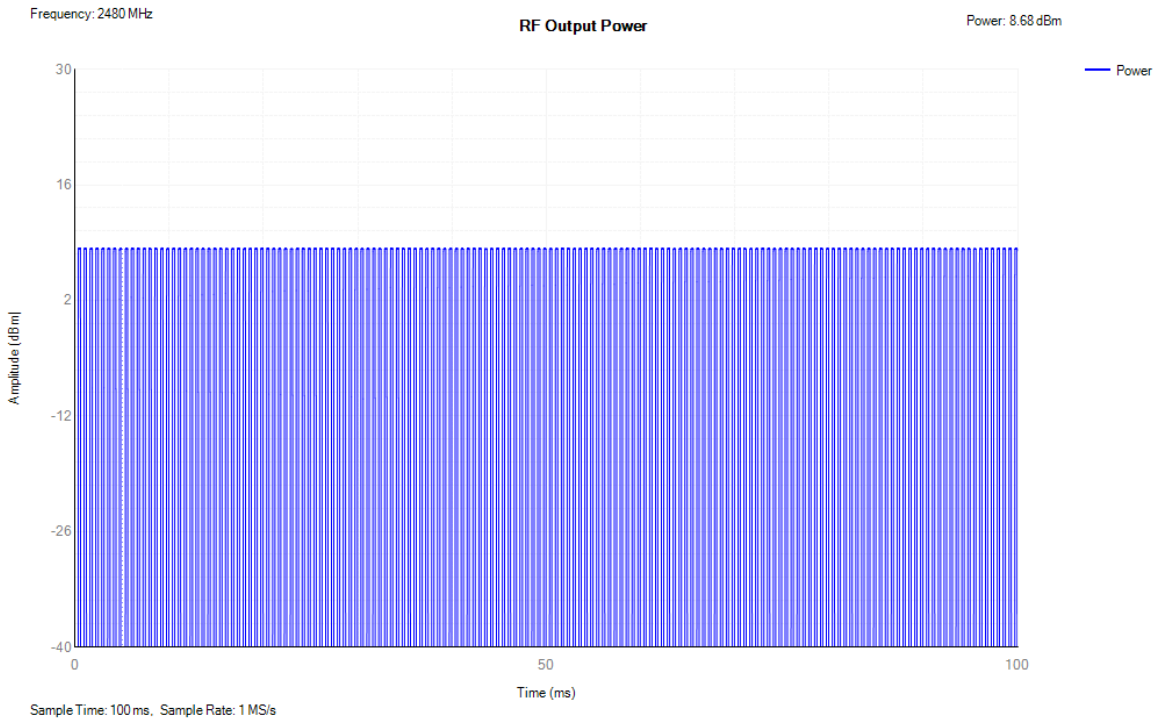
Power NVLT BLE 2M 2402MHz Ant1



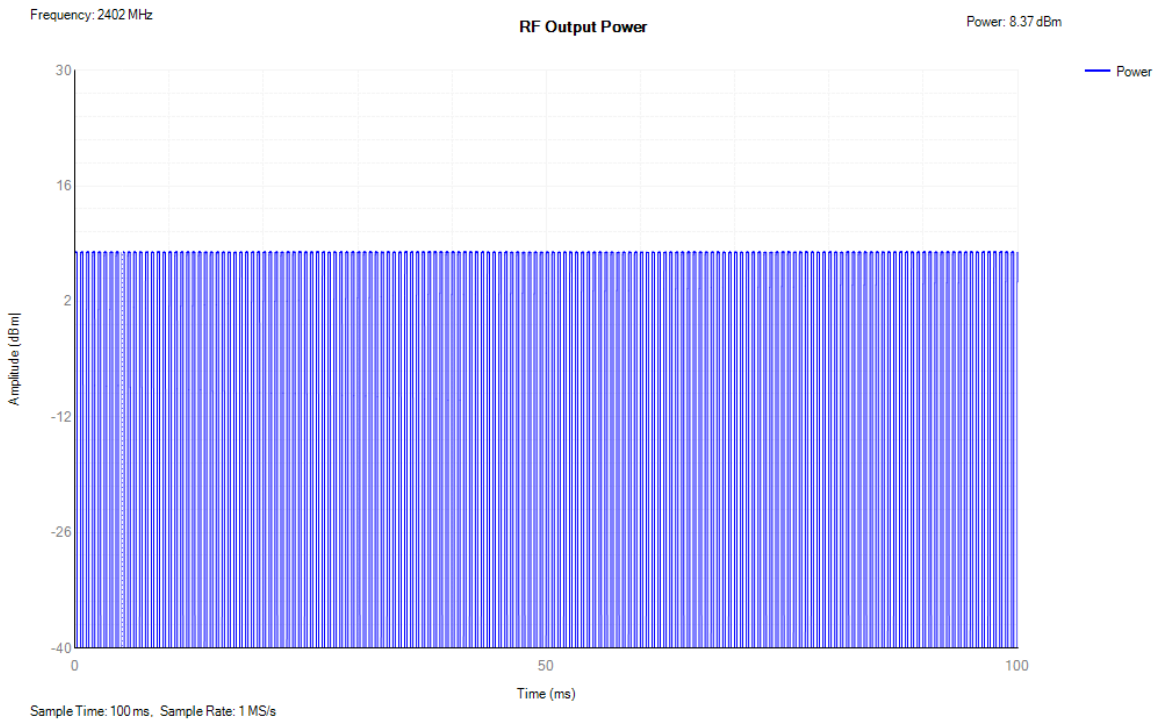

Power NVLT BLE 2M 2440MHz Ant1



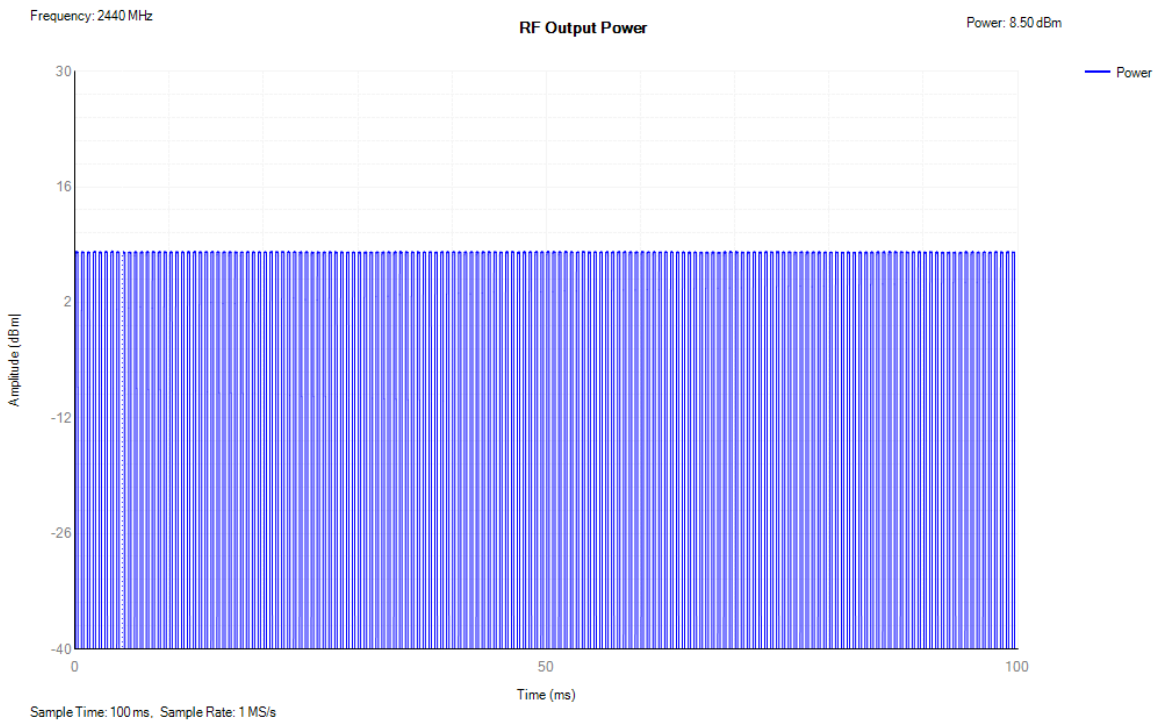
Power NVLT BLE 2M 2480MHz Ant1



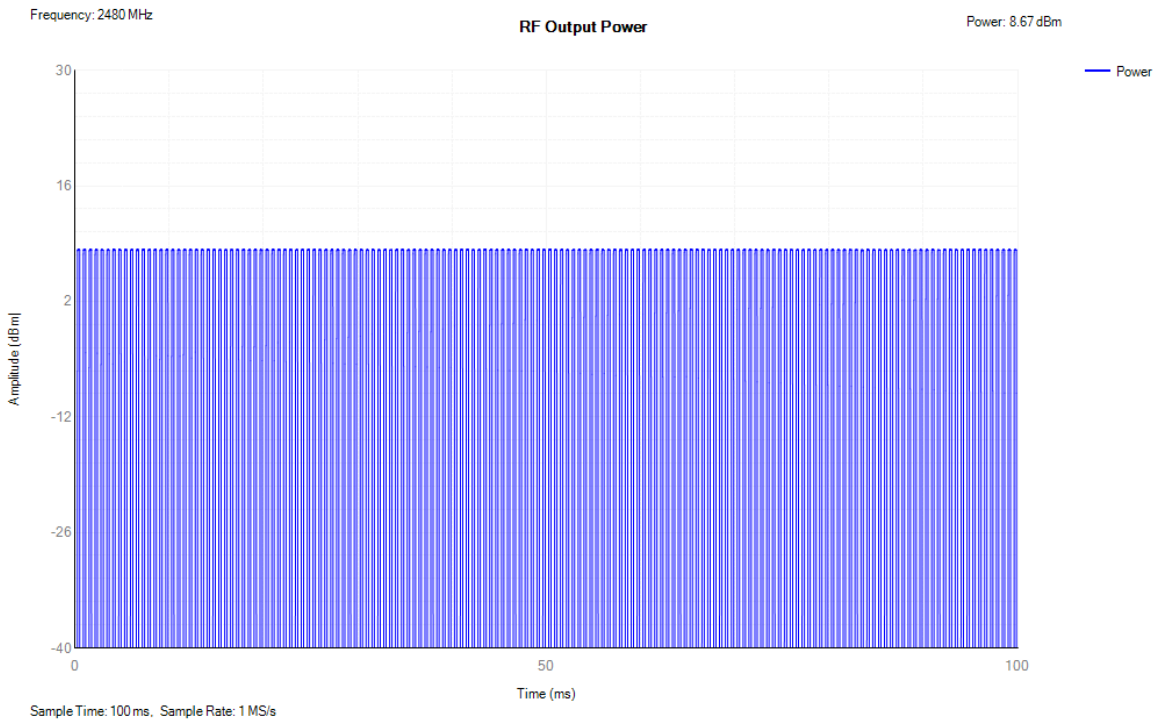

Power NVHT BLE 2M 2402MHz Ant1



Power NVHT BLE 2M 2440MHz Ant1




Power NVHT BLE 2M 2480MHz Ant1

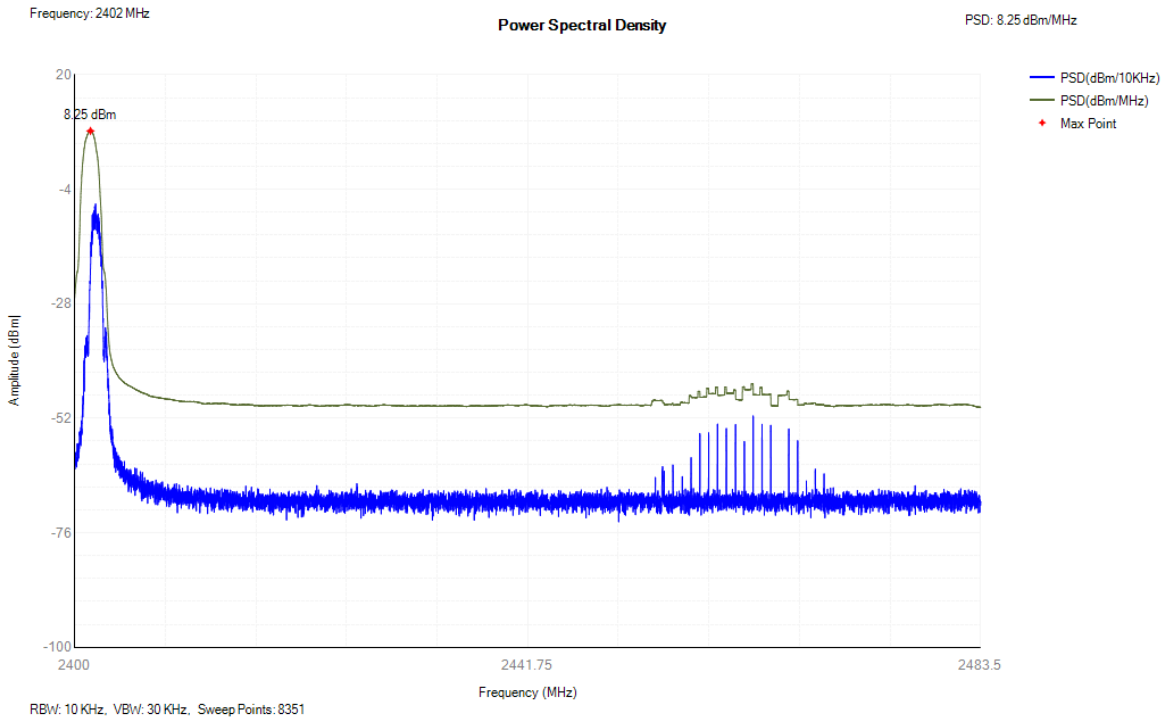


**Power Spectral Density**

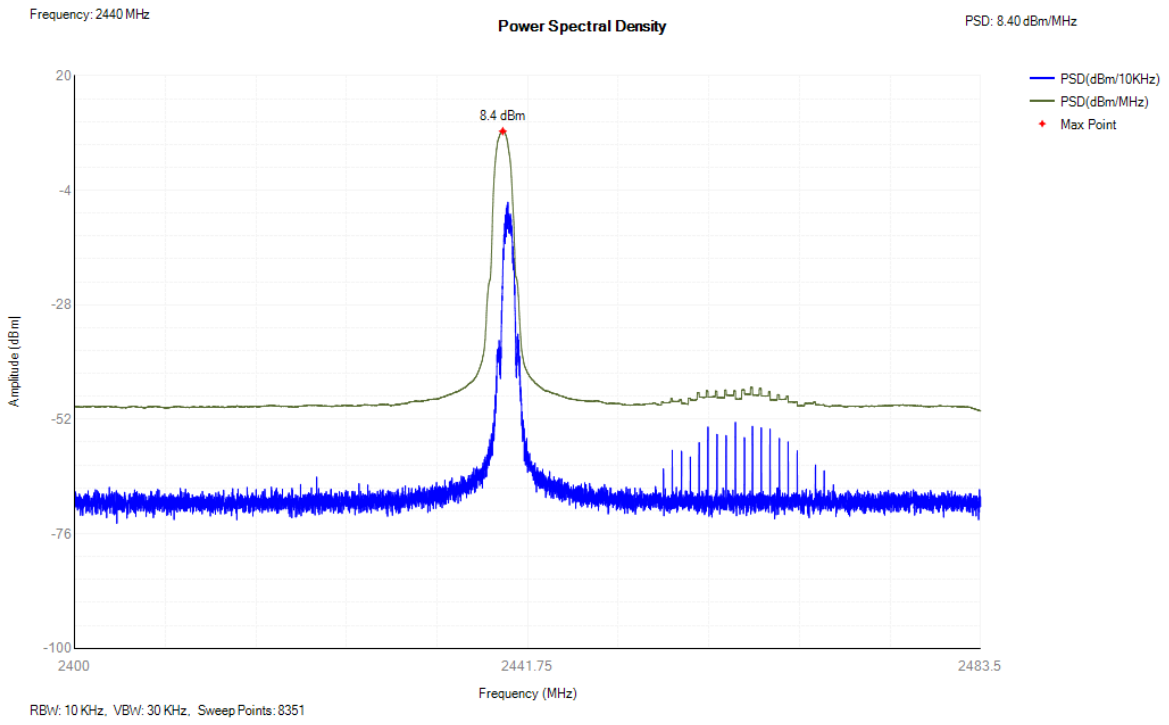
| Condition | Mode | Frequency (MHz) | Antenna | Max PSD (dBm/MHz) | Limit (dBm/MHz) | Verdict |
|---|---|---|---|---|---|---|
| NVNT | BLE 1M | 2402 | Ant1 | 8.25 | 10 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 8.4 | 10 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 8.61 | 10 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 6.95 | 10 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 7.25 | 10 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 7.38 | 10 | Pass |

