# RF Test Report

## For

| | |
|---|---|
| **Applicant name:** | **Shenzhen Yizhita Technology Co., Ltd** |
| Address: | 4219, 4th Floor, Phase I, Huiheng Building, No. 138 Gaoxin South 7th Road, Gaoxin Community, Yuehai Street, Nanshan District, Shenzhen |
| EUT name: | Z87 PRO CUSTOMIZED MECHANICAL KEYBOARD |
| Brand name: | ATK |
| Model number: | ATK Z87 PRO |
| Series model number: | ATK Z87 |

## Issued By

| | |
|---|---|
| **Company Name:** | **BTF Testing Lab (Shenzhen) Co., Ltd.** |
| Address: | F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China |
| Report Number: | BTF240705R01002 |
| Test Standards: | 47 CFR Part 15.247 |
| Test Conclusion: | Pass |
| FCC ID: | 2BE9P-ATKZ87PRO |
| Date of sample receipt: | 2024-07-05 |
| Test Date: | 2024-07-06 to 2024-07-16 |
| Date of Issue: | 2024-07-17 |
| Prepared By: | Chris Liu / Project Engineer |
| Date: | 2024-07-17 |
| Approved By: | Ryan.CJ / EMC Manager |
| Date: | 2024-07-17 |

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| Revision History | | |
|---|---|---|
| Version | Issue Date | Revisions Content |
| R_V0 | 2024-07-17 | Original |
| | | |
| *Note: Once the revision has been made, then previous versions reports are invalid.* | | |

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# 1 Introduction

## 1.1 Identification of Testing Laboratory

| | |
|---|---|
| Company Name: | BTF Testing Lab (Shenzhen) Co., Ltd. |
| Address: | F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China |
| Phone Number: | +86-0755-23146130 |
| Fax Number: | +86-0755-23146130 |

## 1.2 Identification of the Responsible Testing Location

| | |
|---|---|
| Company Name: | BTF Testing Lab (Shenzhen) Co., Ltd. |
| Address: | F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China |
| Phone Number: | +86-0755-23146130 |
| Fax Number: | +86-0755-23146130 |
| FCC Registration Number: | 518915 |
| Designation Number: | CN1330 |

## 1.3 Announcement

(1) The test report reference to the report template version v0.
(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing, reviewing and approving the test report.
(3) The test report is invalid if there is any evidence and/or falsification.
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# 2 Product Information

## 2.1 Application Information

| | |
|---|---|
| Company Name: | Shenzhen Yizhita Technology Co., Ltd |
| Address: | 4219, 4th Floor, Phase I, Huiheng Building, No. 138 Gaoxin South 7th Road, Gaoxin Community, Yuehai Street, Nanshan District, Shenzhen |

## 2.2 Manufacturer Information

| | |
|---|---|
| Company Name: | Dongguan Nuobida Intelligent Technology Co., Ltd |
| Address: | Building 7, No.1, Junma Road, Chigang, Humen Town, Dongguan City, Guangdong Province |

## 2.3 Factory Information

| | |
|---|---|
| Company Name: | Dongguan Nuobida Intelligent Technology Co., Ltd |
| Address: | Building 7, No.1, Junma Road, Chigang, Humen Town, Dongguan City, Guangdong Province |

## 2.4 General Description of Equipment under Test (EUT)

| | |
|---|---|
| EUT Name: | Z87 PRO CUSTOMIZED MECHANICAL KEYBOARD |
| Test Model Number: | ATK Z87 PRO |
| Serial Model Number: | ATK Z87 |
| Model difference description | Only the model name is different, everything else is the same. |
| Hardware version | MK821-SMARGBKC-RDR-XDW-20240222-V03 |
| Software version | N/A |

## 2.5 Technical Information

| | |
|---|---|
| Power Supply: | DC 5V from adaptor or DC 3.7V from battery |
| Power Adaptor: | N/A |
| Operation Frequency: | 2402MHz to 2480MHz |
| Number of Channels: | 79 |
| Modulation Type: | GFSK |
| Antenna Type: | PCB ANT |
| Transmission rate | 1M |
| Antenna Gain#: | 0.338dBi |
| Note:<br>#: The antenna gain provided by the applicant, and the laboratory will not be responsible for the accumulated calculation results which covers the information provided by the applicant. | |
| Bluetooth Version: | 5.0 |

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# 3 Summary of Test Results

## 3.1 Test Standards

The tests were performed according to following standards:
**47 CFR Part 15.247:** Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

## 3.2 Uncertainty of Test

| Item | Measurement Uncertainty |
|---|---|
| Conducted Emission (150 kHz-30 MHz) | ±2.64dB |
| Occupied Bandwidth | ±69kHz |
| Transmitter Power, Conducted | ±0.87dB |
| Power Spectral Density | ±0.69dB |
| Conducted Spurious Emissions | ±0.95dB |
| Radiated Spurious Emissions (above 1GHz) | 1-6GHz: ±3.94dB<br>6-18GHz: ±4.16dB |
| Radiated Spurious Emissions (30M - 1GHz) | ±4.12dB |
| The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2. | |

## 3.3 Summary of Test Result

| Item | Standard | Requirement | Result |
|---|---|---|---|
| Antenna requirement | 47 CFR Part 15.247 | 47 CFR 15.203 | Pass |
| Conducted Emission at AC power line | 47 CFR Part 15.247 | 47 CFR 15.207(a) | Pass |
| Occupied Bandwidth | 47 CFR Part 15.247 | 47 CFR 15.247(a)(2) | Pass |
| Maximum Conducted Output Power | 47 CFR Part 15.247 | 47 CFR 15.247(b)(3) | Pass |
| Power Spectral Density | 47 CFR Part 15.247 | 47 CFR 15.247(e) | Pass |
| Emissions in non-restricted frequency bands | 47 CFR Part 15.247 | 47 CFR 15.247(d), 15.209, 15.205 | Pass |
| Band edge emissions (Radiated) | 47 CFR Part 15.247 | 47 CFR 15.247(d), 15.209, 15.205 | Pass |
| Emissions in frequency bands (below 1GHz) | 47 CFR Part 15.247 | 47 CFR 15.247(d), 15.209, 15.205 | Pass |
| Emissions in frequency bands (above 1GHz) | 47 CFR Part 15.247 | 47 CFR 15.247(d), 15.209, 15.205 | Pass |

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# 4 Test Configuration

## 4.1 Test Equipment List

| Conducted Emission at AC power line | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No** | **Inventory No** | **Cal Date** | **Cal Due Date** |
| Pulse Limiter | SCHWARZBECK | VTSD 9561-F | 00953 | 2023-11-16 | 2024-11-15 |
| Coaxial Switcher | SCHWARZBECK | CX210 | CX210 | 2023-11-16 | 2024-11-15 |
| V-LISN | SCHWARZBECK | NSLK 8127 | 01073 | 2023-11-16 | 2024-11-15 |
| LISN | AFJ | LS16/110VAC | 16010020076 | 2023-11-16 | 2024-11-15 |
| EMI Receiver | ROHDE&SCHWARZ | ESCI3 | 101422 | 2023-11-16 | 2024-11-15 |

| Occupied Bandwidth<br>Maximum Conducted Output Power<br>Power Spectral Density<br>Emissions in non-restricted frequency bands | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No** | **Inventory No** | **Cal Date** | **Cal Due Date** |
| RFTest software | / | V1.00 | / | / | / |
| RF Control Unit | Techy | TR1029-1 | / | 2023-11-16 | 2024-11-15 |
| RF Sensor Unit | Techy | TR1029-2 | / | 2023-11-16 | 2024-11-15 |
| Programmable constant temperature and humidity box | ZZCKONG | ZZ-K02A | 20210928007 | 2023-11-16 | 2024-11-15 |
| Adjustable Direct Current Regulated Power Supply | Dongguan Tongmen Electronic Technology Co., LTD | etm-6050c | 20211026123 | 2023-11-16 | 2024-11-15 |
| WIDEBAND RADIO COMMNUNICATION TESTER | Rohde & Schwarz | CMW500 | 161997 | 2023-11-16 | 2024-11-15 |
| MXA Signal Analyzer | KEYSIGHT | N9020A | MY50410020 | 2023-11-16 | 2024-11-15 |

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| Band edge emissions (Radiated)<br>Emissions in frequency bands (below 1GHz)<br>Emissions in frequency bands (above 1GHz) | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No** | **Inventory No** | **Cal Date** | **Cal Due Date** |
| Coaxial cable Multiflex 141 | Schwarzbeck | N/SMA 0.5m | 517386 | 2023-03-24 | 2024-03-23 |
| Preamplifier | SCHWARZBECK | BBV9744 | 00246 | 2023-11-16 | 2024-11-15 |
| RE Cable | REBES Talent | UF1-SMASMAM-10m | 21101566 | 2023-11-16 | 2024-11-15 |
| RE Cable | REBES Talent | UF2-NMNM-10m | 21101570 | 2023-11-16 | 2024-11-15 |
| RE Cable | REBES Talent | UF1-SMASMAM-1m | 21101568 | 2023-11-16 | 2024-11-15 |
| RE Cable | REBES Talent | UF2-NMNM-1m | 21101576 | 2023-11-16 | 2024-11-15 |
| RE Cable | REBES Talent | UF2-NMNM-2.5m | 21101573 | 2023-11-16 | 2024-11-15 |
| POSITIONAL CONTROLLER | SKET | PCI-GPIB | / | 2023-11-16 | 2024-11-15 |
| Horn Antenna | SCHWARZBECK | BBHA9170 | 01157 | 2023-11-13 | 2024-11-12 |
| EMI TEST RECEIVER | ROHDE&SCHWARZ | ESCI7 | 101032 | 2023-11-16 | 2024-11-15 |
| SIGNAL ANALYZER | ROHDE&SCHWARZ | FSQ40 | 100010 | 2023-11-16 | 2024-11-15 |
| POSITIONAL CONTROLLER | SKET | PCI-GPIB | / | 2023-11-16 | 2024-11-15 |
| Broadband Preamplilifier | SCHWARZBECK | BBV9718D | 00008 | 2023-11-16 | 2024-11-15 |
| Horn Antenna | SCHWARZBECK | BBHA9120D | 2597 | 2022-05-22 | 2024-05-21 |
| EZ_EMC | Frad | FA-03A2 RE+ | / | 2023-11-16 | 2024-11-15 |
| POSITIONAL CONTROLLER | SKET | PCI-GPIB | / | 2023-11-16 | 2024-11-15 |
| Log periodic antenna | SCHWARZBECK | VULB 9168 | 01328 | 2023-11-13 | 2024-11-12 |

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## 4.2 Test Auxiliary Equipment

| Description | Manufacturer | Model | Serial No. | Length | Description | Use |
|---|---|---|---|---|---|---|
| MacBookPro15 | Apple Inc. | DESKTOP-85CPSPJ | / | / | / | ☒ |
| | | | | | | |

## 4.3 Test Modes

| No. | Test Modes | Description |
|---|---|---|
| TM1 | TX mode | Keep the EUT connect to AC power line and works in continuously transmitting mode with BLE 1M GFSK modulation. |
| TM2 | TX mode | Keep the EUT connect to AC power line and works in continuously transmitting mode with BLE 2M GFSK modulation. |

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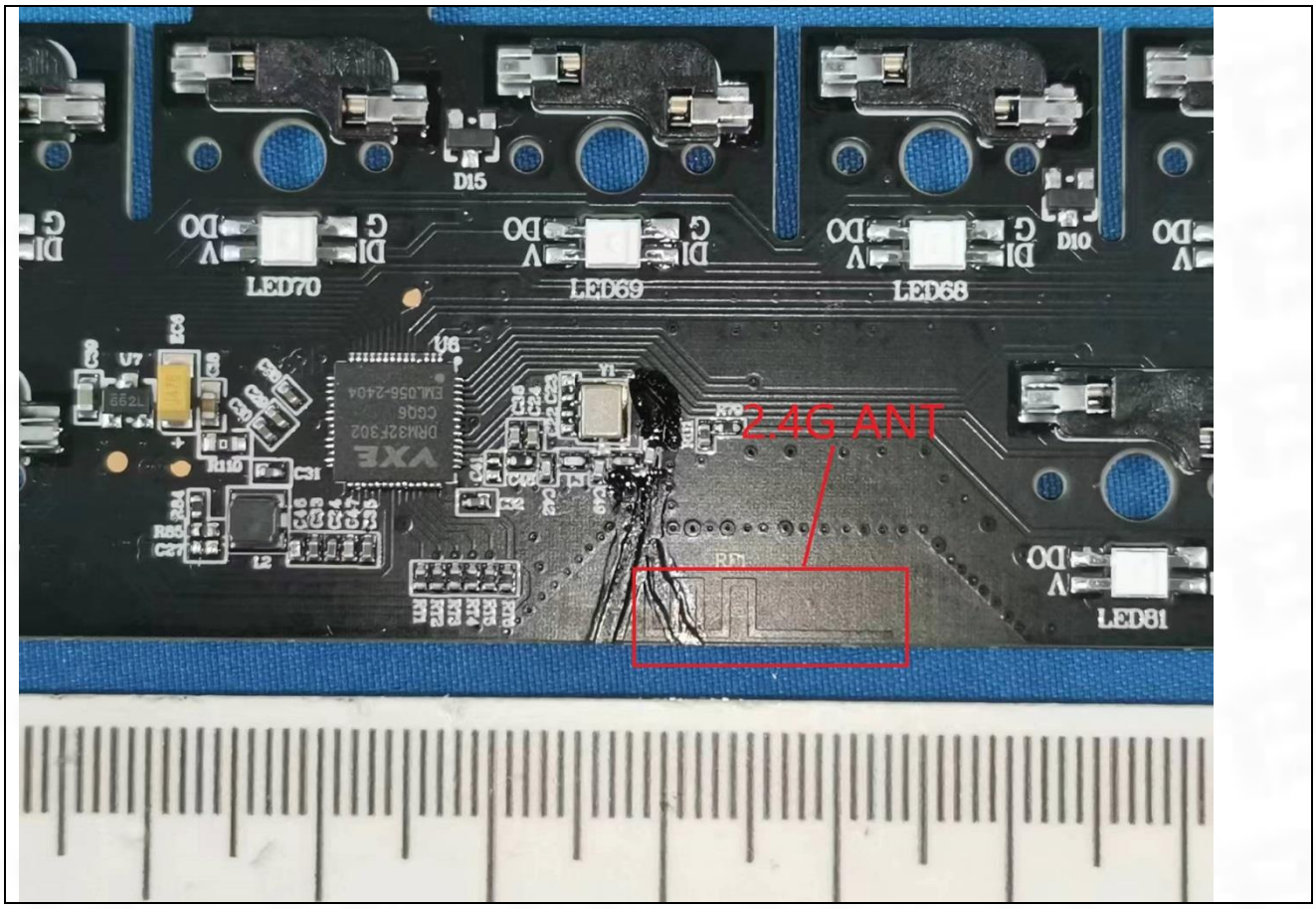
# 5 Evaluation Results (Evaluation)

## 5.1 Antenna requirement

| | |
|---|---|
| Test Requirement: | Refer to 47 CFR Part 15.203, 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. |

### 5.1.1 Conclusion:



# 6 Radio Spectrum Matter Test Results (RF)

## 6.1 Conducted Emission at AC power line

| | |
|---|---|
| Test Requirement: | Refer to 47 CFR 15.207(a), Except as shown in paragraphs (b)and (c)of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). |
| Test Method: | ANSI C63.10-2013 section 6.2 |
| Test Limit: | |

| Frequency of emission (MHz) | Conducted limit (dBµV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

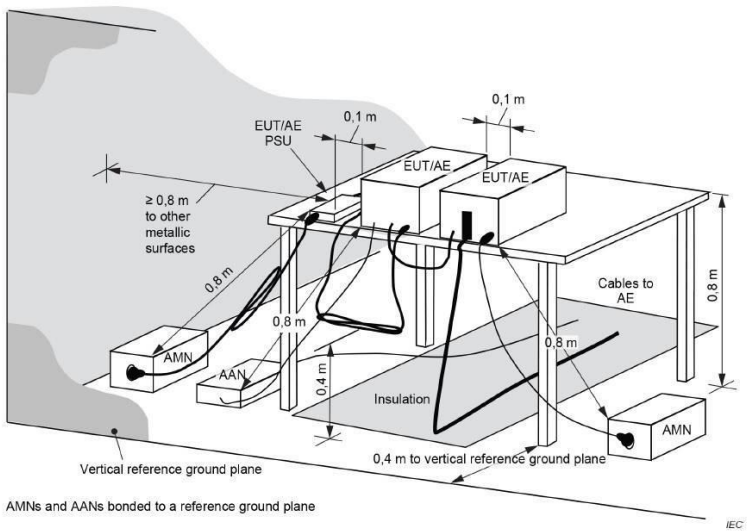
*Decreases with the logarithm of the frequency.

| | |
|---|---|
| Procedure: | Refer to ANSI C63.10-2013 section 6.2, standard test method for ac power-line conducted emissions from unlicensed wireless devices |

### 6.1.1 E.U.T. Operation:

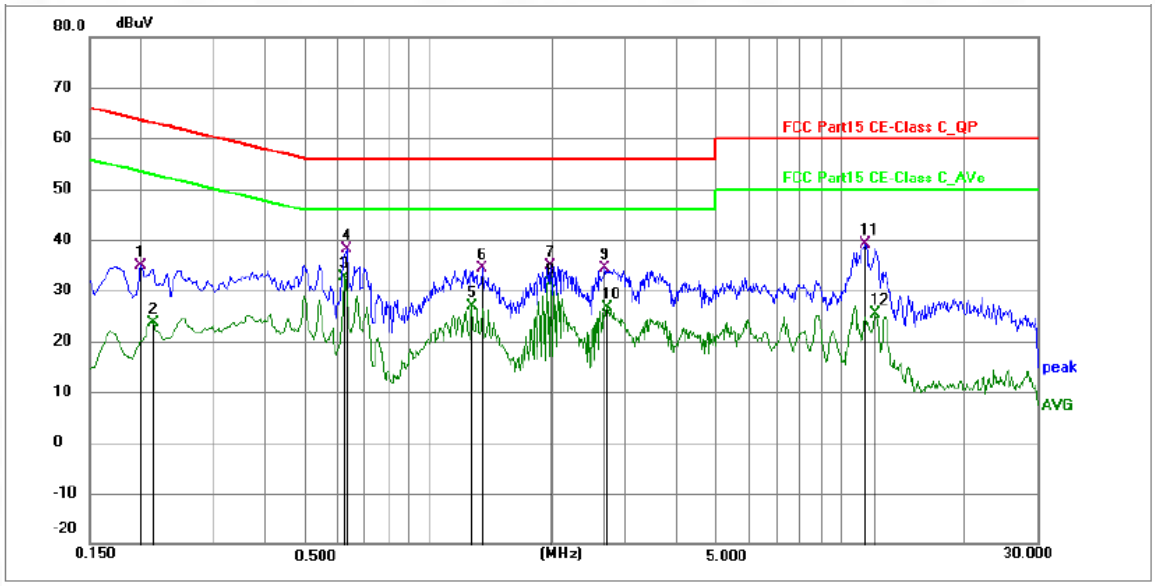
| Operating Environment: | |
|---|---|
| Temperature: | 23.1 °C |
| Humidity: | 52.4 % |
| Atmospheric Pressure: | 1010 mbar |

### 6.1.2 Test Setup Diagram:



### 6.1.3 Test Data:

All modes are tested, and only the worst mode GFSK 2M 2480MHz is showed in the report




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.1995 | 24.36 | 10.56 | 34.92 | 63.63 | -28.71 | QP | P | |
| 2 | 0.2130 | 12.99 | 10.56 | 23.55 | 53.09 | -29.54 | AVG | P | |
| 3 * | 0.6225 | 21.97 | 10.64 | 32.61 | 46.00 | -13.39 | AVG | P | |
| 4 | 0.6312 | 27.51 | 10.65 | 38.16 | 56.00 | -17.84 | QP | P | |
| 5 | 1.2702 | 16.11 | 10.66 | 26.77 | 46.00 | -19.23 | AVG | P | |
| 6 | 1.3512 | 23.78 | 10.66 | 34.44 | 56.00 | -21.56 | QP | P | |
| 7 | 1.9770 | 24.17 | 10.68 | 34.85 | 56.00 | -21.15 | QP | P | |
| 8 | 1.9770 | 20.73 | 10.68 | 31.41 | 46.00 | -14.59 | AVG | P | |
| 9 | 2.6745 | 23.77 | 10.67 | 34.44 | 56.00 | -21.56 | QP | P | |
| 10 | 2.7195 | 15.99 | 10.67 | 26.66 | 46.00 | -19.34 | AVG | P | |
| 11 | 11.4450 | 28.37 | 10.87 | 39.24 | 60.00 | -20.76 | QP | P | |
| 12 | 12.1740 | 14.58 | 10.87 | 25.45 | 50.00 | -24.55 | AVG | P | |

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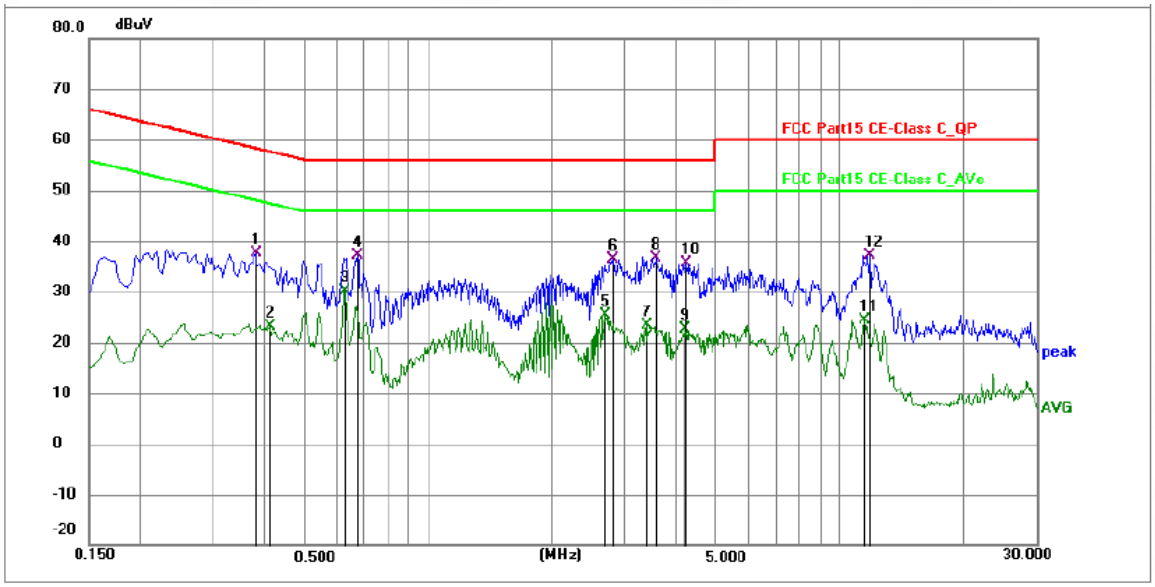
TM1 / Line: Neutral / Band: 2400-2483.5 MHz / BW: 1 / CH: M




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.3795 | 27.10 | 10.57 | 37.67 | 58.29 | -20.62 | QP | P | |
| 2 | 0.4110 | 12.48 | 10.57 | 23.05 | 47.63 | -24.58 | AVG | P | |
| 3 * | 0.6270 | 19.61 | 10.64 | 30.25 | 46.00 | -15.75 | AVG | P | |
| 4 | 0.6720 | 26.49 | 10.67 | 37.16 | 56.00 | -18.84 | QP | P | |
| 5 | 2.6790 | 14.67 | 10.67 | 25.34 | 46.00 | -20.66 | AVG | P | |
| 6 | 2.8050 | 25.79 | 10.68 | 36.47 | 56.00 | -19.53 | QP | P | |
| 7 | 3.4125 | 12.84 | 10.64 | 23.48 | 46.00 | -22.52 | AVG | P | |
| 8 | 3.5790 | 26.10 | 10.64 | 36.74 | 56.00 | -19.26 | QP | P | |
| 9 | 4.1955 | 12.02 | 10.69 | 22.71 | 46.00 | -23.29 | AVG | P | |
| 10 | 4.2313 | 24.99 | 10.69 | 35.68 | 56.00 | -20.32 | QP | P | |
| 11 | 11.4450 | 13.61 | 10.84 | 24.45 | 50.00 | -25.55 | AVG | P | |
| 12 | 11.7461 | 26.33 | 10.83 | 37.16 | 60.00 | -22.84 | QP | P | |

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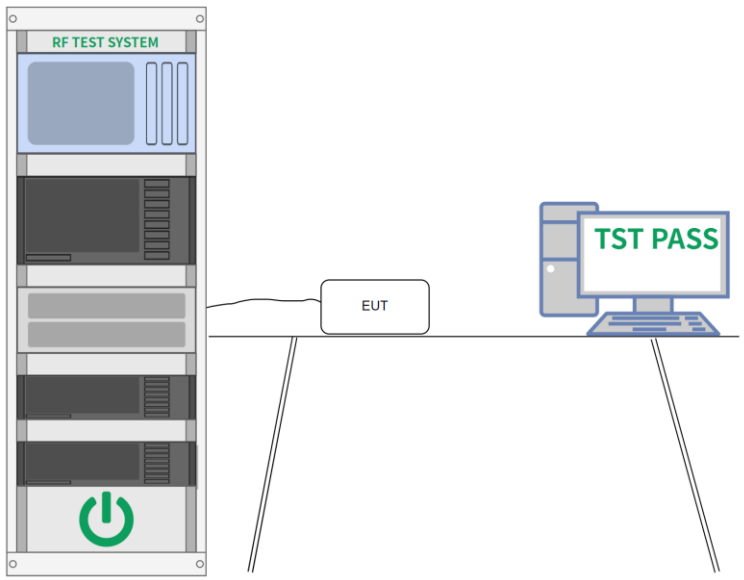
## 6.2 Occupied Bandwidth

| | |
|---|---|
| Test Requirement: | 47 CFR 15.247(a)(2) |
| Test Method: | ANSI C63.10-2013, section 11.8<br>KDB 558074 D01 15.247 Meas Guidance v05r02 |
| Test Limit: | Refer to 47 CFR 15.247(a)(2), Systems using digital modulation techniques may operate in the 902-928 MHz, and 2400-2483.5 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz. |
| Procedure: | a) Set RBW = 100 kHz.<br>b) Set the VBW >= [3 × RBW].<br>c) Detector = peak.<br>d) Trace mode = max hold.<br>e) Sweep = auto couple.<br>f) Allow the trace to stabilize.<br>g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. |

### 6.2.1 E.U.T. Operation:

| Operating Environment: | |
|---|---|
| Temperature: | 22.9 °C |
| Humidity: | 52.7 % |
| Atmospheric Pressure: | 1010 mbar |

### 6.2.2 Test Setup Diagram:




### 6.2.3 Test Data:

Please Refer to Appendix for Details.