Test Graphs

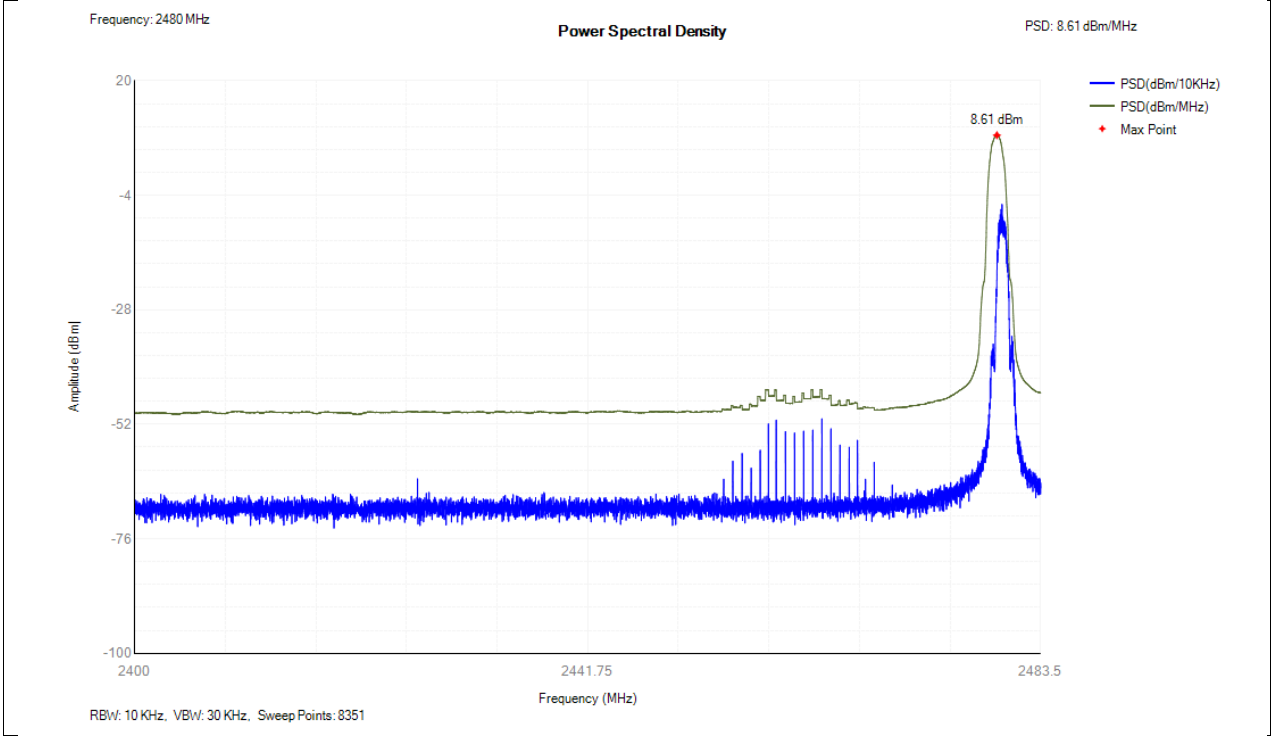
PSD NVNT BLE 1M 2402MHz Ant1



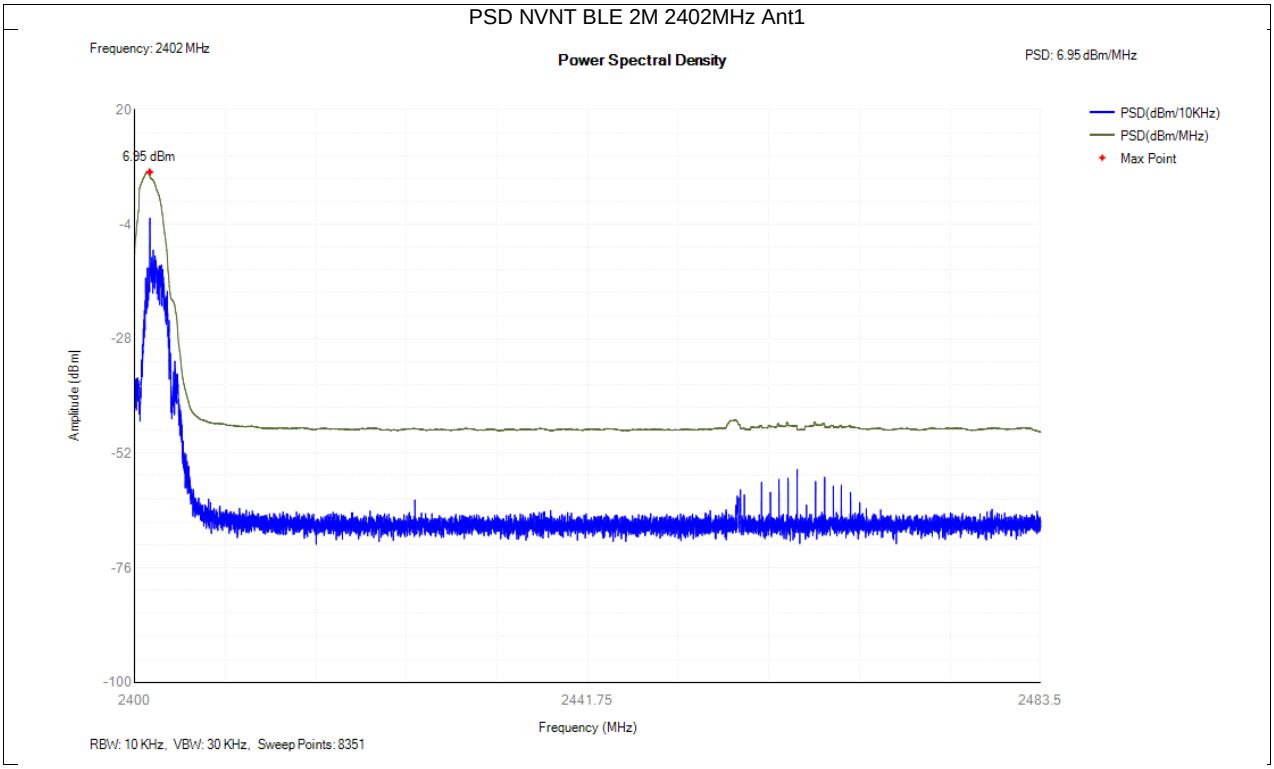

PSD NVNT BLE 1M 2440MHz Ant1



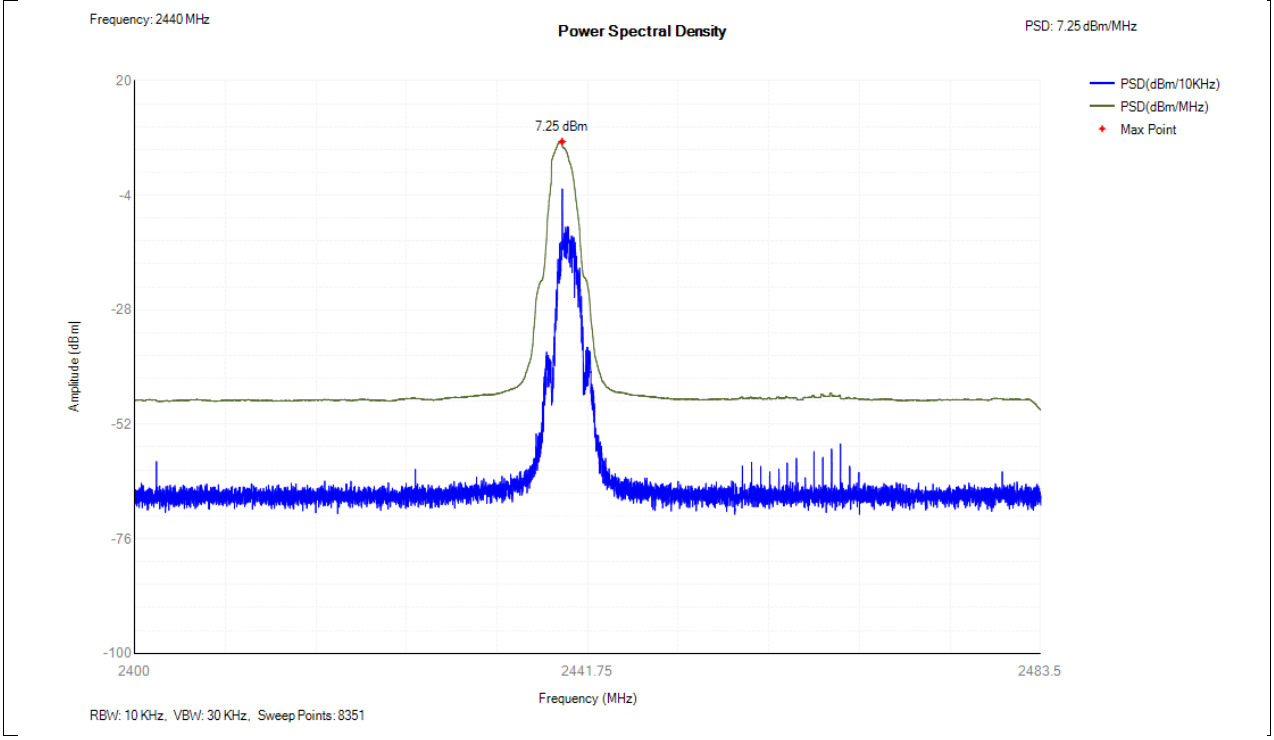
PSD NVNT BLE 1M 2480MHz Ant1



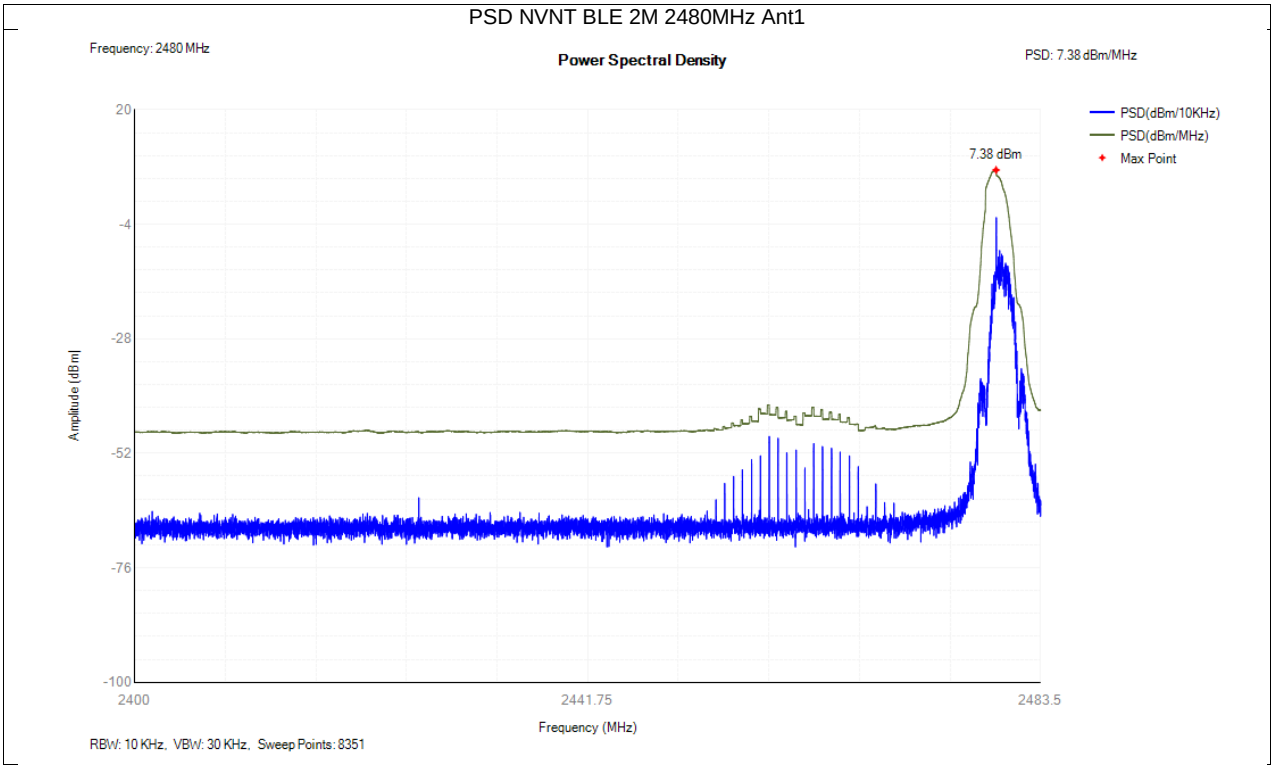

PSD NVNT BLE 2M 2402MHz Ant1



PSD NVNT BLE 2M 2440MHz Ant1




PSD NVNT BLE 2M 2480MHz Ant1

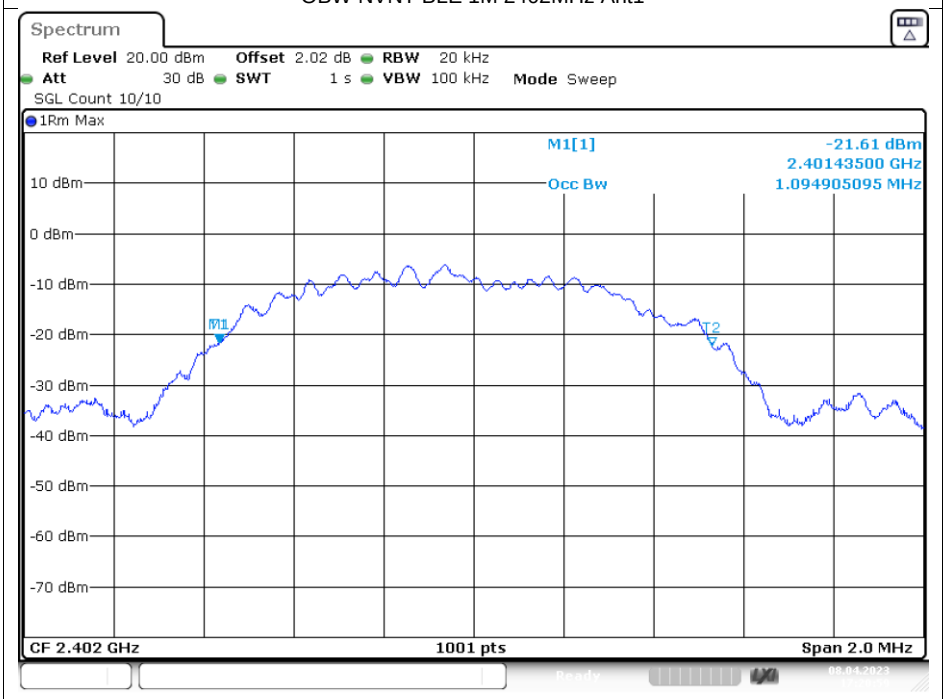


**Occupied Channel Bandwidth**

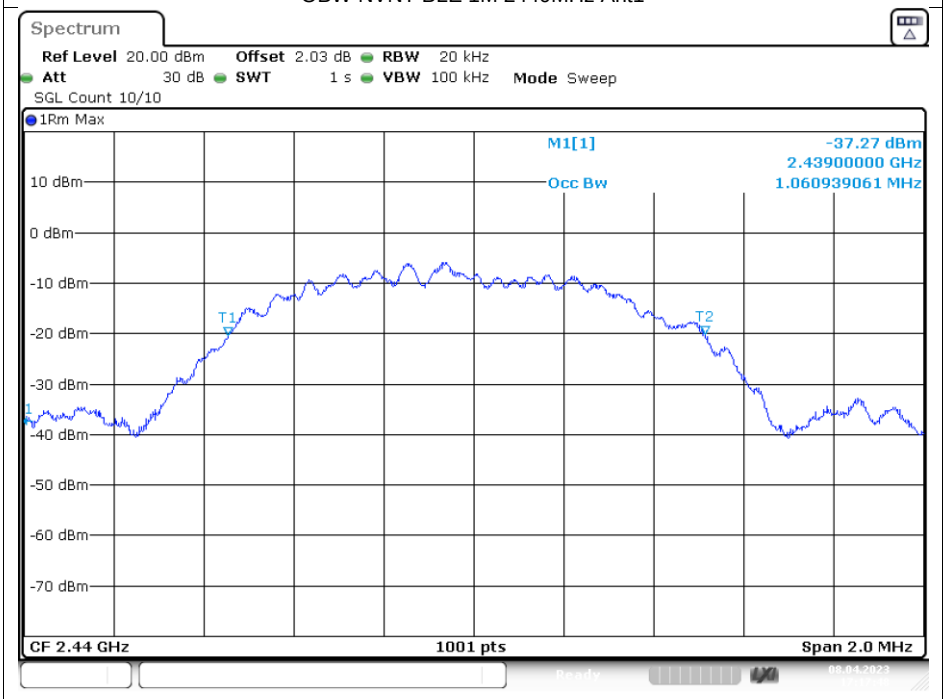
| Condition | Mode | Frequency (MHz) | Antenna | Center Frequency (MHz) | OBW (MHz) | Lower Edge (MHz) | Upper Edge (MHz) | Limit OBW (MHz) | Verdict |
|---|---|---|---|---|---|---|---|---|---|
| NVNT | BLE 1M | 2402 | Ant1 | 2401.982 | 1.095 | 2401.435 | 2402.529 | 20 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 2439.983 | 1.061 | 2439.453 | 2440.513 | 20 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 2479.982 | 1.063 | 2479.451 | 2480.513 | 20 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 2402.006 | 1.079 | 2401.467 | 2402.545 | 20 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 2401.992 | 2.246 | 2400.869 | 2403.115 | 20 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 2439.996 | 2.166 | 2438.913 | 2441.079 | 20 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 2479.992 | 2.182 | 2478.901 | 2481.083 | 20 | Pass |

Test Graphs

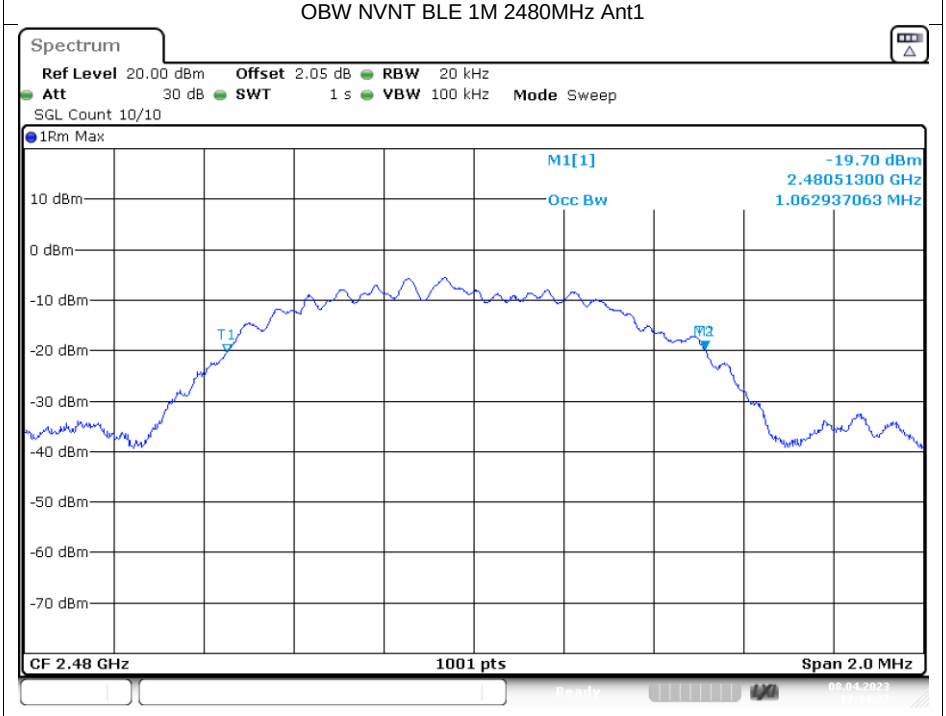
OBW NVNT BLE 1M 2402MHz Ant1



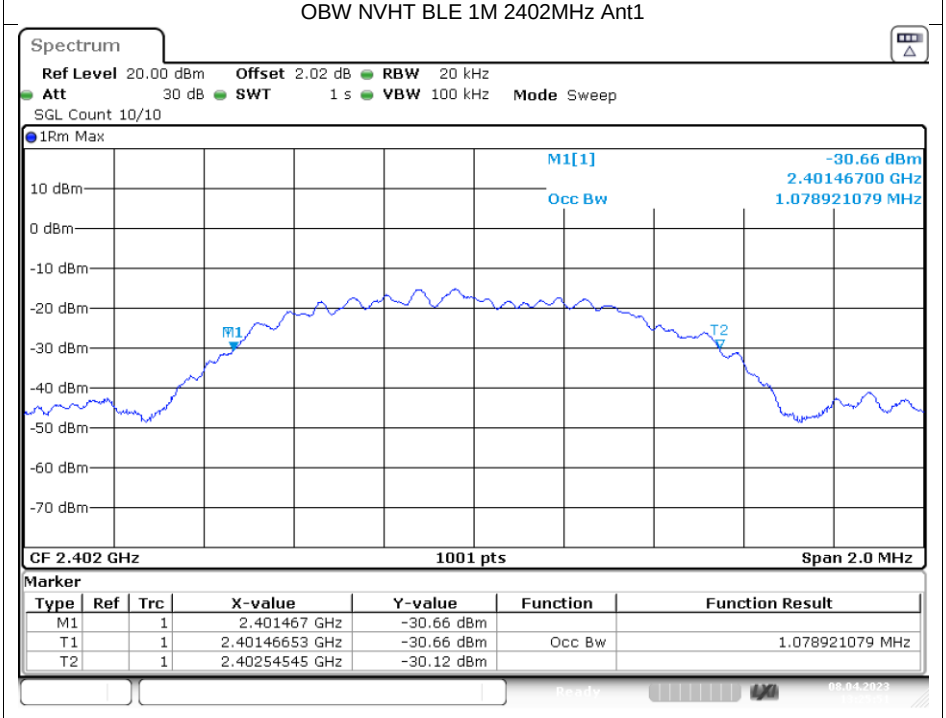

OBW NVNT BLE 1M 2440MHz Ant1



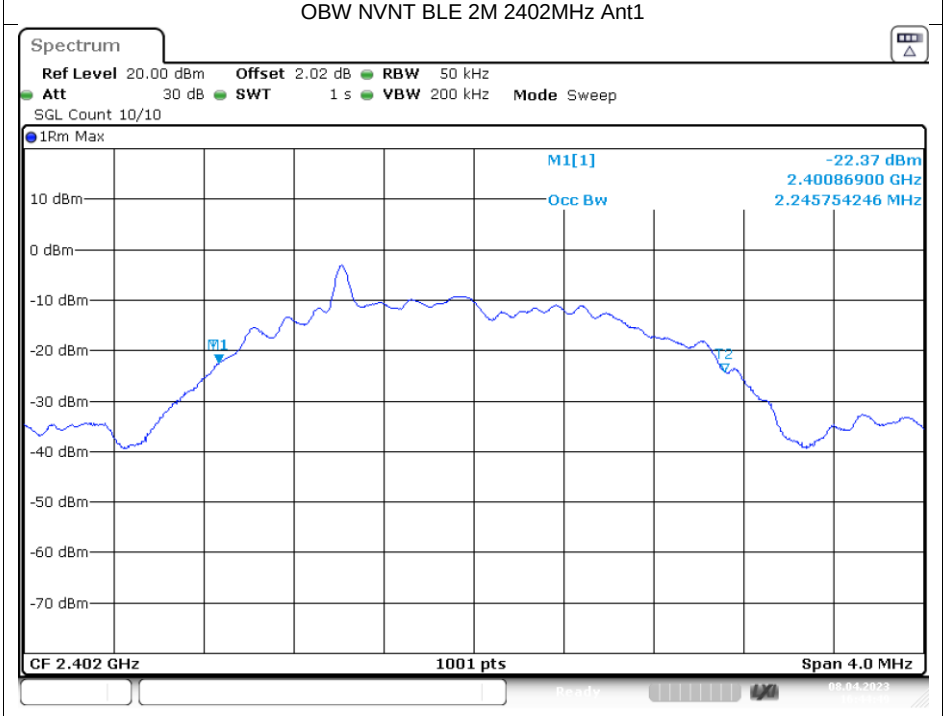
OBW NVNT BLE 1M 2480MHz Ant1



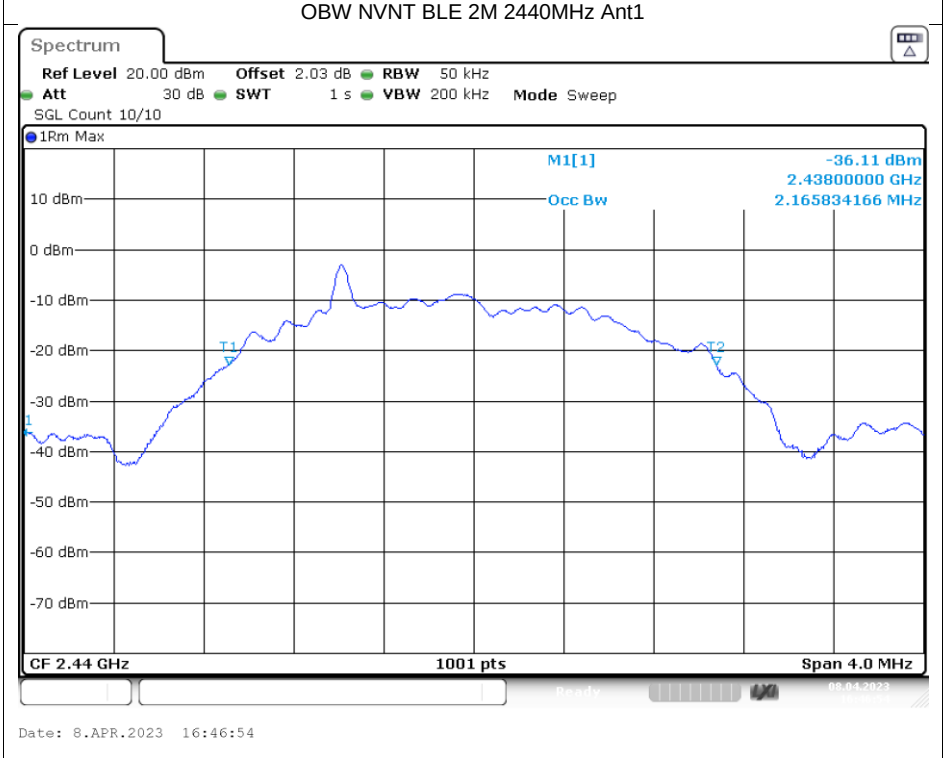

OBW NVHT BLE 1M 2402MHz Ant1



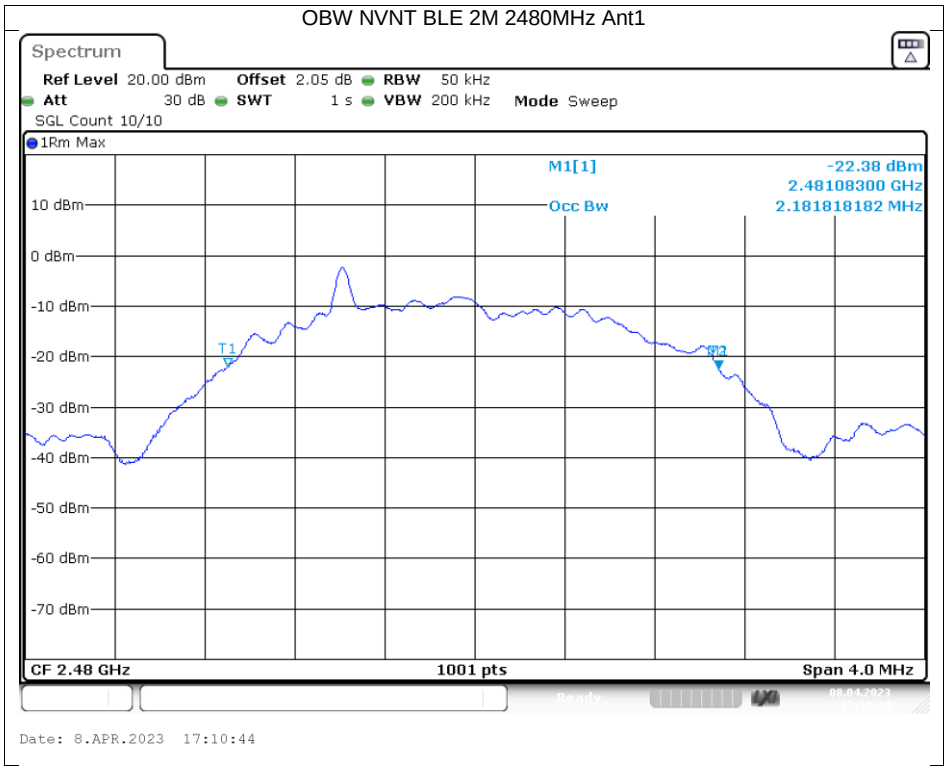
OBW NVNT BLE 2M 2402MHz Ant1




OBW NVNT BLE 2M 2440MHz Ant1



OBW NVNT BLE 2M 2480MHz Ant1

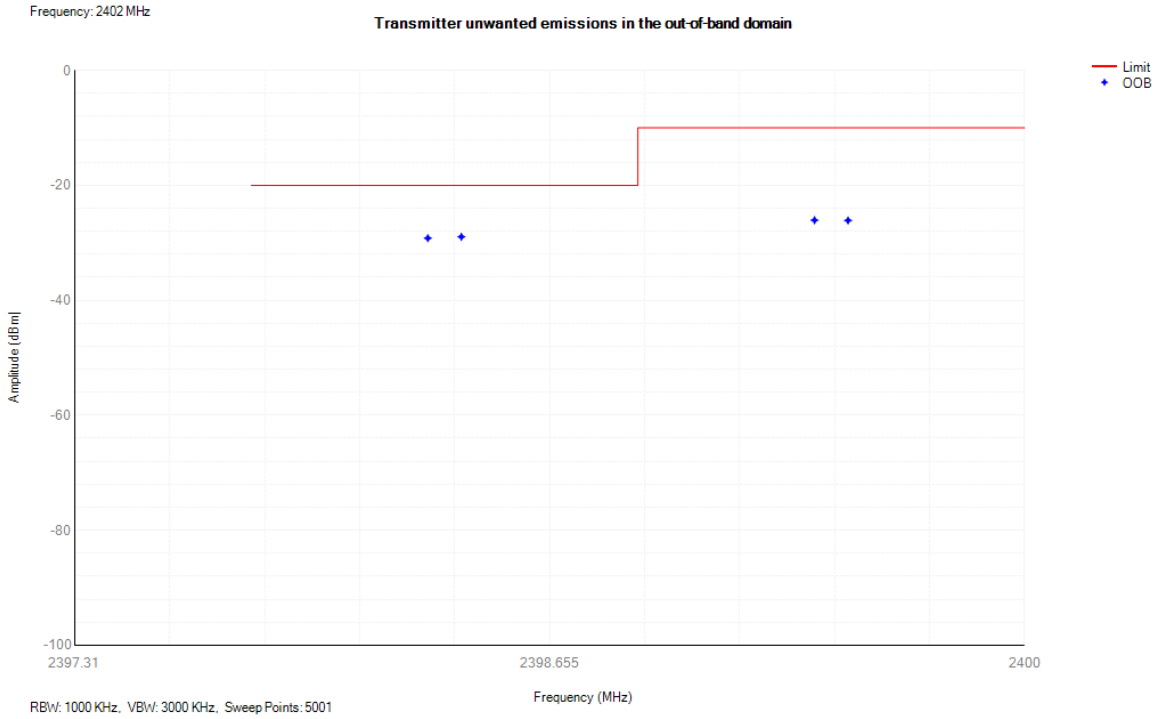


**Transmitter unwanted emissions in the out-of-band domain**

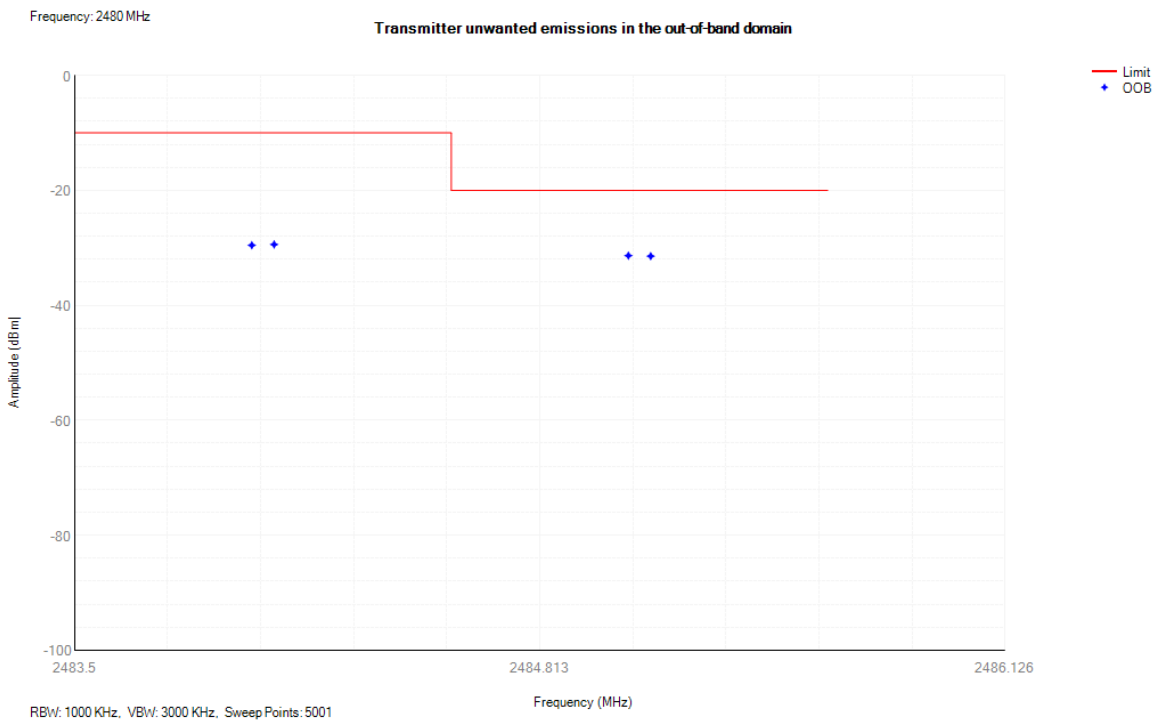
| Condition | Mode | Frequency (MHz) | Antenna | OOB Frequency (MHz) | Level (dBm/MHz) | Limit (dBm/MHz) | Verdict |
|---|---|---|---|---|---|---|---|
| NVNT | BLE 1M | 2402 | Ant1 | 2399.5 | -26.1 | -10 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 2399.405 | -26.05 | -10 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 2398.405 | -28.94 | -20 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 2398.31 | -29.18 | -20 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 2484 | -29.54 | -10 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 2484.063 | -29.41 | -10 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 2485.063 | -31.35 | -20 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 2485.126 | -31.44 | -20 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 2399.5 | -44.22 | -10 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 2399.421 | -44.49 | -10 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 2398.421 | -49.03 | -20 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 2398.342 | -49.19 | -20 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 2399.5 | -17.68 | -10 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 2399.393 | -21.51 | -10 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 2398.393 | -29.42 | -20 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 2398.286 | -29.54 | -20 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 2484 | -29.11 | -10 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 2485 | -31.13 | -10 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 2485.182 | -31.48 | -10 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 2486.182 | -32.74 | -20 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 2487.182 | -34.31 | -20 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 2487.364 | -34.64 | -20 | Pass |

Test Graphs

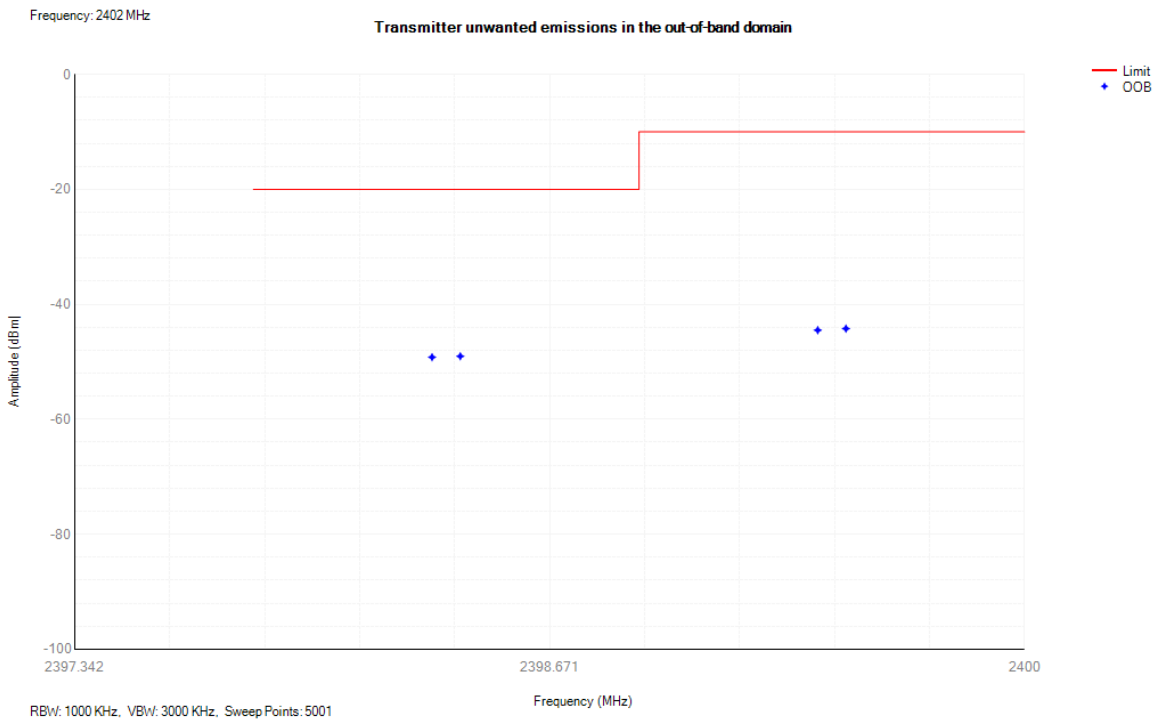
Tx. Emissions OOB NVNT BLE 1M 2402MHz Ant1