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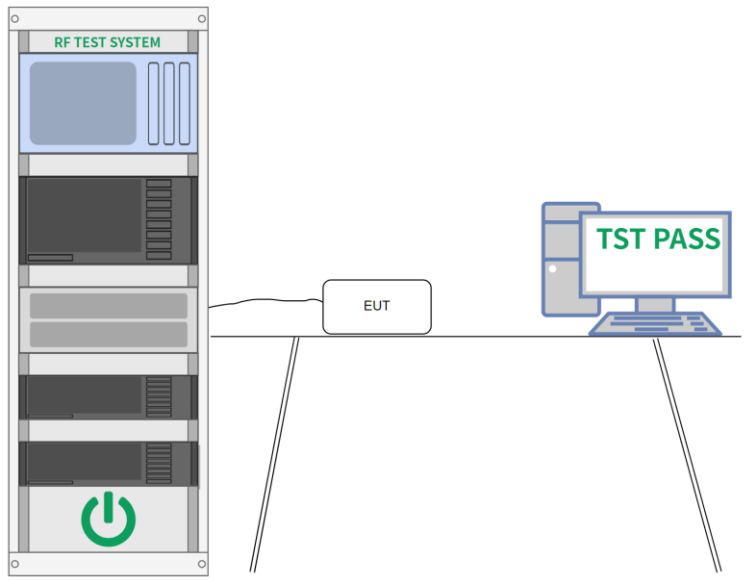
## 6.3 Maximum Conducted Output Power

| | |
|---|---|
| Test Requirement: | 47 CFR 15.247(b)(3) |
| Test Method: | ANSI C63.10-2013, section 11.9.1<br>KDB 558074 D01 15.247 Meas Guidance v05r02 |
| Test Limit: | Refer to 47 CFR 15.247(b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode. |
| Procedure: | ANSI C63.10-2013, section 11.9.1 Maximum peak conducted output power |

### 6.3.1 E.U.T. Operation:

| Operating Environment: | |
|---|---|
| Temperature: | 22.9 °C |
| Humidity: | 52.7 % |
| Atmospheric Pressure: | 1010 mbar |

### 6.3.2 Test Setup Diagram:




### 6.3.3 Test Data:

Please Refer to Appendix for Details.

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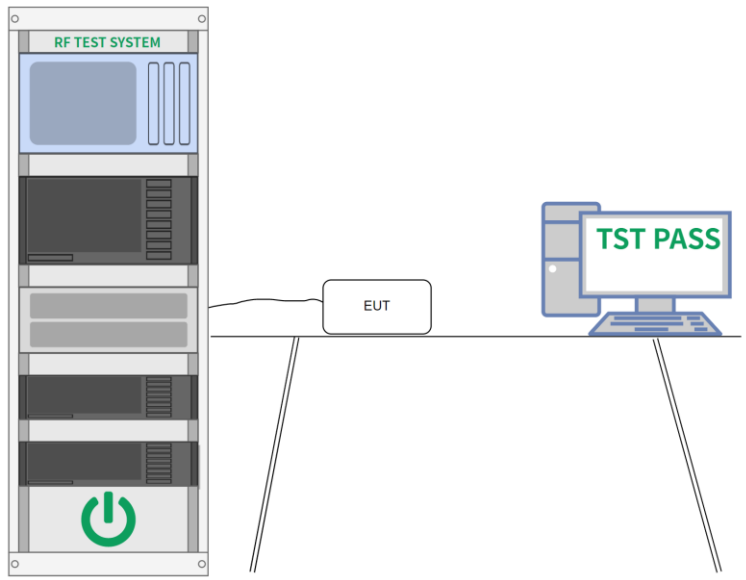
## 6.4 Power Spectral Density

| | |
|---|---|
| Test Requirement: | 47 CFR 15.247(e) |
| Test Method: | ANSI C63.10-2013, section 11.10<br>KDB 558074 D01 15.247 Meas Guidance v05r02 |
| Test Limit: | Refer to 47 CFR 15.247(e), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density. |
| Procedure: | ANSI C63.10-2013, section 11.10, Maximum power spectral density level in the fundamental emission |

### 6.4.1 E.U.T. Operation:

| Operating Environment: | |
|---|---|
| Temperature: | 22.9 °C |
| Humidity: | 52.7 % |
| Atmospheric Pressure: | 1010 mbar |

### 6.4.2 Test Setup Diagram:




### 6.4.3 Test Data:

Please Refer to Appendix for Details.

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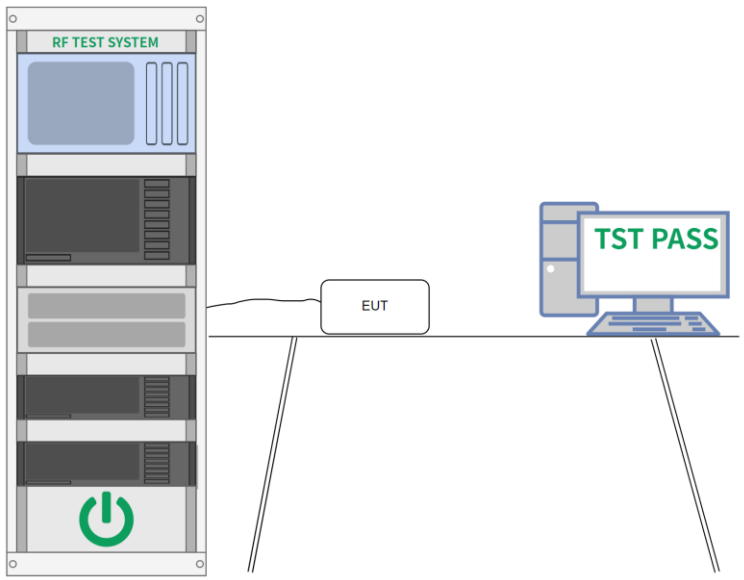
## 6.5 Emissions in non-restricted frequency bands

| | |
|---|---|
| Test Requirement: | 47 CFR 15.247(d), 15.209, 15.205 |
| Test Method: | ANSI C63.10-2013 section 11.11<br>KDB 558074 D01 15.247 Meas Guidance v05r02 |
| Test Limit: | Refer to 47 CFR 15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. |
| Procedure: | ANSI C63.10-2013<br>Section 11.11.1, Section 11.11.2, Section 11.11.3 |

### 6.5.1 E.U.T. Operation:

| Operating Environment: | |
|---|---|
| Temperature: | 22.9 °C |
| Humidity: | 52.7 % |
| Atmospheric Pressure: | 1010 mbar |

### 6.5.2 Test Setup Diagram:




### 6.5.3 Test Data:

Please Refer to Appendix for Details.

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## 6.6 Band edge emissions (Radiated)

| | |
|---|---|
| Test Requirement: | Refer to 47 CFR 15.247(d), In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)(see § 15.205(c)).` |
| Test Method: | ANSI C63.10-2013 section 6.10<br>KDB 558074 D01 15.247 Meas Guidance v05r02 |
| Test Limit: | |

| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (meters) |
|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30.0 | 30 | 30 |
| 30-88 | 100 ** | 3 |
| 88-216 | 150 ** | 3 |
| 216-960 | 200 ** | 3 |
| Above 960 | 500 | 3 |

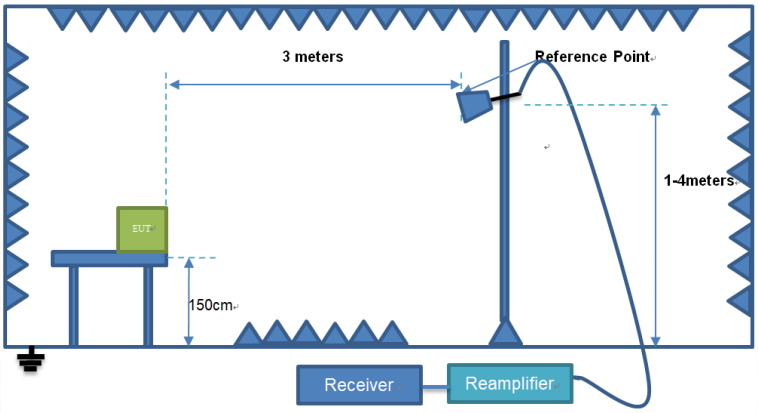
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.
In the emission table above, the tighter limit applies at the band edges.
The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

| | |
|---|---|
| Procedure: | ANSI C63.10-2013 section 6.10.5.2 |

### 6.6.1 E.U.T. Operation:

| Operating Environment: | |
|---|---|
| Temperature: | 25.7 °C |
| Humidity: | 48.1 % |
| Atmospheric Pressure: | 1010 mbar |

### 6.6.2 Test Setup Diagram:



### 6.6.3 Test Data:

Note:
All modes are tested, and only the worst mode GFSK is showed in the report

TM1 / Polarization: Horizontal / Band: 2400-2483.5 MHz / BW: 1 / CH: L

| No. | Frequency (MHz) | Reading Level(dBuV) | Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2310.00 | 91.54 | -43.68 | 47.86 | 74.00 | -26.14 | peak |
| 2 | 2390.00 | 90.99 | -43.64 | 47.35 | 74.00 | -26.65 | peak |

TM1 / Polarization: Vertical / Band: 2400-2483.5 MHz / BW: 1 / CH: L

| No. | Frequency (MHz) | Reading Level(dBuV) | Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2310.00 | 91.86 | -43.68 | 48.18 | 74.00 | -25.82 | peak |
| 2 | 2390.00 | 91.31 | -43.64 | 47.67 | 74.00 | -26.33 | peak |

TM1 / Polarization: Horizontal / Band: 2400-2483.5 MHz / BW: 1 / CH: H

| No. | Frequency (MHz) | Reading Level(dBuV) | Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2483.50 | 92.63 | -43.58 | 49.05 | 74.00 | -24.95 | peak |
| 2 | 2500.00 | 92.88 | -43.58 | 49.30 | 74.00 | -24.70 | peak |

TM1 / Polarization: Vertical / Band: 2400-2483.5 MHz / BW: 1 / CH: H

| No. | Frequency (MHz) | Reading Level(dBuV) | Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2483.50 | 92.95 | -43.58 | 49.37 | 74.00 | -24.63 | peak |
| 2 | 2500.00 | 93.20 | -43.58 | 49.62 | 74.00 | -24.38 | peak |

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## 6.7 Emissions in frequency bands (below 1GHz)

| | |
|---|---|
| Test Requirement: | Refer to 47 CFR 15.247(d), In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)(see § 15.205(c)).` |
| Test Method: | ANSI C63.10-2013 section 6.6.4<br>KDB 558074 D01 15.247 Meas Guidance v05r02 |
| Test Limit: | |

| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (meters) |
|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30.0 | 30 | 30 |
| 30-88 | 100 ** | 3 |
| 88-216 | 150 ** | 3 |
| 216-960 | 200 ** | 3 |
| Above 960 | 500 | 3 |