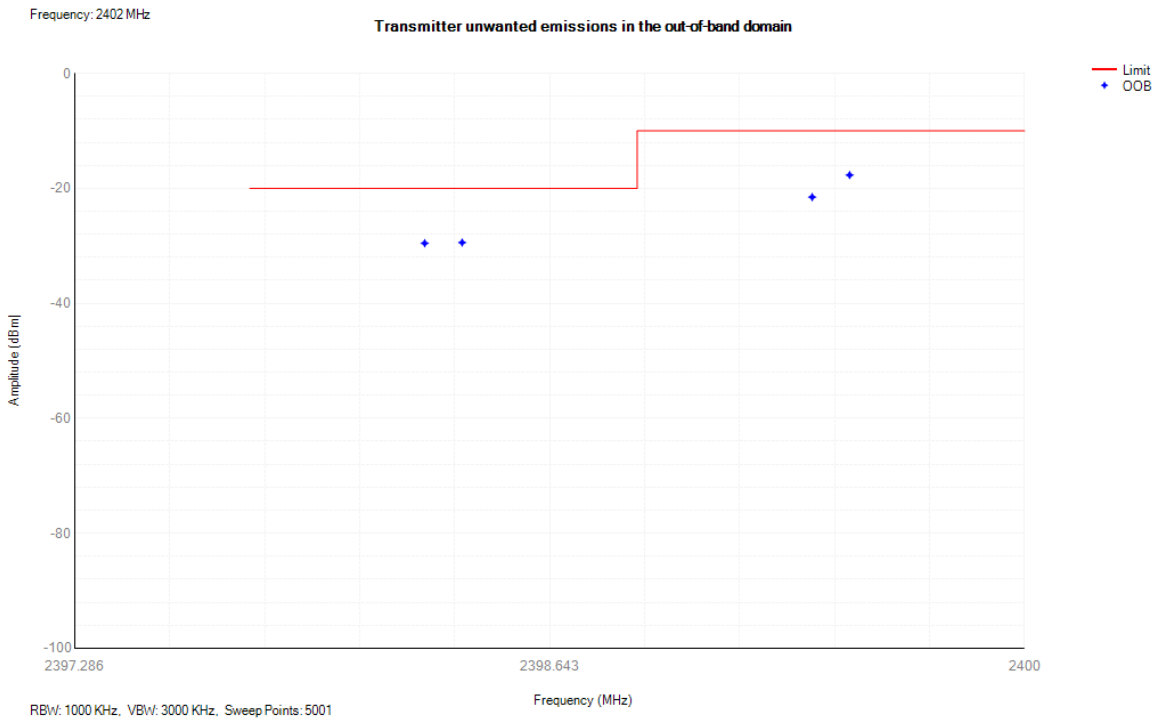

Tx. Emissions OOB NVNT BLE 1M 2480MHz Ant1



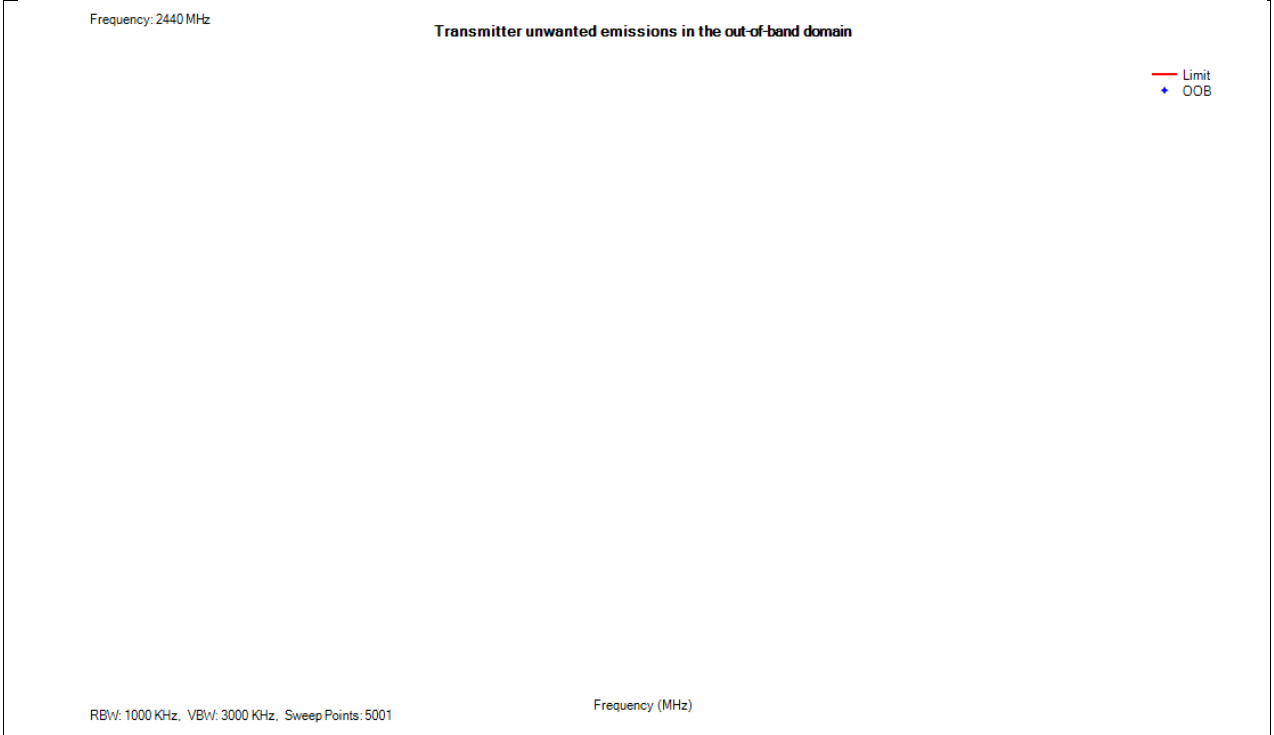
Tx. Emissions OOB NVHT BLE 1M 2402MHz Ant1



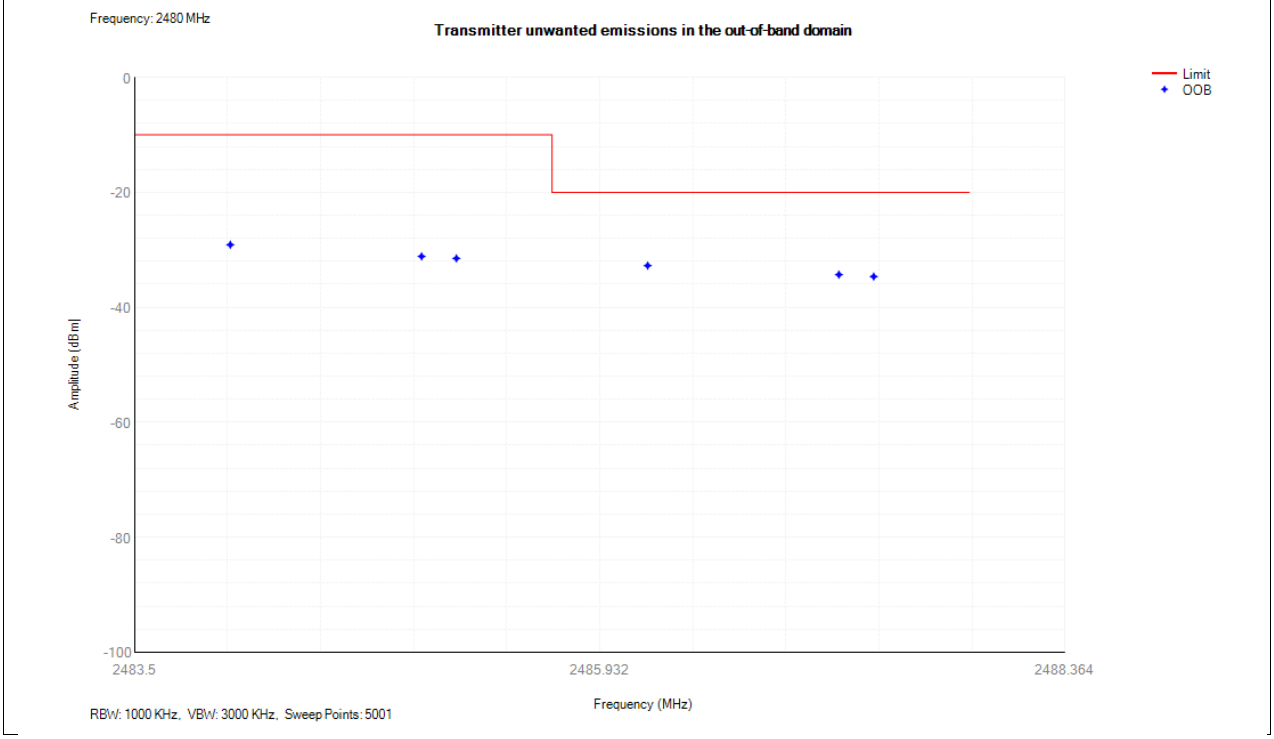

Tx. Emissions OOB NVNT BLE 2M 2402MHz Ant1



Tx. Emissions OOB NVNT BLE 2M 2440MHz Ant1




Tx. Emissions OOB NVNT BLE 2M 2480MHz Ant1



**Transmitter unwanted emissions in the spurious domain**

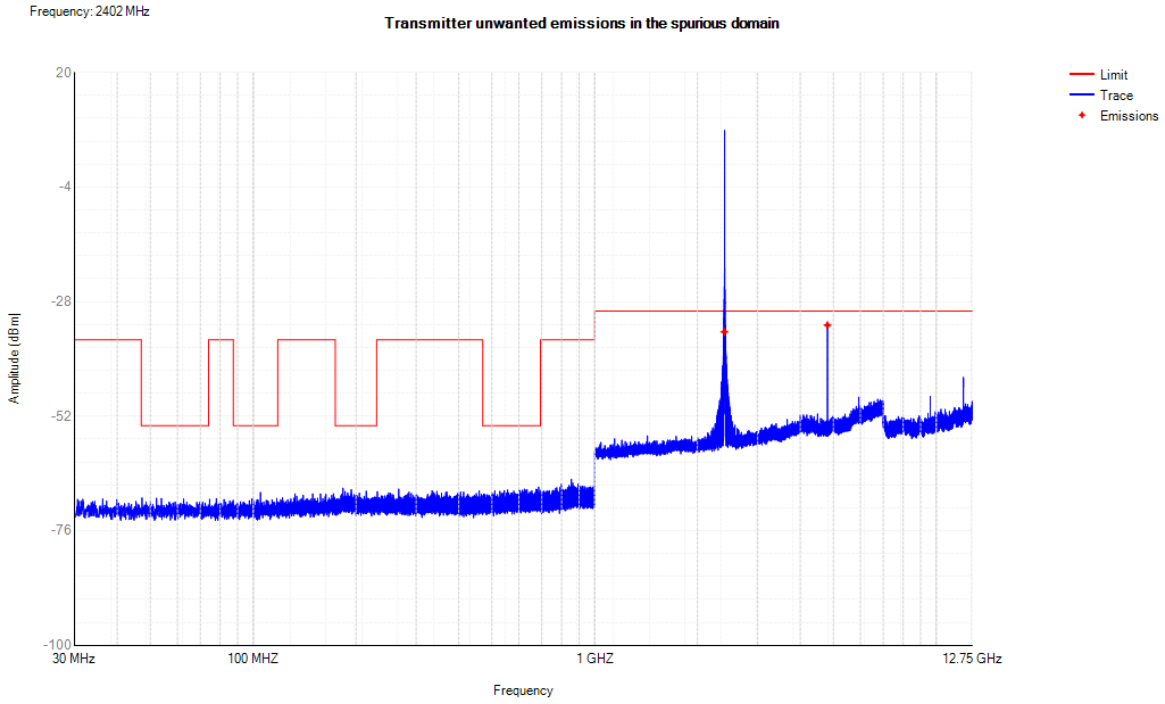
| Condition | Mode | Frequency (MHz) | Antenna | Range (MHz) | Spur Freq (MHz) | Peak (dBm) | RMS (dBm) | Limit (dBm) | Verdict |
|---|---|---|---|---|---|---|---|---|---|
| NVNT | BLE 1M | 2402 | Ant1 | 30 -47 | 36.25 | -69.35 | NA | -36 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 47 -74 | 47.25 | -69.11 | NA | -54 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 74 -87.5 | 78.00 | -69.26 | NA | -36 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 87.5 -118 | 105.05 | -67.98 | NA | -54 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 118 -174 | 171.85 | -68.25 | NA | -36 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 174 -230 | 183.15 | -67.07 | NA | -54 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 230 -470 | 266.80 | -67.27 | NA | -36 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 470 -694 | 684.90 | -66.85 | NA | -54 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 694 -1000 | 854.40 | -65.19 | NA | -36 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 1000 -2398 | 2397.50 | -25.50 | -34.34 | -30 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 2485.5 - 12750 | 4804.50 | -32.53 | -32.94 | -30 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 30 -47 | 39.55 | -69.10 | NA | -36 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 47 -74 | 71.80 | -69.29 | NA | -54 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 74 -87.5 | 81.30 | -68.92 | NA | -36 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 87.5 -118 | 98.80 | -68.20 | NA | -54 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 118 -174 | 146.90 | -68.28 | NA | -36 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 174 -230 | 199.40 | -67.79 | NA | -54 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 230 -470 | 288.85 | -66.98 | NA | -36 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 470 -694 | 682.05 | -66.39 | NA | -54 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 694 -1000 | 911.30 | -66.12 | NA | -36 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 1000 -2398 | 2396.00 | -44.58 | NA | -30 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 2485.5 - 12750 | 4880.50 | -34.06 | -34.56 | -30 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 30 -47 | 45.50 | -69.27 | NA | -36 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 47 -74 | 59.65 | -68.79 | NA | -54 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 74 -87.5 | 83.90 | -69.09 | NA | -36 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 87.5 -118 | 114.90 | -68.37 | NA | -54 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 118 -174 | 147.20 | -67.54 | NA | -36 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 174 -230 | 186.95 | -67.34 | NA | -54 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 230 -470 | 460.90 | -67.21 | NA | -36 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 470 -694 | 641.80 | -67.02 | NA | -54 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 694 -1000 | 824.35 | -66.00 | NA | -36 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 1000 -2398 | 2397.00 | -49.77 | NA | -30 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 2485.5 - 12750 | 2486.00 | -29.07 | -35.9 | -30 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 30 -47 | 33.75 | -69.02 | NA | -36 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 47 -74 | 57.30 | -69.07 | NA | -54 | Pass |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NVHT | BLE 1M | 2402 | Ant1 | 74 -87.5 | 79.10 | -68.94 | NA | -36 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 87.5 -118 | 89.05 | -68.90 | NA | -54 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 118 -174 | 161.60 | -68.28 | NA | -36 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 174 -230 | 195.10 | -67.89 | NA | -54 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 230 -470 | 320.85 | -67.30 | NA | -36 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 470 -694 | 625.10 | -66.80 | NA | -54 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 694 -1000 | 920.50 | -65.66 | NA | -36 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 1000 -2398 | 2397.50 | -48.99 | NA | -30 | Pass |
| NVHT | BLE 1M | 2402 | Ant1 | 2485.5 - 12750 | 4804.50 | -43.46 | NA | -30 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 30 -47 | 36.30 | -69.29 | NA | -36 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 47 -74 | 53.90 | -68.85 | NA | -54 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 74 -87.5 | 87.25 | -69.70 | NA | -36 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 87.5 -118 | 107.20 | -68.78 | NA | -54 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 118 -174 | 139.70 | -67.75 | NA | -36 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 174 -230 | 180.80 | -67.88 | NA | -54 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 230 -470 | 408.30 | -67.24 | NA | -36 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 470 -694 | 647.60 | -66.74 | NA | -54 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 694 -1000 | 724.15 | -65.92 | NA | -36 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 1000 -2396 | 2395.00 | -30.21 | -33.64 | -30 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 2487.5 - 12750 | 4803.00 | -32.84 | -33.66 | -30 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 30 -47 | 31.90 | -68.99 | NA | -36 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 47 -74 | 60.45 | -69.31 | NA | -54 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 74 -87.5 | 76.60 | -68.88 | NA | -36 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 87.5 -118 | 106.95 | -68.31 | NA | -54 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 118 -174 | 163.85 | -68.26 | NA | -36 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 174 -230 | 191.55 | -66.60 | NA | -54 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 230 -470 | 435.05 | -67.50 | NA | -36 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 470 -694 | 664.05 | -66.23 | NA | -54 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 694 -1000 | 888.20 | -65.59 | NA | -36 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 1000 -2396 | 2395.50 | -45.54 | NA | -30 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 2487.5 - 12750 | 4879.00 | -34.33 | -60.49 | -30 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 30 -47 | 39.60 | -69.18 | NA | -36 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 47 -74 | 49.15 | -69.47 | NA | -54 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 74 -87.5 | 85.25 | -68.42 | NA | -36 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 87.5 -118 | 92.45 | -68.77 | NA | -54 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 118 -174 | 152.05 | -68.14 | NA | -36 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 174 -230 | 186.30 | -67.25 | NA | -54 | Pass |

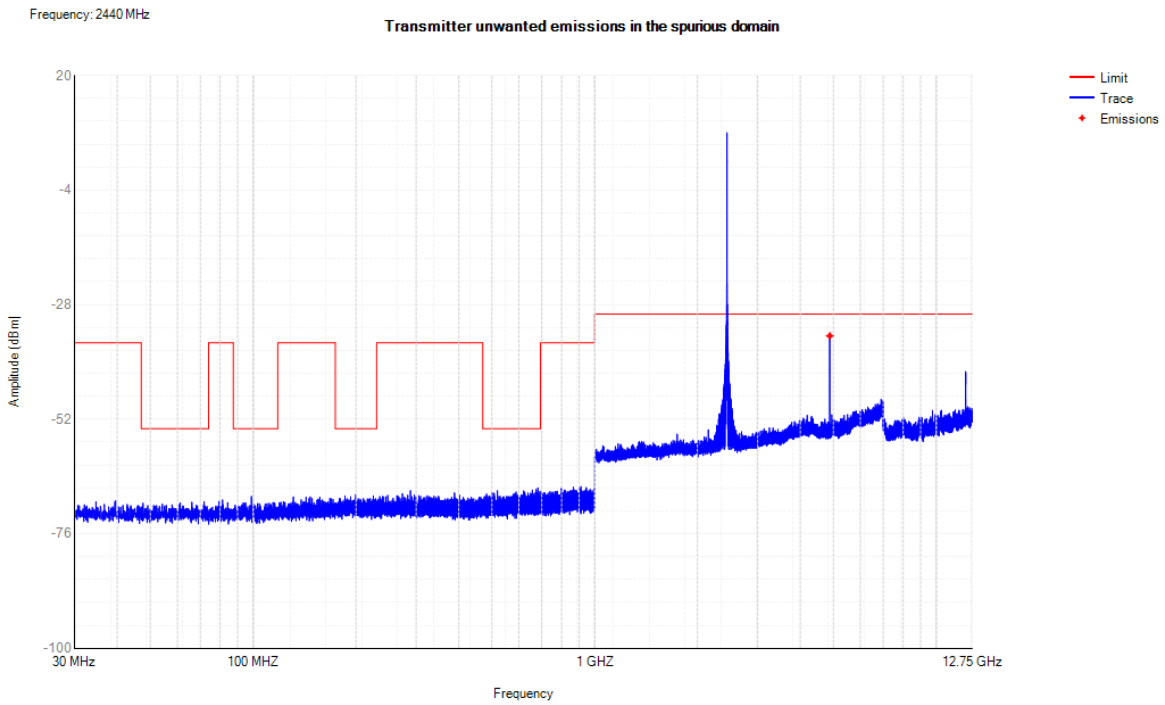
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NVNT | BLE 2M | 2480 | Ant1 | 230 -470 | 317.60 | -67.51 | NA | -36 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 470 -694 | 590.70 | -66.65 | NA | -54 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 694 -1000 | 855.00 | -66.23 | NA | -36 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 1000 -2396 | 2395.00 | -48.42 | NA | -30 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 2487.5 - 12750 | 2488.00 | -30.75 | -34.08 | -30 | Pass |