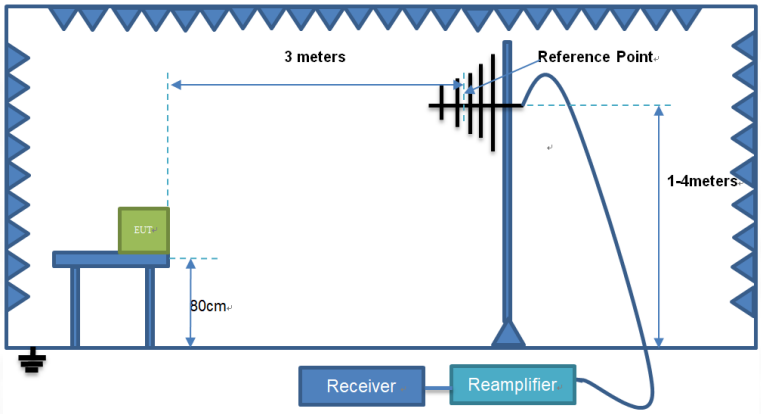
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.
In the emission table above, the tighter limit applies at the band edges.
The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

| | |
|---|---|
| Procedure: | ANSI C63.10-2013 section 6.6.4 |

### 6.7.1 E.U.T. Operation:

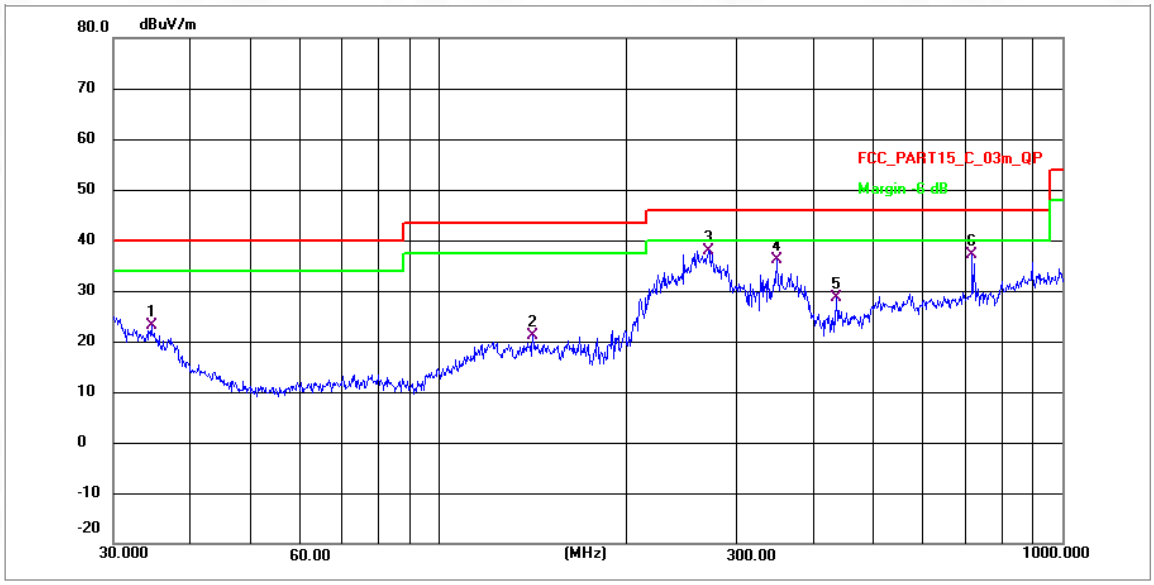
| Operating Environment: | |
|---|---|
| Temperature: | 25.7 °C |
| Humidity: | 48.1 % |
| Atmospheric Pressure: | 1010 mbar |

### 6.7.2 Test Setup Diagram:



### 6.7.3 Test Data:

TM1 / Polarization: Horizontal / Band: 2400-2483.5 MHz / BW: 1 / CH: M




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | P/F |
|---|---|---|---|---|---|---|---|---|
| 1 | 34.6385 | 27.34 | -4.31 | 23.03 | 40.00 | -16.97 | QP | P |
| 2 | 141.3298 | 43.23 | -22.09 | 21.14 | 43.50 | -22.36 | QP | P |
| 3 * | 270.3748 | 58.77 | -20.88 | 37.89 | 46.00 | -8.11 | QP | P |
| 4 | 348.6382 | 56.38 | -20.24 | 36.14 | 46.00 | -9.86 | QP | P |
| 5 | 435.5898 | 48.17 | -19.52 | 28.65 | 46.00 | -17.35 | QP | P |
| 6 | 717.9397 | 54.75 | -17.66 | 37.09 | 46.00 | -8.91 | QP | P |

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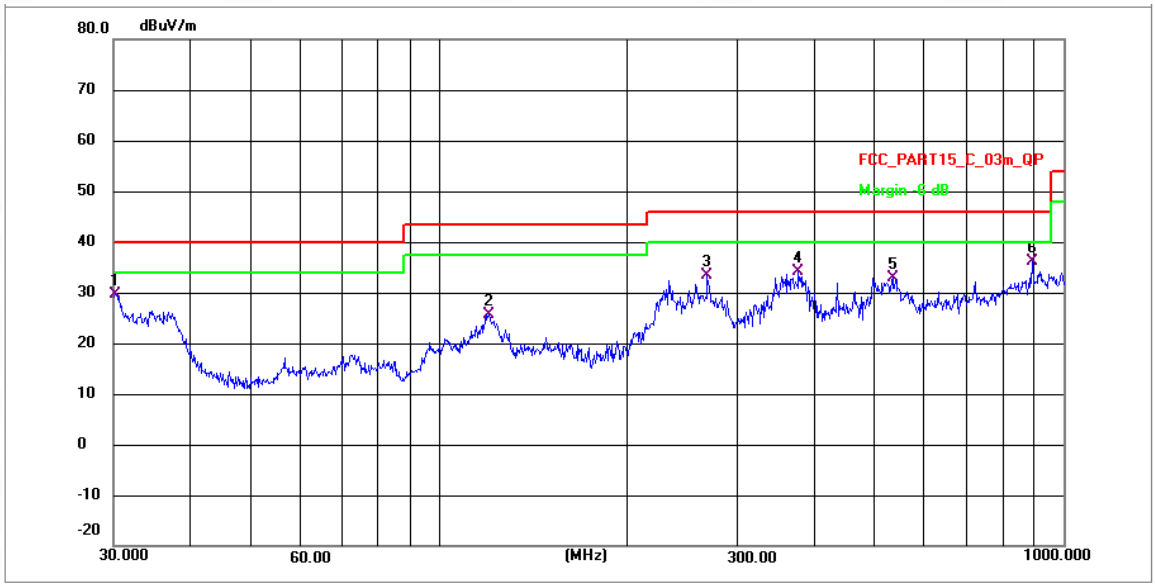
TM1 / Polarization: Vertical / Band: 2400-2483.5 MHz / BW: 1 / CH: M




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | P/F |
|---|---|---|---|---|---|---|---|---|
| 1 | 30.2111 | 33.20 | -3.53 | 29.67 | 40.00 | -10.33 | QP | P |
| 2 | 119.8556 | 48.01 | -22.29 | 25.72 | 43.50 | -17.78 | QP | P |
| 3 | 268.9564 | 54.29 | -20.89 | 33.40 | 46.00 | -12.60 | QP | P |
| 4 | 376.5982 | 54.08 | -20.01 | 34.07 | 46.00 | -11.93 | QP | P |
| 5 | 533.8321 | 51.58 | -18.76 | 32.82 | 46.00 | -13.18 | QP | P |
| 6 * | 893.8567 | 52.54 | -16.32 | 36.22 | 46.00 | -9.78 | QP | P |

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## 6.8 Emissions in frequency bands (above 1GHz)

| | |
|---|---|
| Test Requirement: | In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)(see § 15.205(c)).` |
| Test Method: | ANSI C63.10-2013 section 6.6.4<br>KDB 558074 D01 15.247 Meas Guidance v05r02 |
| Test Limit: | |

| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (meters) |
|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30.0 | 30 | 30 |
| 30-88 | 100 ** | 3 |
| 88-216 | 150 ** | 3 |
| 216-960 | 200 ** | 3 |
| Above 960 | 500 | 3 |

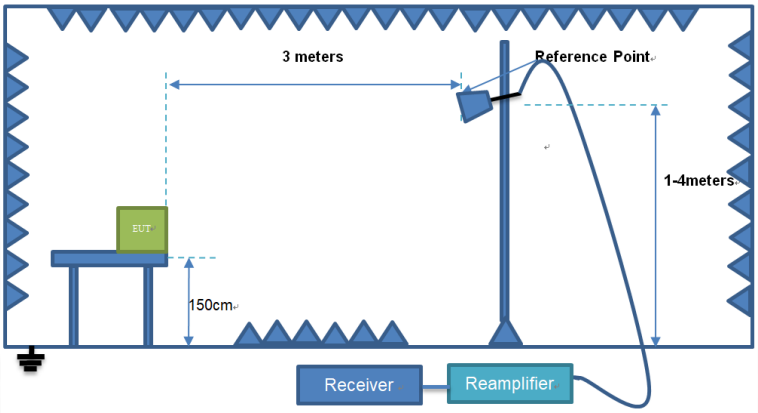
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.
In the emission table above, the tighter limit applies at the band edges.
The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

| | |
|---|---|
| Procedure: | ANSI C63.10-2013 section 6.6.4 |

### 6.8.1 E.U.T. Operation:

| Operating Environment: | |
|---|---|
| Temperature: | 25.7 °C |
| Humidity: | 48.1 % |
| Atmospheric Pressure: | 1010 mbar |

### 6.8.2 Test Setup Diagram:



### 6.8.3 Test Data:

Note:
All modes are tested, and only the worst mode GFSK 2M is showed in the report
TM1 / Polarization: Horizontal / Band: 2400-2483.5 MHz / BW: 1 / CH: L

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | P/F |
|---|---|---|---|---|---|---|---|---|
| 1 | 4804.000 | 85.21 | -48.83 | 36.38 | 74.00 | -37.62 | peak | P |
| 2 | 7206.000 | 87.15 | -46.88 | 40.27 | 74.00 | -33.73 | peak | P |
| 3 | 9608.000 | 89.25 | -45.51 | 43.74 | 74.00 | -30.26 | peak | P |

TM1 / Polarization: Vertical / Band: 2400-2483.5 MHz / BW: 1 / CH: L

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | P/F |
|---|---|---|---|---|---|---|---|---|
| 1 | 4804.000 | 85.56 | -48.83 | 36.73 | 74.00 | -37.27 | peak | P |
| 2 | 7206.000 | 87.40 | -46.88 | 40.52 | 74.00 | -33.48 | peak | P |
| 3 | 9608.000 | 89.93 | -45.51 | 44.42 | 74.00 | -29.58 | peak | P |

TM1 / Polarization: Horizontal / Band: 2400-2483.5 MHz / BW: 1 / CH: M

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | P/F |
|---|---|---|---|---|---|---|---|---|
| 1 | 4882.000 | 84.65 | -48.83 | 35.82 | 74.00 | -38.18 | peak | P |
| 2 | 7323.000 | 86.59 | -46.88 | 39.71 | 74.00 | -34.29 | peak | P |
| 3 | 9764.000 | 88.69 | -45.51 | 43.18 | 74.00 | -30.82 | peak | P |

TM1 / Polarization: Vertical / Band: 2400-2483.5 MHz / BW: 1 / CH: M

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | P/F |
|---|---|---|---|---|---|---|---|---|
| 1 | 4882.000 | 85.00 | -48.83 | 36.17 | 74.00 | -37.83 | peak | P |
| 2 | 7323.000 | 86.84 | -46.88 | 39.96 | 74.00 | -34.04 | peak | P |
| 3 | 9764.000 | 89.37 | -45.51 | 43.86 | 74.00 | -30.14 | peak | P |

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TM1 / Polarization: Horizontal / Band: 2400-2483.5 MHz / BW: 1 / CH: H

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | P/F |
|---|---|---|---|---|---|---|---|---|
| 1 | 4960.000 | 85.67 | -48.71 | 36.96 | 74.00 | -37.04 | peak | P |
| 2 | 7440.000 | 87.61 | -46.76 | 40.85 | 74.00 | -33.15 | peak | P |
| 3 | 9920.000 | 89.71 | -45.39 | 44.32 | 74.00 | -29.68 | peak | P |

TM1 / Polarization: Vertical / Band: 2400-2483.5 MHz / BW: 1 / CH: H

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | P/F |
|---|---|---|---|---|---|---|---|---|
| 1 | 4960.000 | 85.96 | -48.71 | 37.25 | 74.00 | -36.75 | peak | P |
| 2 | 7440.000 | 87.80 | -46.76 | 41.04 | 74.00 | -32.96 | peak | P |
| 3 | 9920.000 | 90.33 | -45.39 | 44.94 | 74.00 | -29.06 | peak | P |

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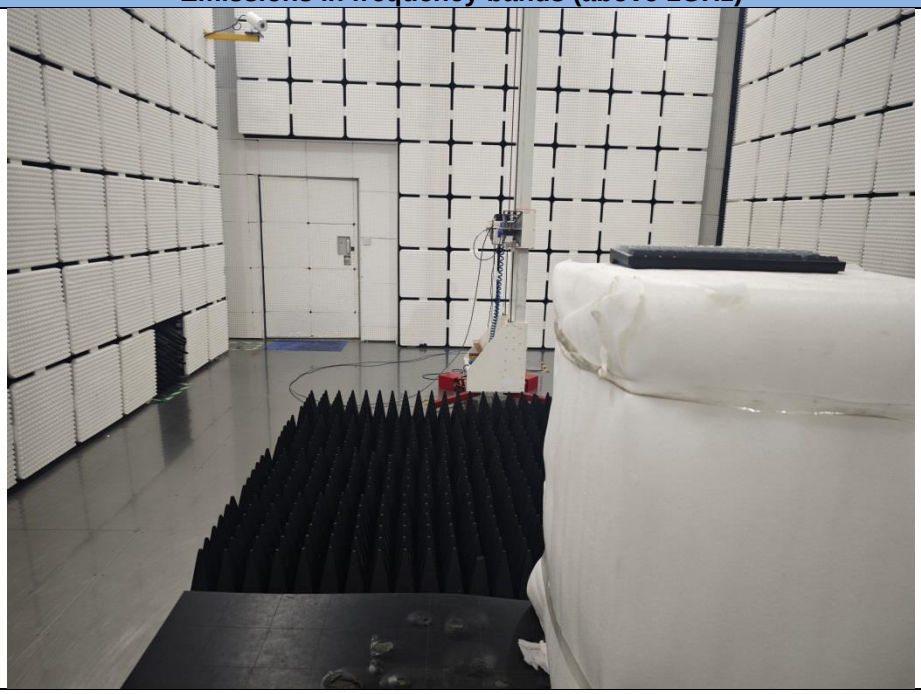
# 7 Test Setup Photos

| Conducted Emission at AC power line |
|---|
| |

| Band edge emissions (Radiated)<br>Emissions in frequency bands (above 1GHz) |
|---|
|  |

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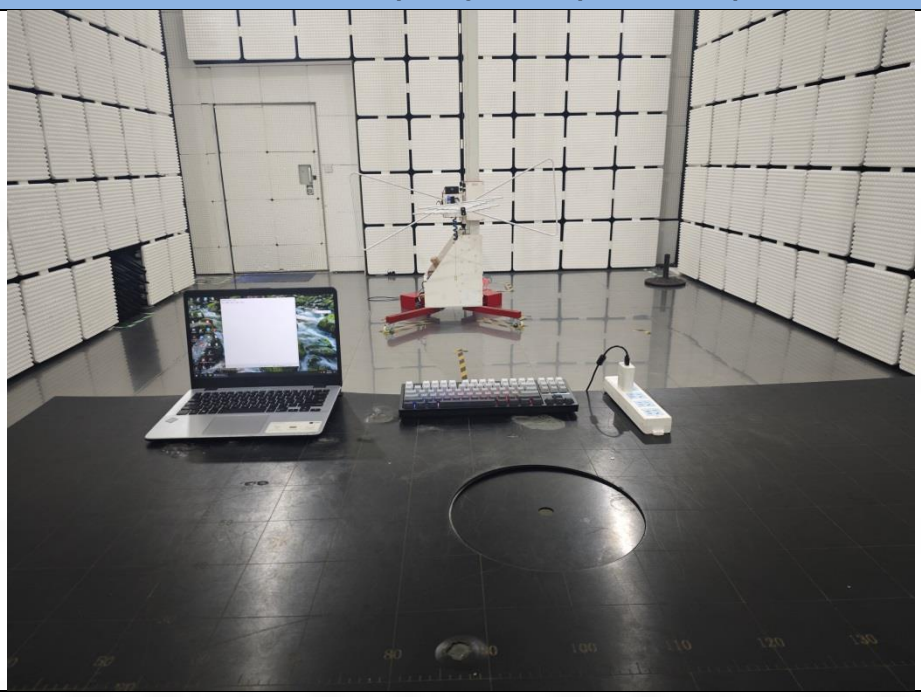
| Emissions in frequency bands (below 1GHz) |
| --- |
|  |

# 8 EUT Constructional Details (EUT Photos)

Please refer to the test report No. BTF240705R01001

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# Appendix

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# 1. Duty Cycle

## 1.1 Test Result

### 1.1.1 Ant1

| Ant1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mode | TX Type | Frequency (MHz) | T_on (ms) | Period (ms) | Duty Cycle (%) | Duty Cycle Correction Factor (dB) | Max. DC Variation (%) |
| 1 | SISO | 2402 | 0.387 | 2.706 | 14.30 | 8.45 | 0.39 |
| | | 2441 | 0.385 | 2.703 | 14.24 | 8.46 | 0.50 |
| | | 2480 | 0.387 | 2.703 | 14.32 | 8.44 | 0.37 |

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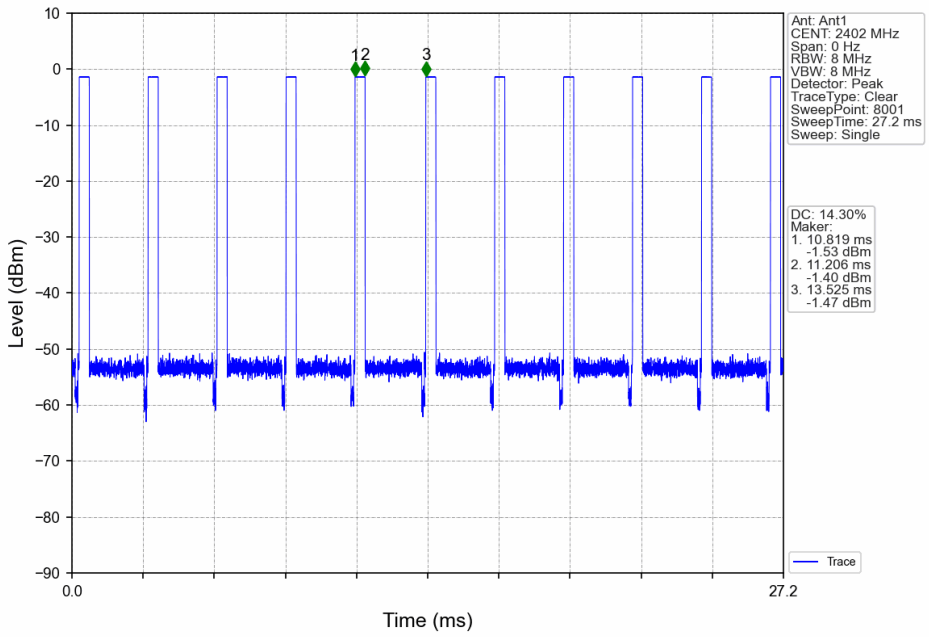
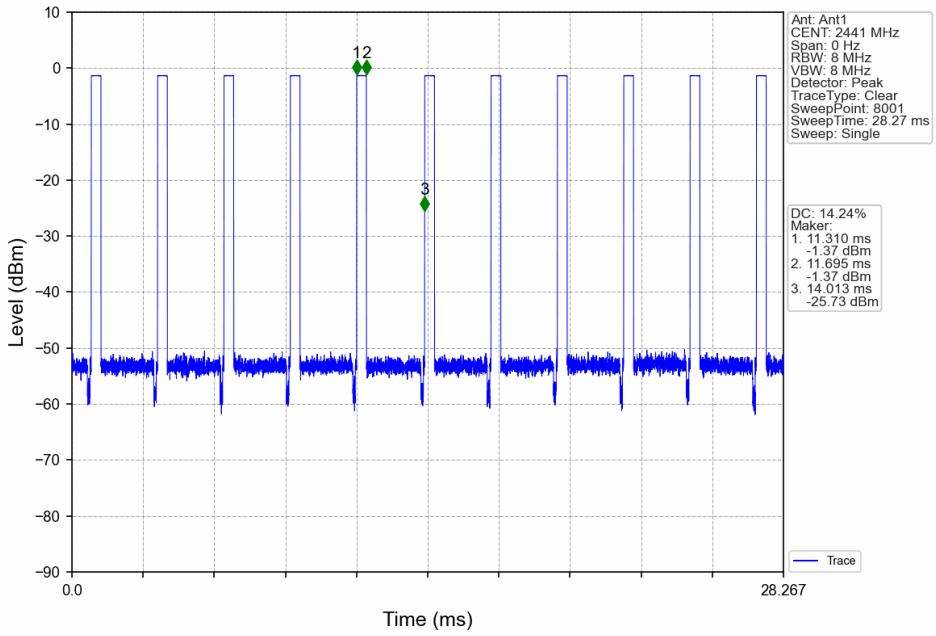
## 1.2 Test Graph

### 1.2.1 Ant1

1_LCH_2402MHz_Ant1_NTNV




1_MCH_2441MHz_Ant1_NTNV

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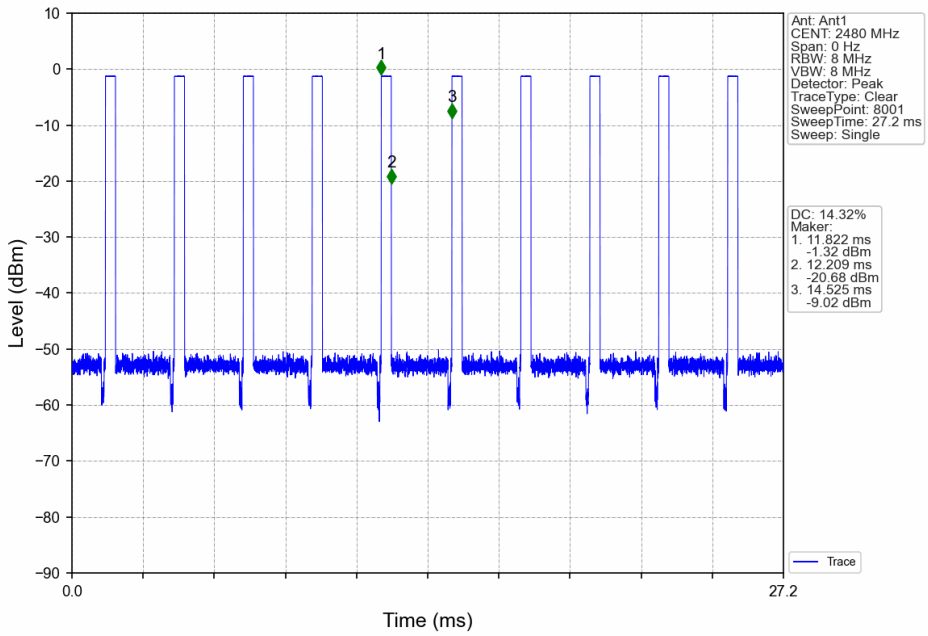
1_HCH_2480MHz_Ant1_NTNV



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# 2. Bandwidth

## 2.1 Test Result

### 2.1.1 OBW

| Mode | TX Type | Frequency (MHz) | ANT | 99% Occupied Bandwidth (MHz) | | Verdict |
|---|---|---|---|---|---|---|
| | | | | Result | Limit | |
| 1 | SISO | 2402 | 1 | 1.037 | / | Pass |
| | | 2441 | 1 | 1.039 | / | Pass |
| | | 2480 | 1 | 1.039 | / | Pass |

### 2.1.2 6dB BW

| Mode | TX Type | Frequency (MHz) | ANT | 6dB Bandwidth (MHz) | | Verdict |
|---|---|---|---|---|---|---|
| | | | | Result | Limit | |
| 1 | SISO | 2402 | 1 | 0.671 | >=0.5 | Pass |
| | | 2441 | 1 | 0.678 | >=0.5 | Pass |
| | | 2480 | 1 | 0.671 | >=0.5 | Pass |

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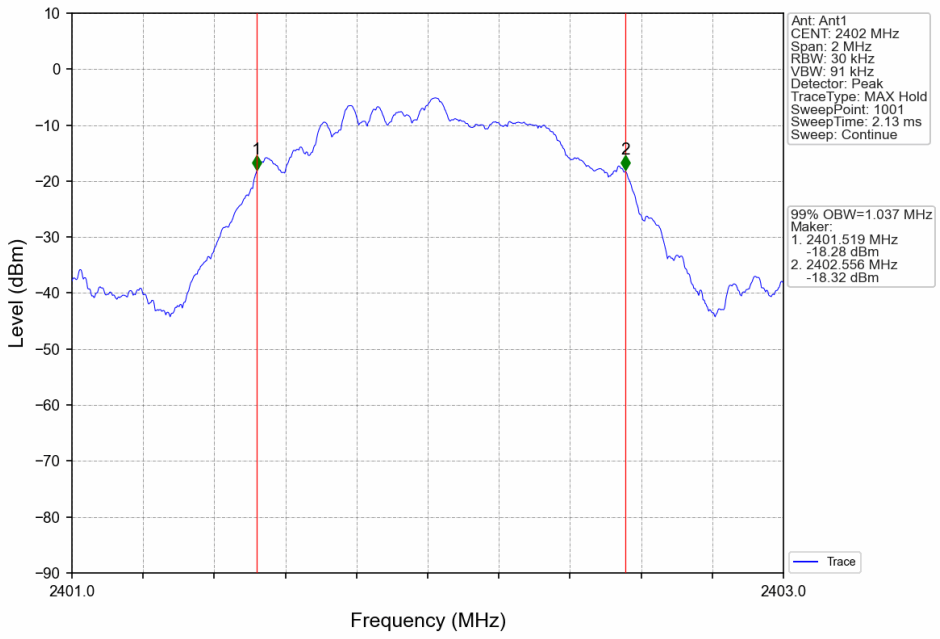
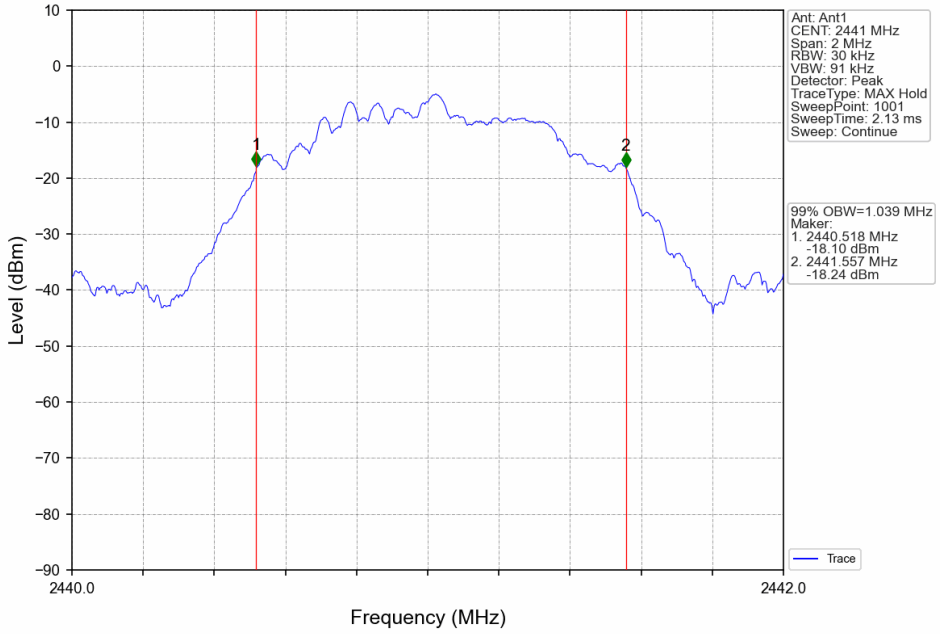
## 2.2 Test Graph