Test Graphs

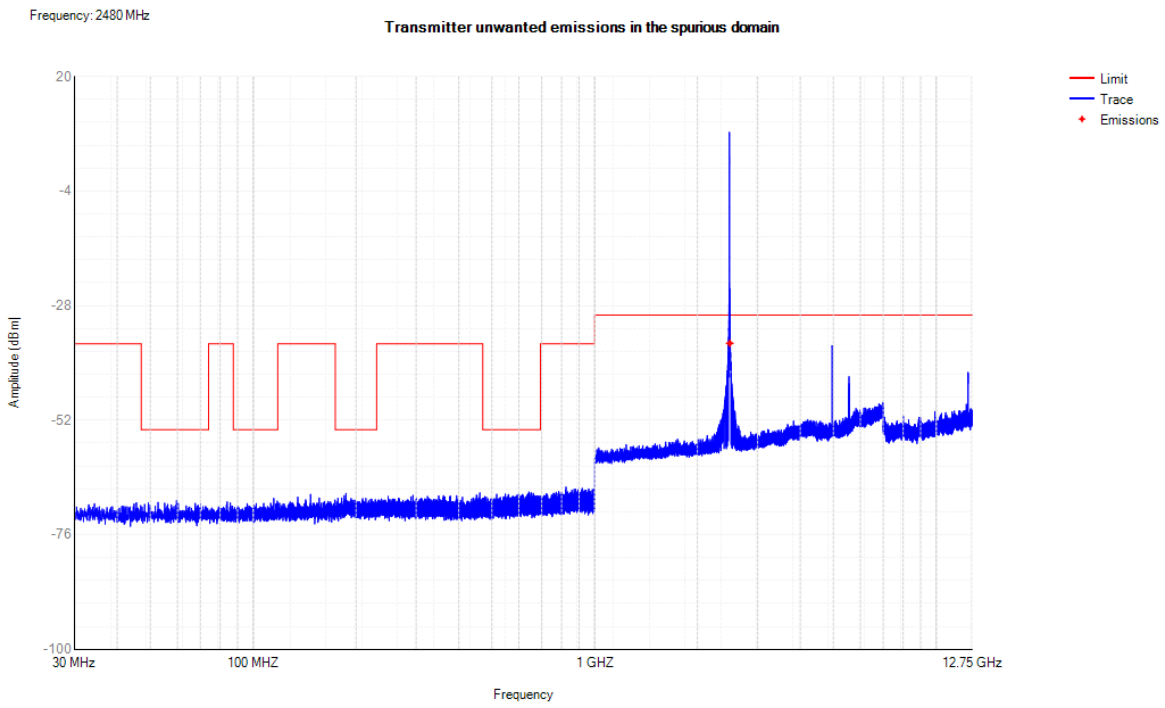
Tx. Spurious NVNT BLE 1M 2402MHz Ant1



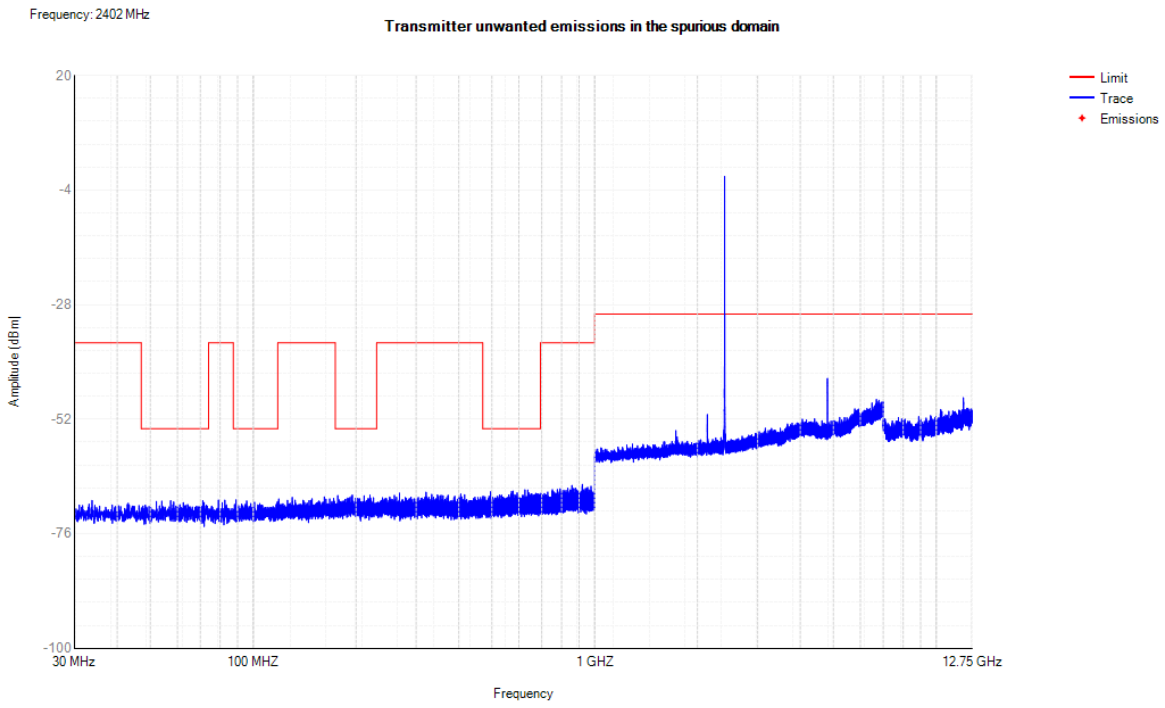

Tx. Spurious NVNT BLE 1M 2440MHz Ant1



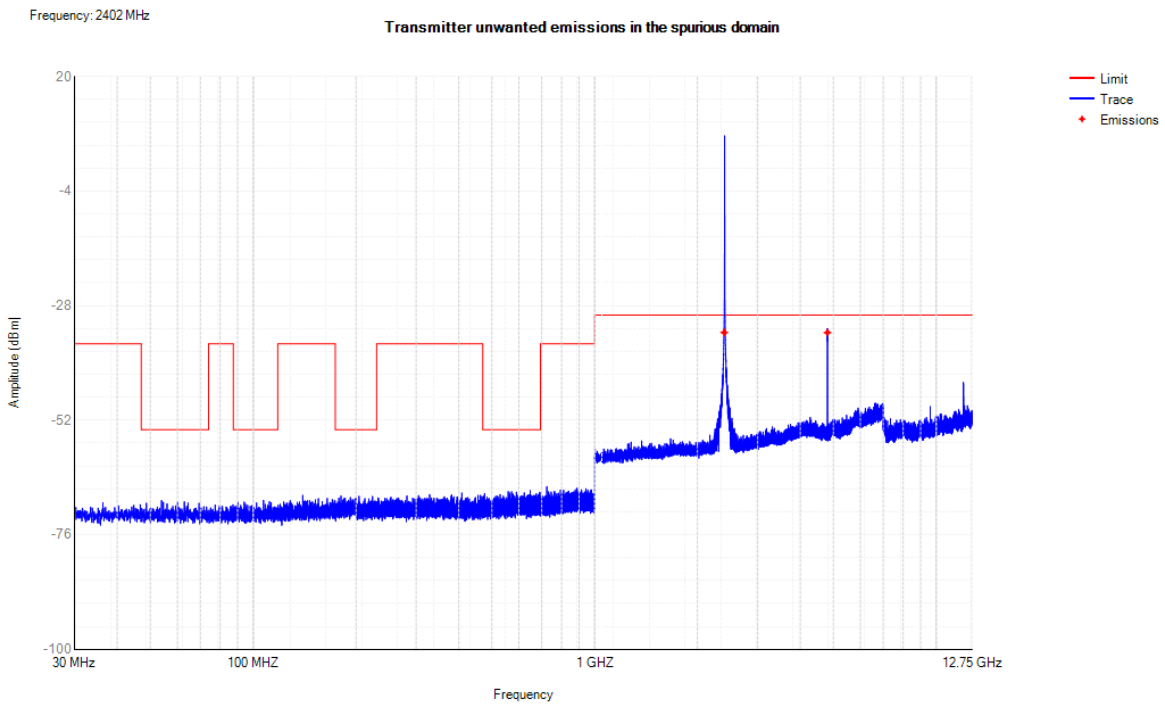
Tx. Spurious NVNT BLE 1M 2480MHz Ant1



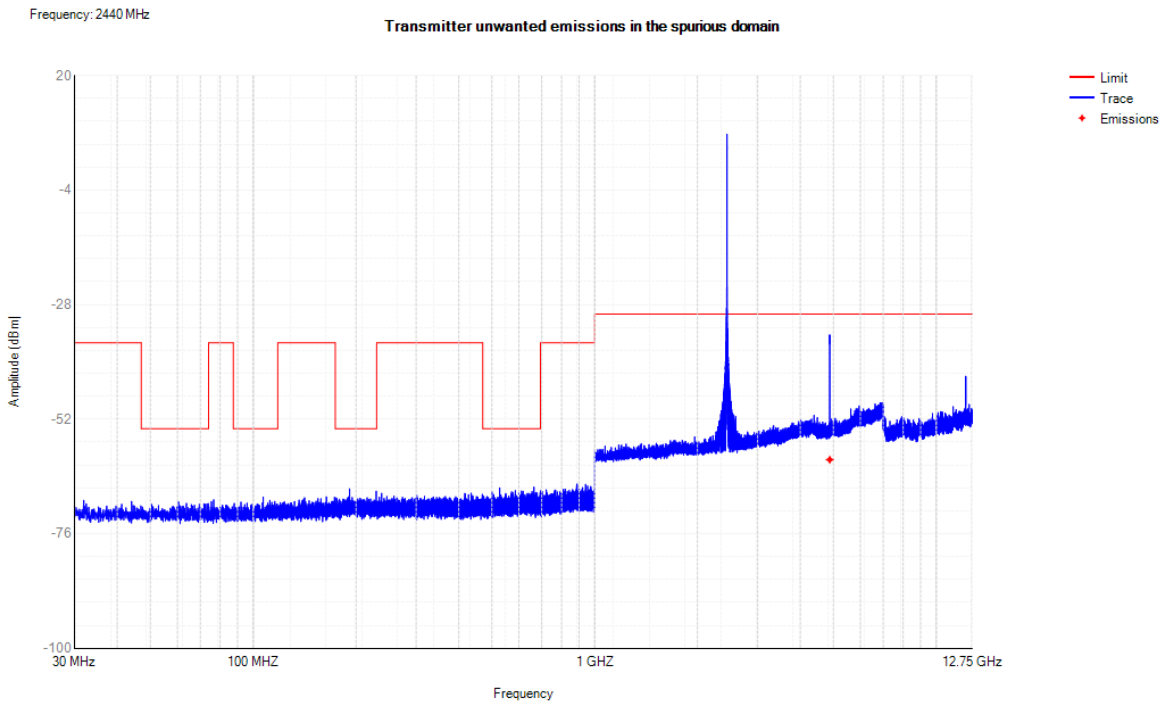

Tx. Spurious NVHT BLE 1M 2402MHz Ant1



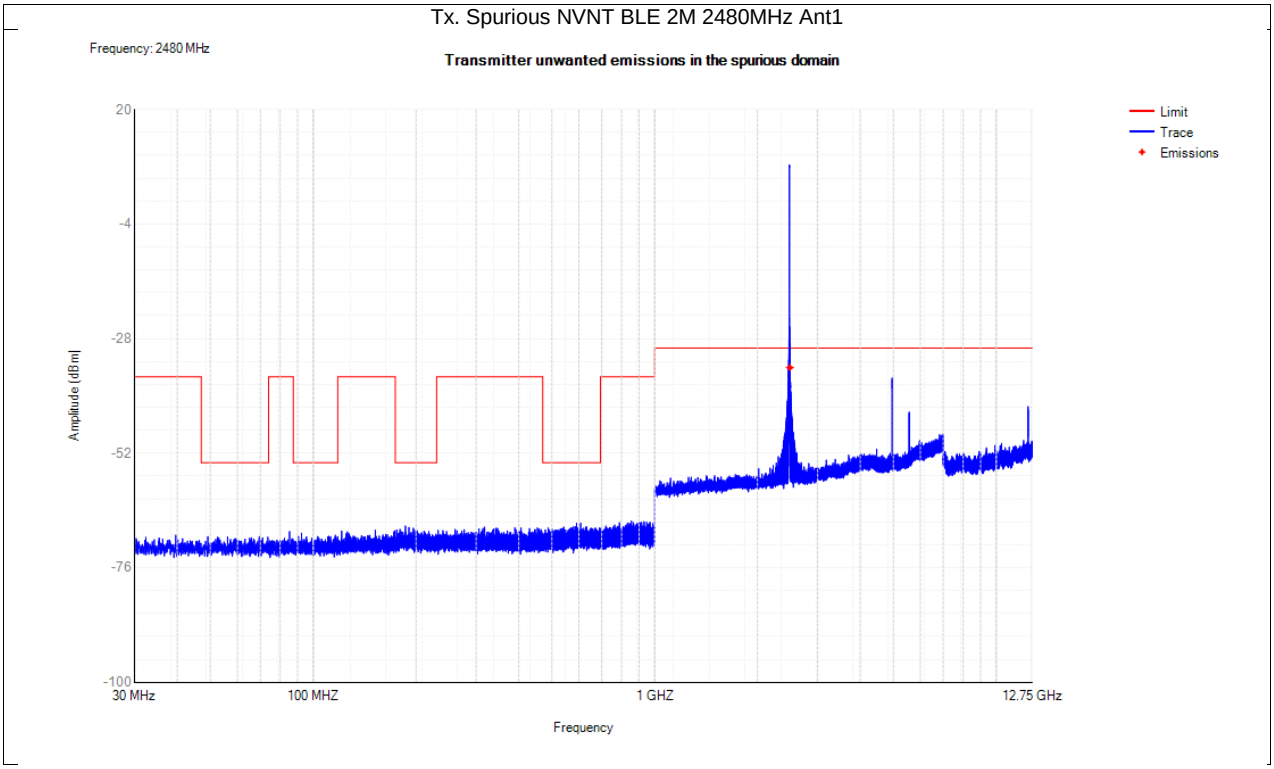
Tx. Spurious NVNT BLE 2M 2402MHz Ant1




Tx. Spurious NVNT BLE 2M 2440MHz Ant1



Tx. Spurious NVNT BLE 2M 2480MHz Ant1

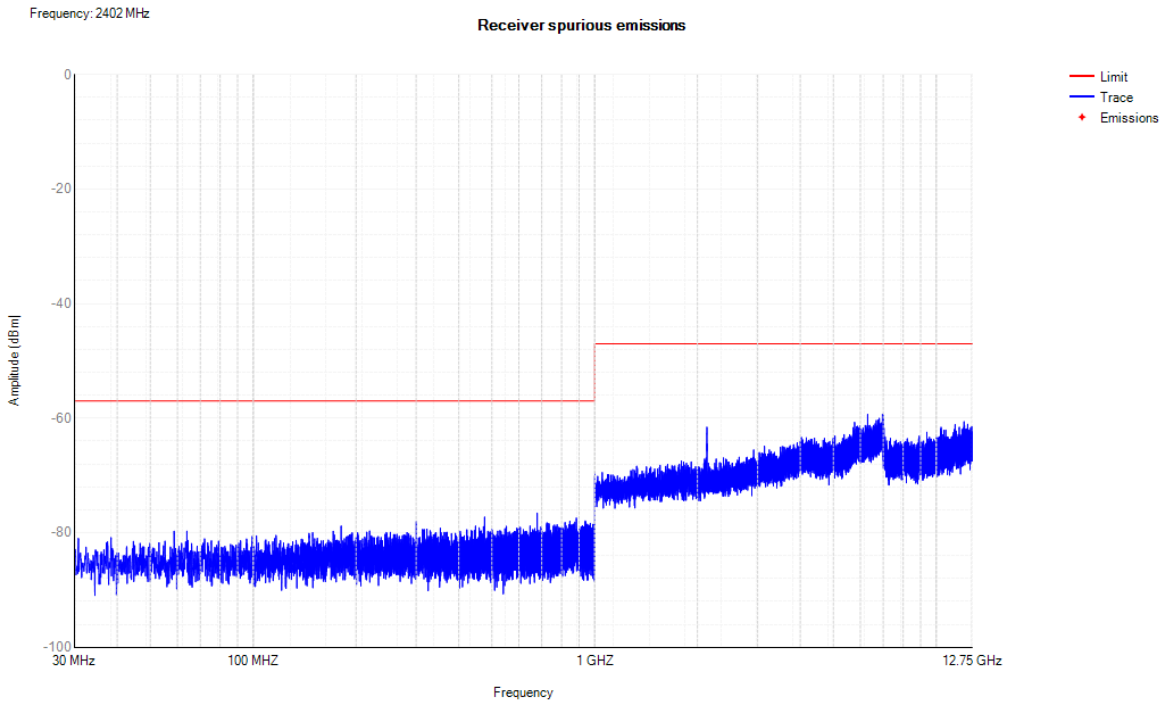


**Receiver spurious emissions**

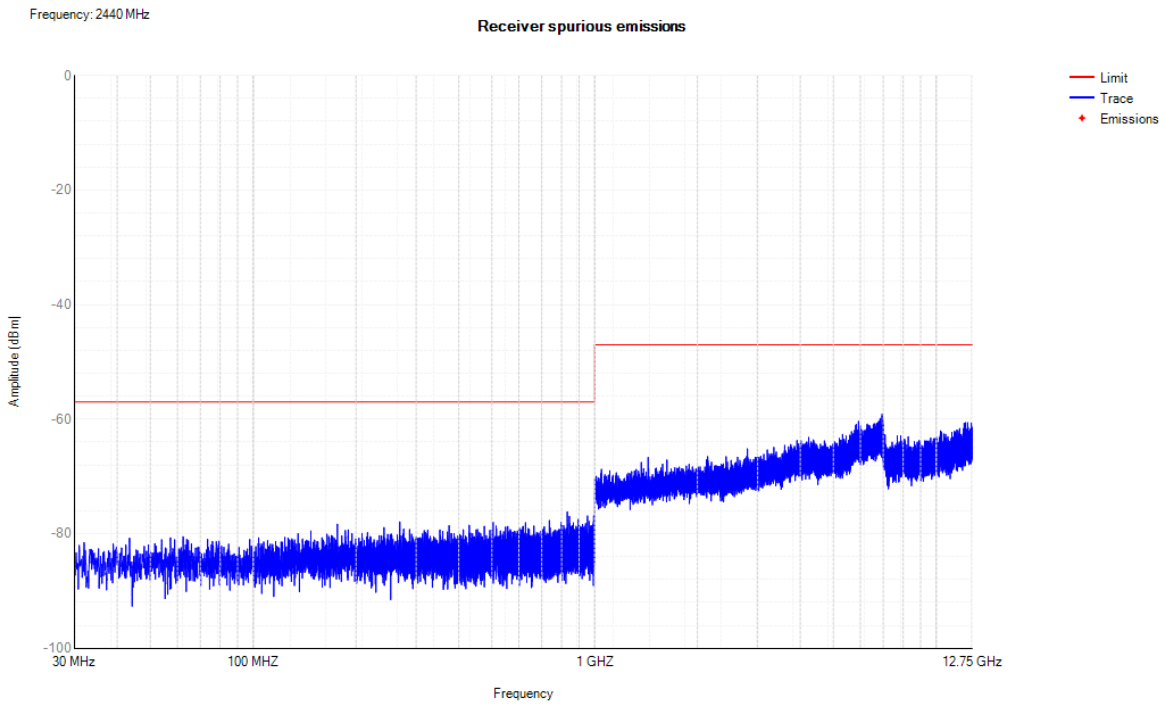
| Condition | Mode | Frequency (MHz) | Antenna | Range (MHz) | Spur Freq (MHz) | Peak (dBm) | RMS (dBm) | Limit (dBm) | Verdict |
|---|---|---|---|---|---|---|---|---|---|
| NVNT | BLE 1M | 2402 | Ant1 | 30 -1000 | 678.6 | -76.57 | NA | -57 | Pass |
| NVNT | BLE 1M | 2402 | Ant1 | 1000 -12750 | 6961 | -59.31 | NA | -47 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 30 -1000 | 831.65 | -76.19 | NA | -57 | Pass |
| NVNT | BLE 1M | 2440 | Ant1 | 1000 -12750 | 6942 | -59.10 | NA | -47 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 30 -1000 | 881.2 | -77.42 | NA | -57 | Pass |
| NVNT | BLE 1M | 2480 | Ant1 | 1000 -12750 | 6949.5 | -58.54 | NA | -47 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 30 -1000 | 944.35 | -76.52 | NA | -57 | Pass |
| NVNT | BLE 2M | 2402 | Ant1 | 1000 -12750 | 6978 | -59.19 | NA | -47 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 30 -1000 | 944.1 | -75.98 | NA | -57 | Pass |
| NVNT | BLE 2M | 2440 | Ant1 | 1000 -12750 | 6997 | -58.79 | NA | -47 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 30 -1000 | 997.65 | -77.14 | NA | -57 | Pass |
| NVNT | BLE 2M | 2480 | Ant1 | 1000 -12750 | 6937 | -59.58 | NA | -47 | Pass |