### 2.2.1 OBW

1_LCH_2402MHz_Ant1_NTNV




1_MCH_2441MHz_Ant1_NTNV

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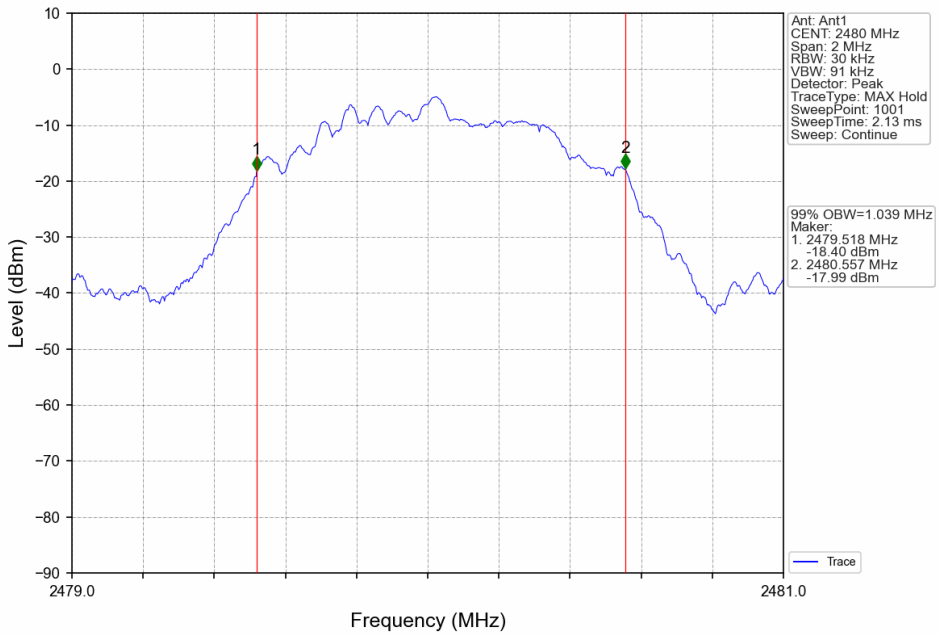
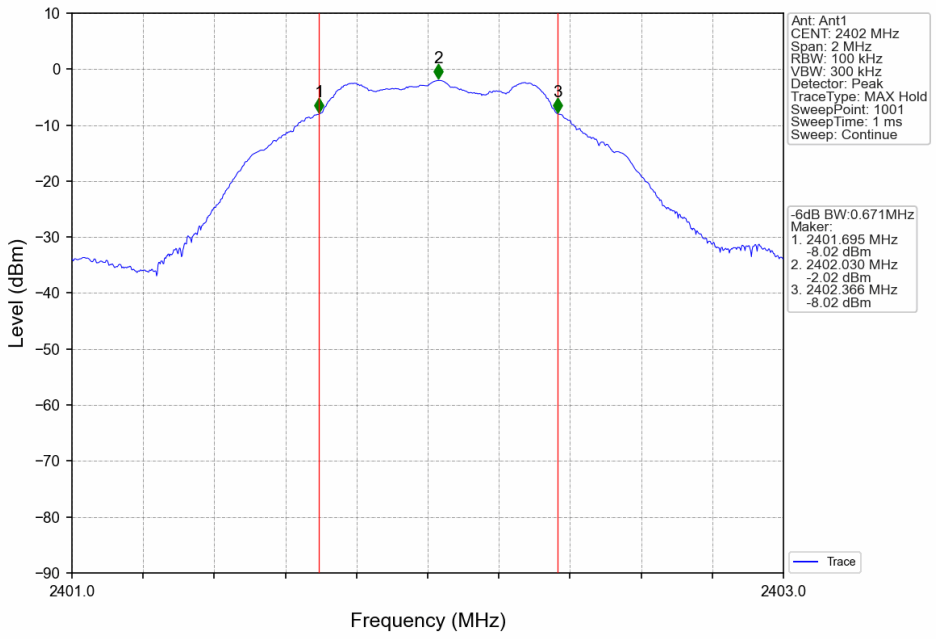
1_HCH_2480MHz_Ant1_NTNV

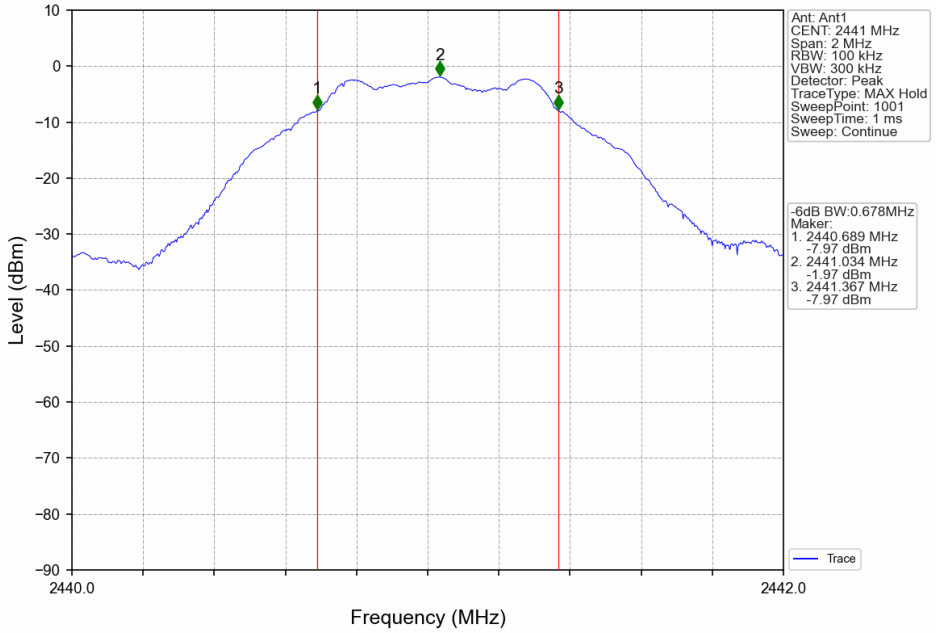


## 2.2.2 6dB BW

1_LCH_2402MHz_Ant1_NTNV




1_MCH_2441MHz_Ant1_NTNV

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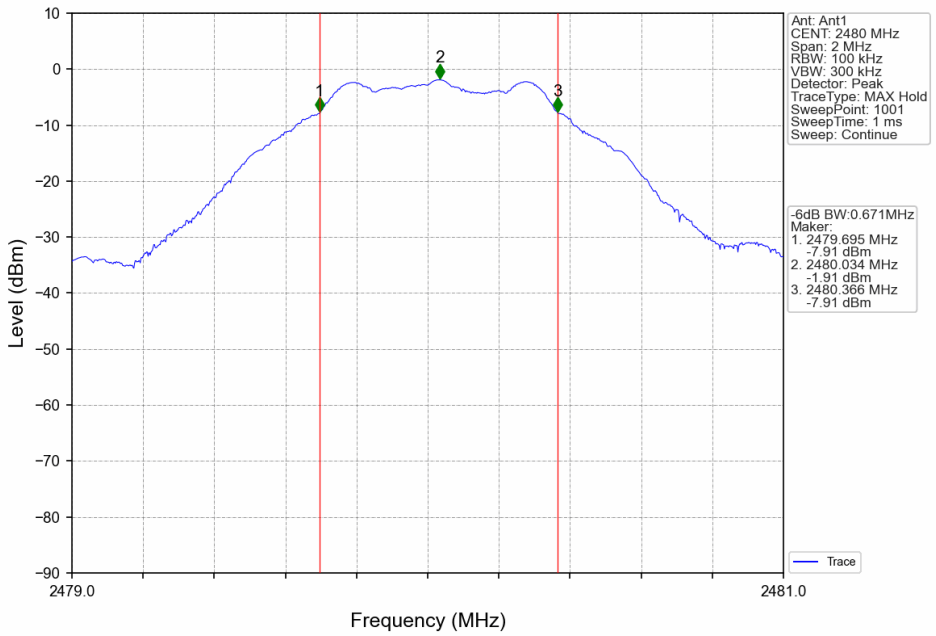
1_HCH_2480MHz_Ant1_NTNV



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# 3. Maximum Conducted Output Power

## 3.1 Test Result

### 3.1.1 Power

| Mode | TX Type | Frequency (MHz) | Maximum Peak Conducted Output Power (dBm) | | Verdict |
|---|---|---|---|---|---|
| | | | ANT1 | Limit | |
| 1 | SISO | 2402 | -1.39 | <=30 | Pass |
| | | 2441 | -1.32 | <=30 | Pass |
| | | 2480 | -1.26 | <=30 | Pass |
| Note1: Antenna Gain: Ant1: 0.338dBi; | | | | | |

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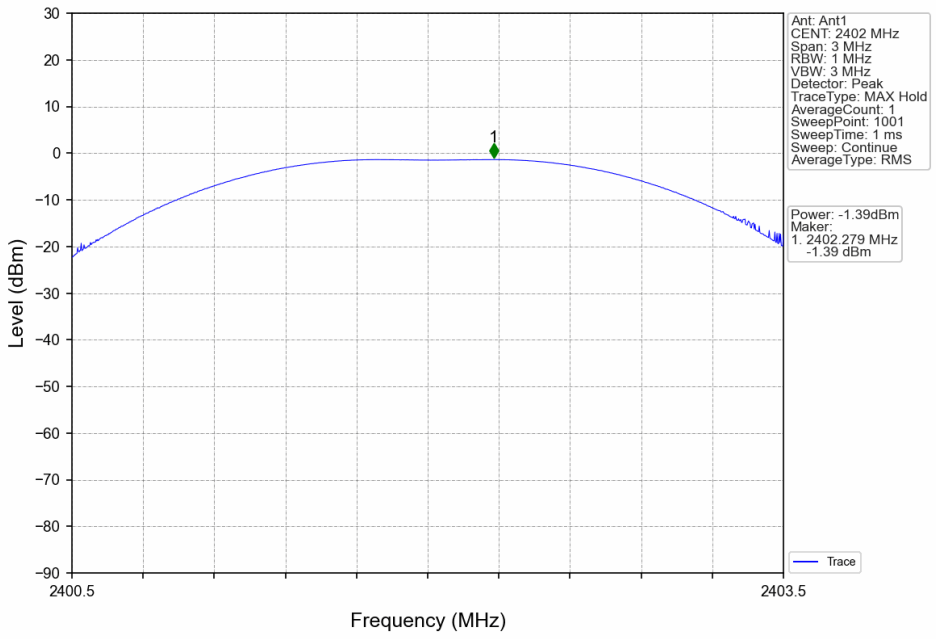
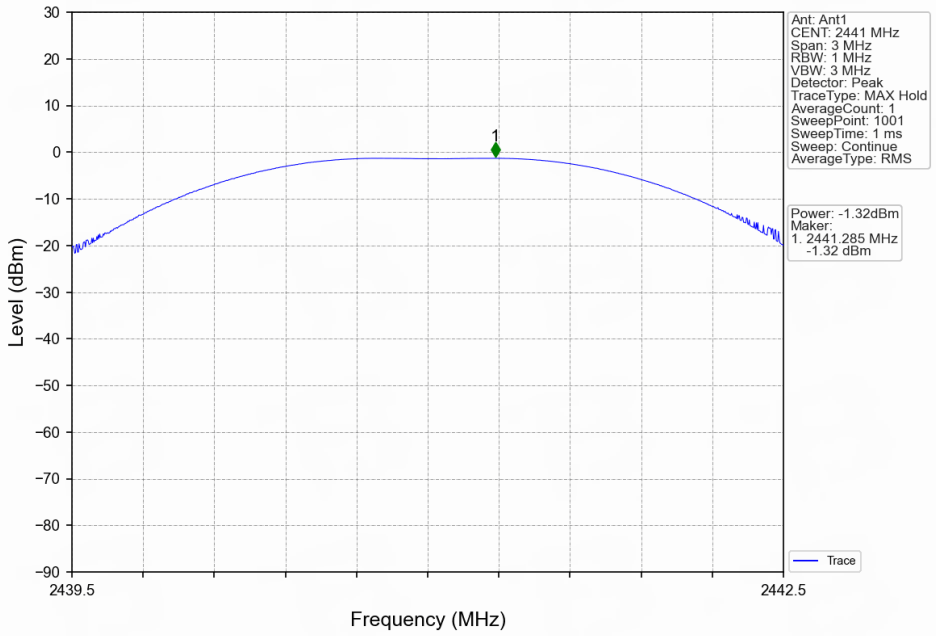
## 3.2 Test Graph