Test Graphs

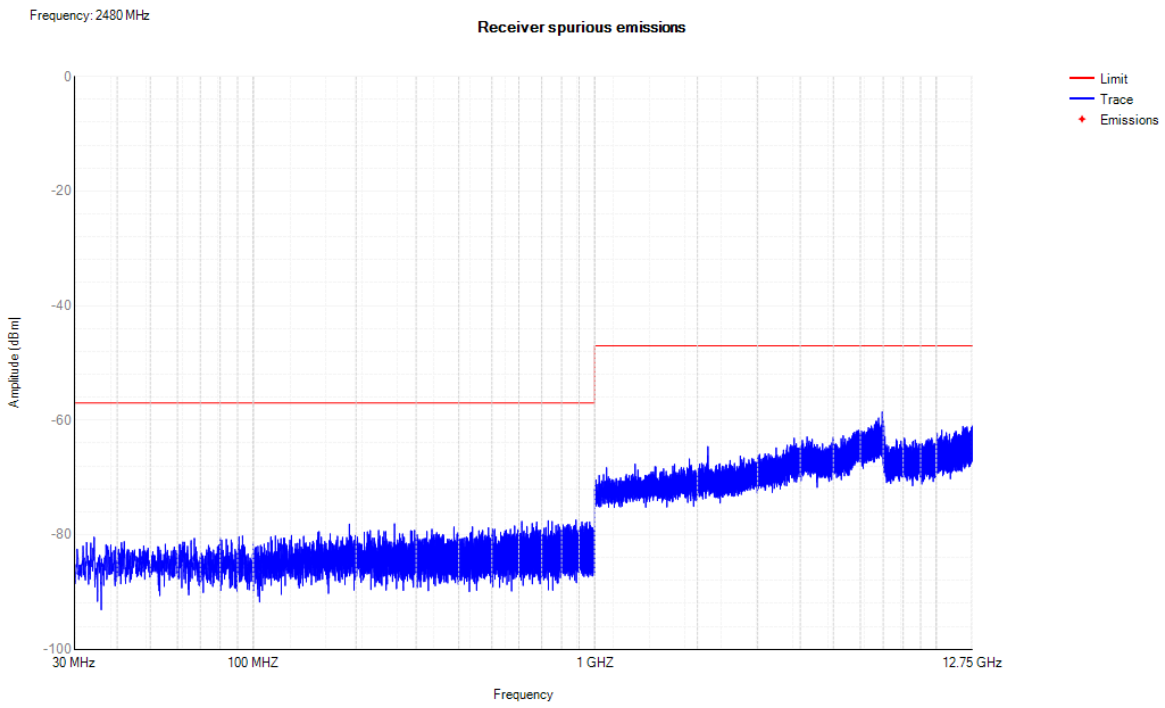
Rx. Spurious NVNT BLE 1M 2402MHz Ant1



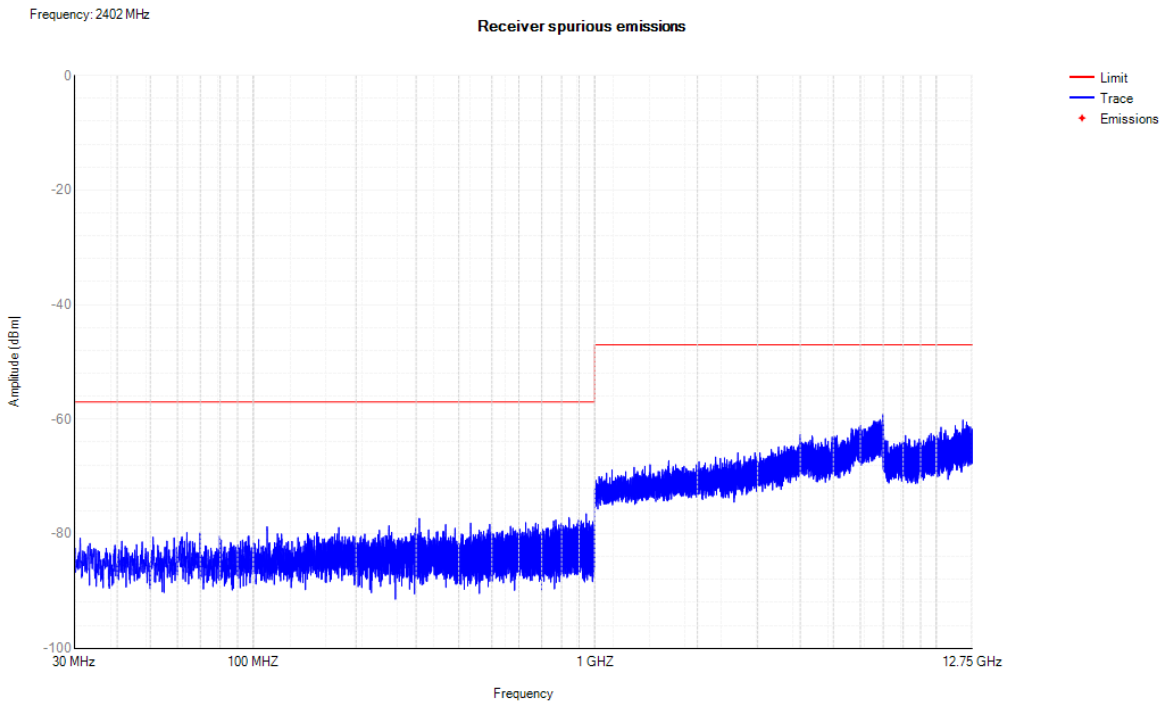

Rx. Spurious NVNT BLE 1M 2440MHz Ant1



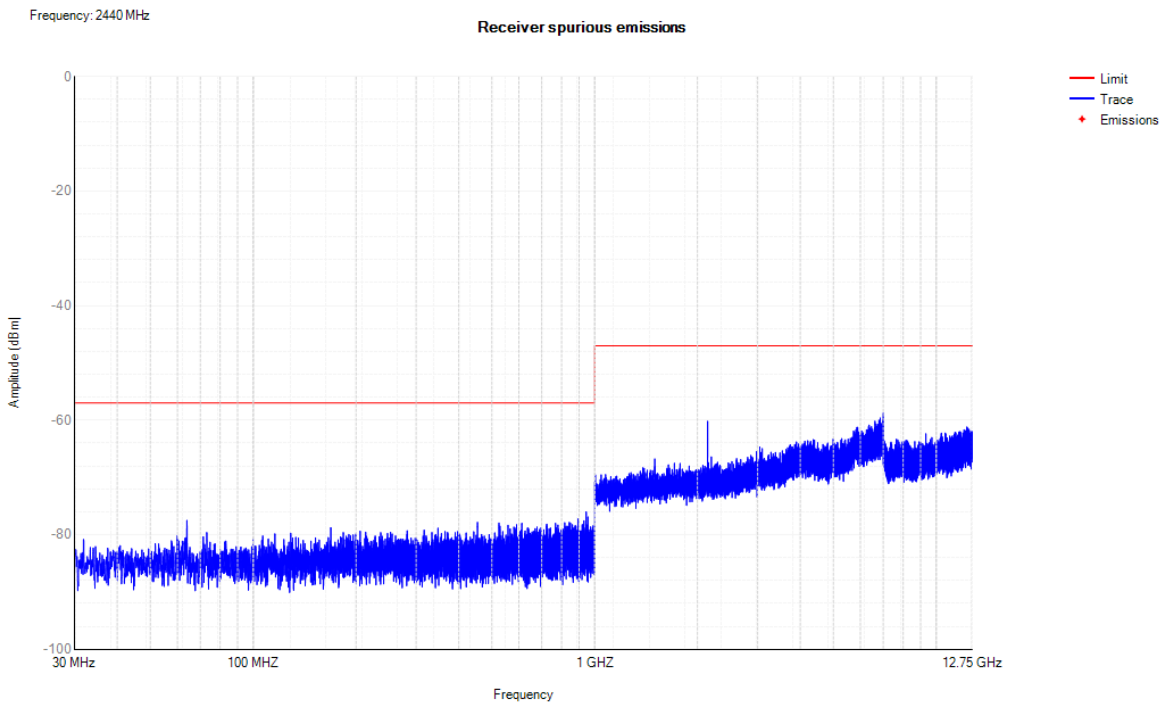
Rx. Spurious NVNT BLE 1M 2480MHz Ant1



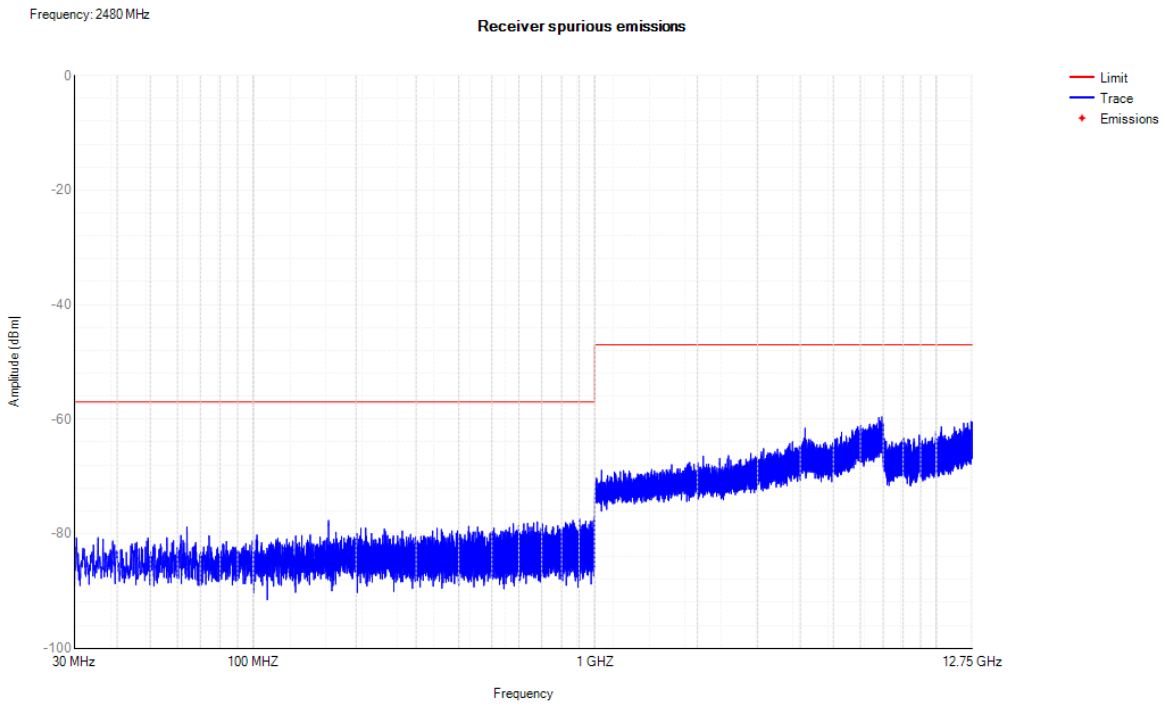

Rx. Spurious NVNT BLE 2M 2402MHz Ant1



Rx. Spurious NVNT BLE 2M 2440MHz Ant1




Rx. Spurious NVNT BLE 2M 2480MHz Ant1



**Receiver Blocking**

| Condition | Mode | Frequency (MHz) | Wanted Power (dBm) | Blocking Frequency (MHz) | Blocking Power (dBm) | PER (%) | Limit (%) | Verdict |
|---|---|---|---|---|---|---|---|---|
| NVNT | BLE | 2402 | -69 | 2380 | -34 | 1.2 | 10 | Pass |
| NVNT | BLE | 2402 | -69 | 2504 | -34 | 1.3 | 10 | Pass |
| NVNT | BLE | 2402 | -69 | 2300 | -34 | 0.8 | 10 | Pass |
| NVNT | BLE | 2402 | -69 | 2584 | -34 | 1.4 | 10 | Pass |
| NVNT | BLE | 2480 | -69 | 2380 | -34 | 0.6 | 10 | Pass |
| NVNT | BLE | 2480 | -69 | 2504 | -34 | 1.1 | 10 | Pass |
| NVNT | BLE | 2480 | -69 | 2300 | -34 | 1.1 | 10 | Pass |
| NVNT | BLE | 2480 | -69 | 2584 | -34 | 0.9 | 10 | Pass |

# APPENDIX: PHOTOGRAPHS OF THE EUT

**Please refer to the test report: E01A23040015E00601.**

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**END OF REPORT**