### 3.2.1 Power

1_LCH_2402MHz_Ant1_NTNV




1_MCH_2441MHz_Ant1_NTNV

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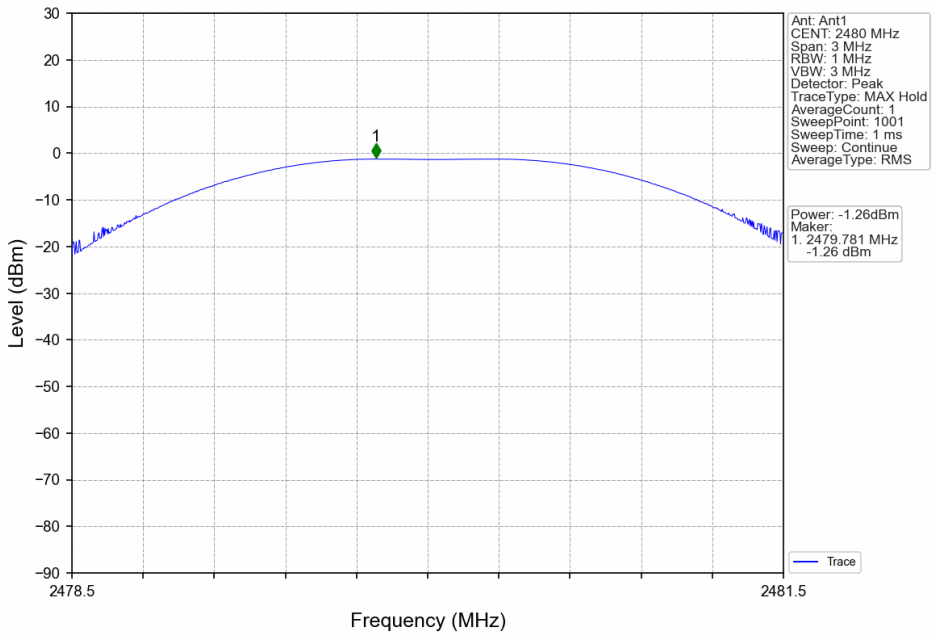
1_HCH_2480MHz_Ant1_NTNV



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# 4. Maximum Power Spectral Density

## 4.1 Test Result

### 4.1.1 PSD

| Mode | TX Type | Frequency (MHz) | Maximum PSD (dBm/3kHz) | | Verdict |
|---|---|---|---|---|---|
| | | | ANT1 | Limit | |
| 1 | SISO | 2402 | -15.79 | <=8 | Pass |
| | | 2441 | -15.78 | <=8 | Pass |
| | | 2480 | -15.72 | <=8 | Pass |
| Note1: Antenna Gain: Ant1: 0.34dBi; | | | | | |

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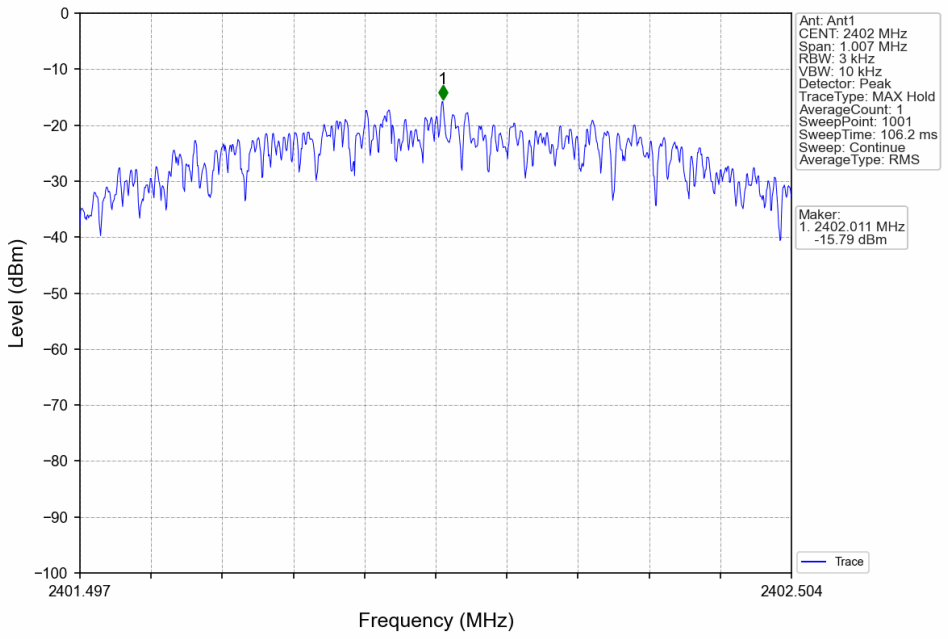
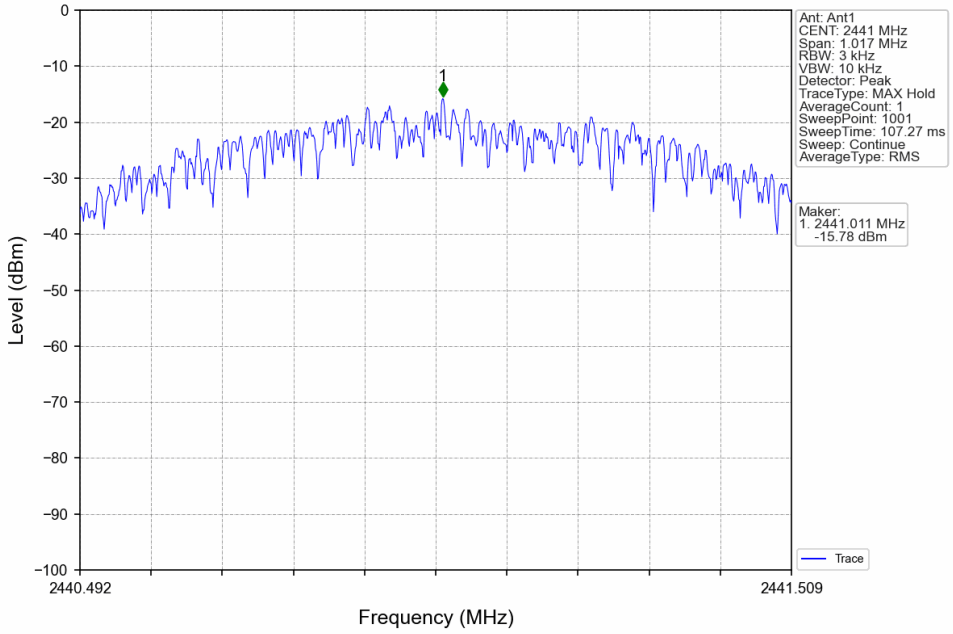
## 4.2 Test Graph

### 4.2.1 PSD

1_LCH_2402MHz_Ant1_NTNV




1_MCH_2441MHz_Ant1_NTNV

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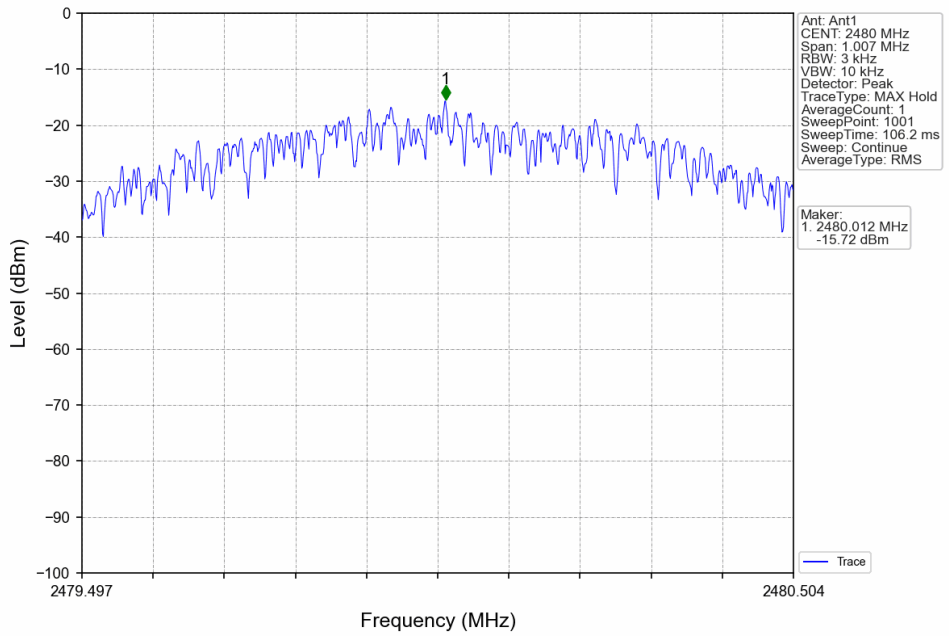
1_HCH_2480MHz_Ant1_NTNV





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# 5. Unwanted Emissions In Non-restricted Frequency Bands

## 5.1 Test Result

### 5.1.1 Ref

| Mode | TX Type | Frequency (MHz) | ANT | Level of Reference (dBm) |
|---|---|---|---|---|
| 1 | SISO | 2402 | 1 | -2.10 |
| | | 2441 | 1 | -2.02 |
| | | 2480 | 1 | -1.90 |
| Note1: Refer to FCC Part 15.247 (d) and ANSI C63.10-2013, the channel contains the maximum PSD level was used to establish the reference level. | | | | |

### 5.1.2 CSE

| Mode | TX Type | Frequency (MHz) | ANT | Level of Reference (dBm) | Limit (dBm) | Verdict |
|---|---|---|---|---|---|---|
| 1 | SISO | 2402 | 1 | -1.90 | -21.90 | Pass |
| | | 2441 | 1 | -1.90 | -21.90 | Pass |
| | | 2480 | 1 | -1.90 | -21.90 | Pass |
| Note1: Refer to FCC Part 15.247 (d) and ANSI C63.10-2013, the channel contains the maximum PSD level was used to establish the reference level. | | | | | | |

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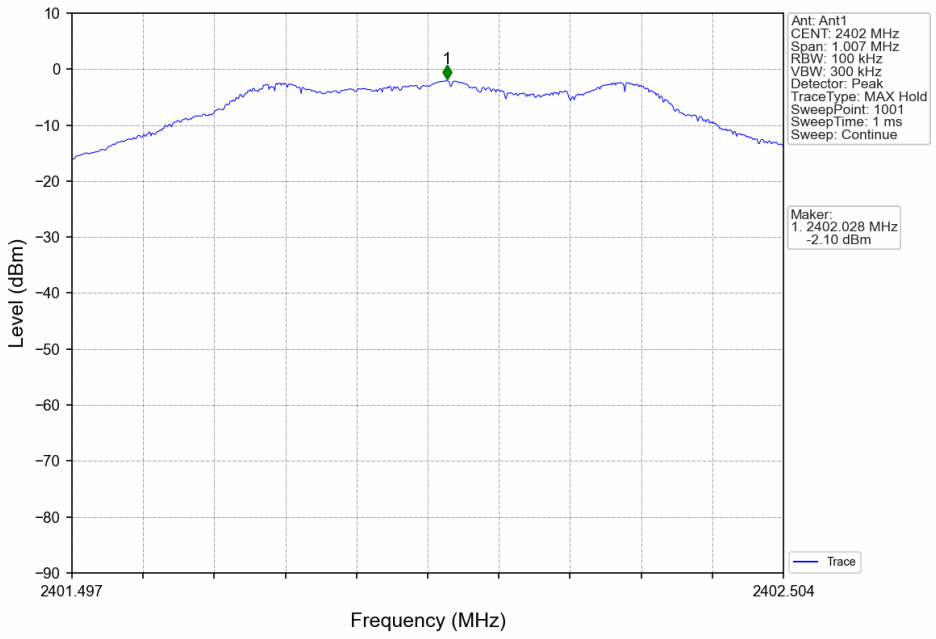
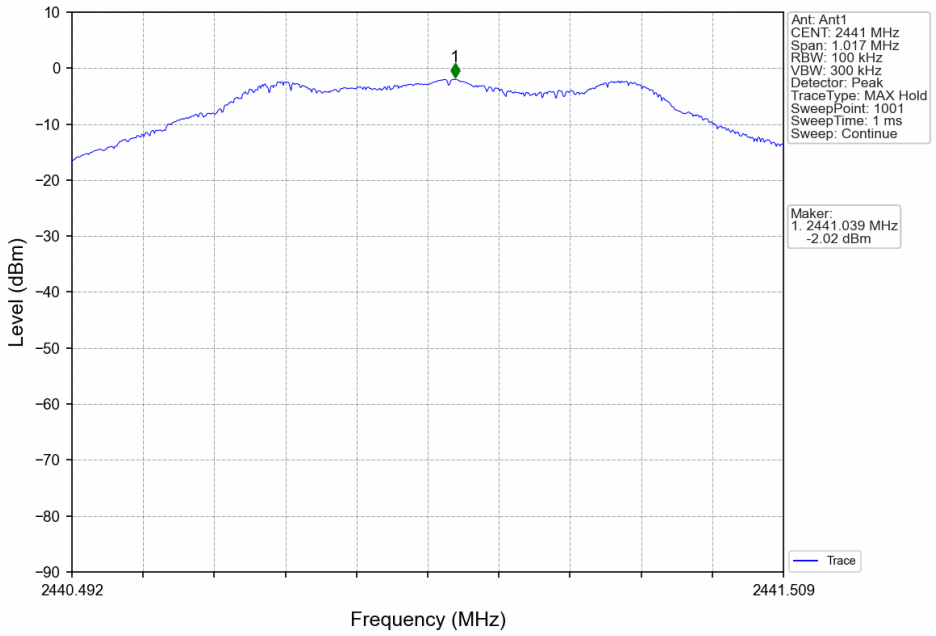
## 5.2 Test Graph

### 5.2.1 Ref

1_LCH_2402MHz_Ant1_NTNV




1_MCH_2441MHz_Ant1_NTNV

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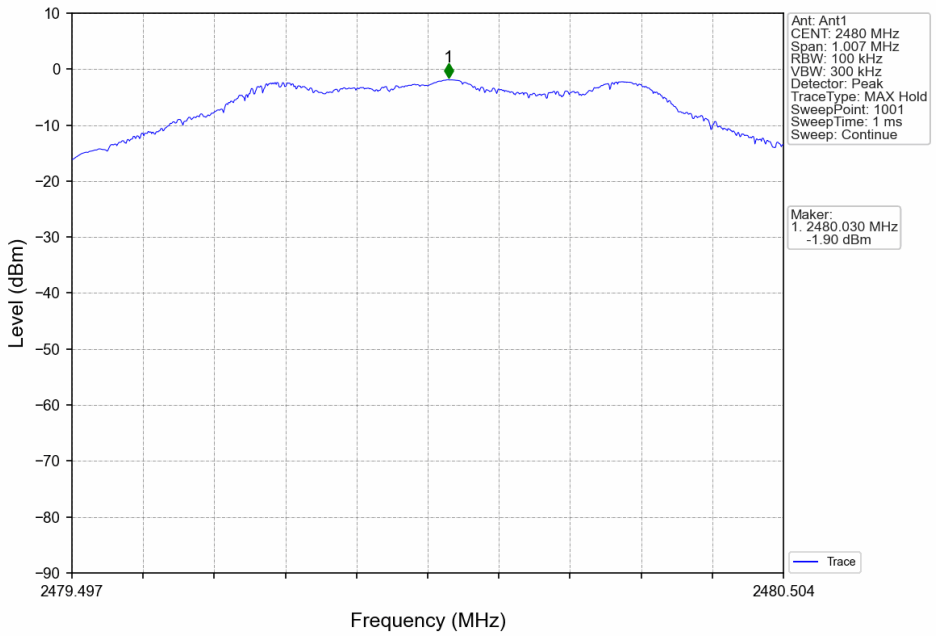
1_HCH_2480MHz_Ant1_NTNV





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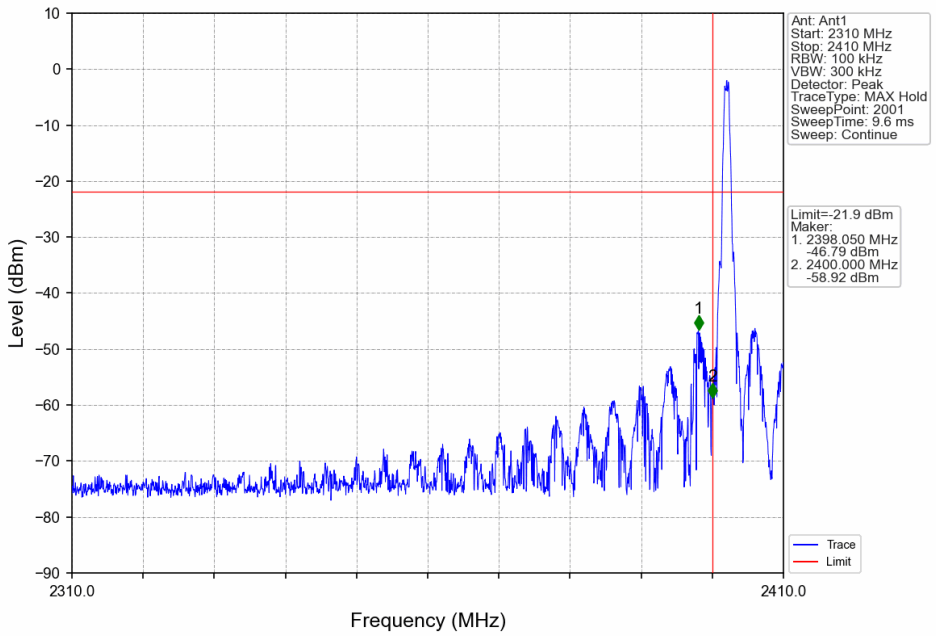
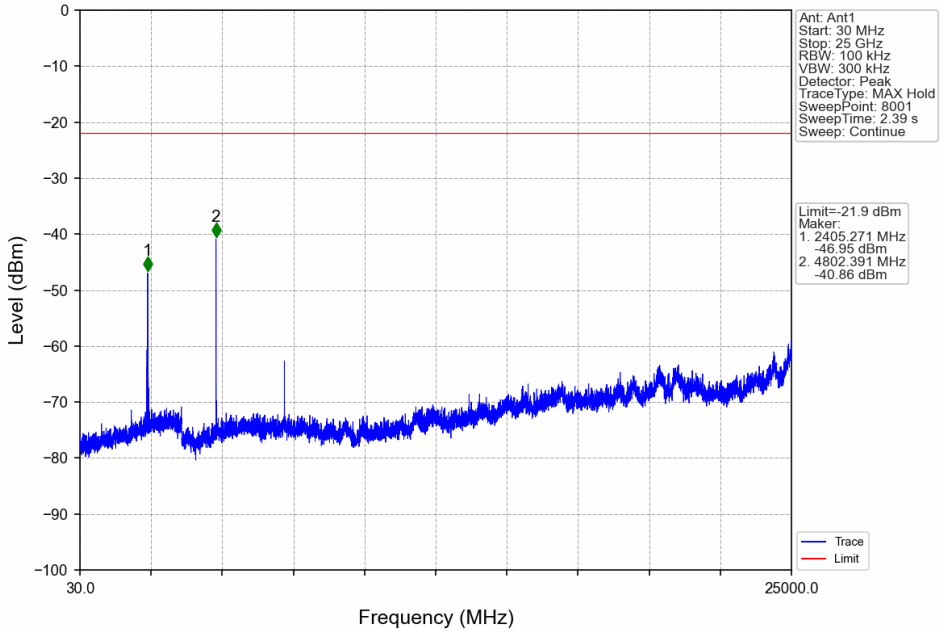
## 5.2.2 CSE

1_LCH_2402MHz_Ant1_NTNV




1_LCH_2402MHz_Ant1_NTNV

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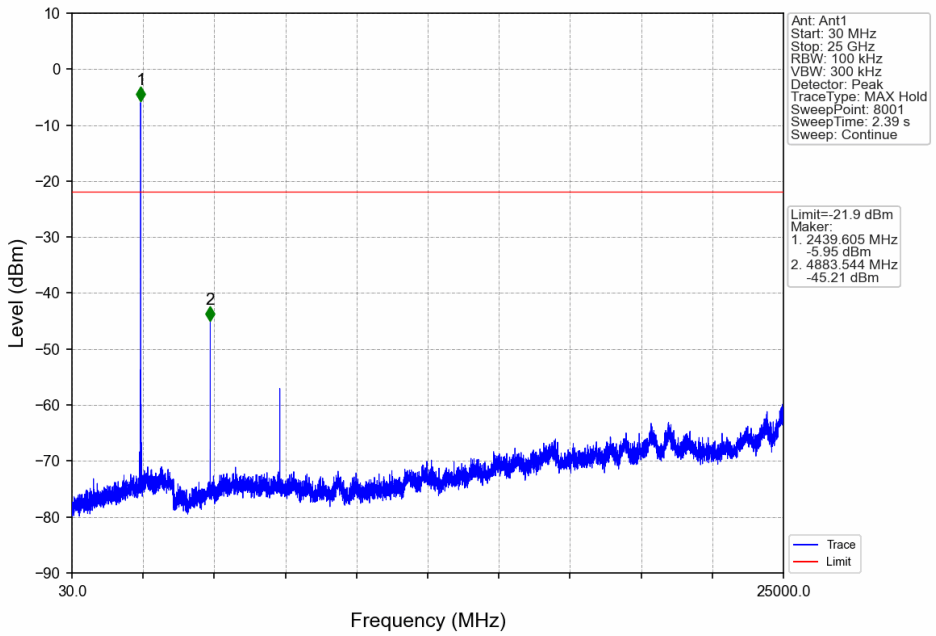
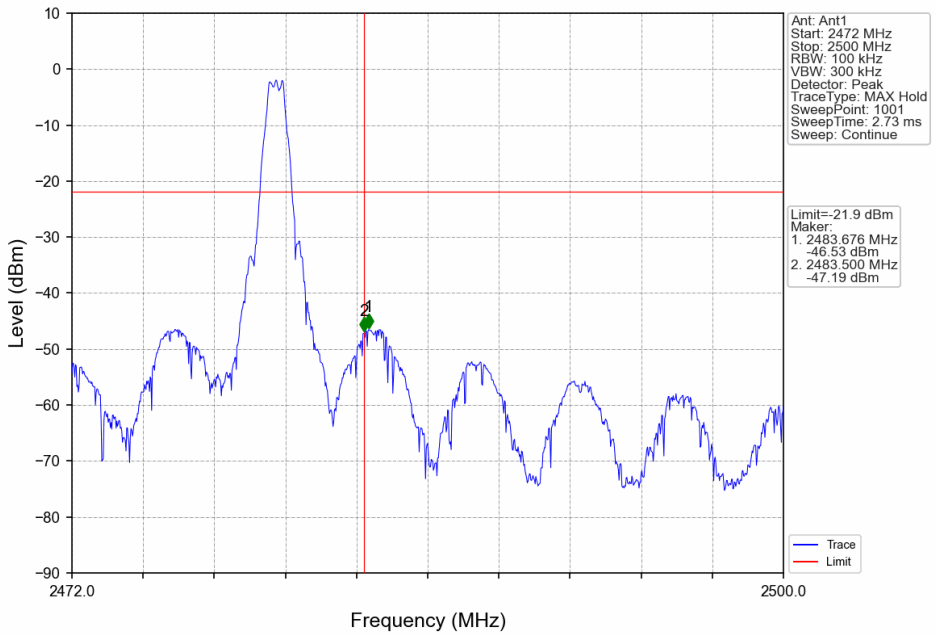
1_MCH_2441MHz_Ant1_NTNV




1_HCH_2480MHz_Ant1_NTNV

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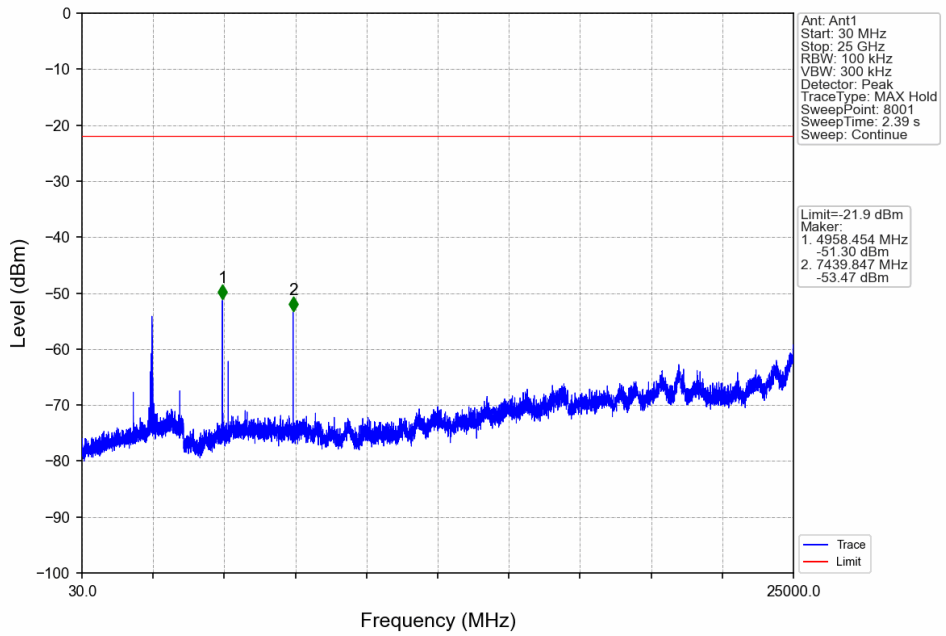
1_HCH_2480MHz_Ant1_NTNV



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# 6. Form731

## 6.1 Test Result

### 6.1.1 Form731

| Lower Freq (MHz) | High Freq (MHz) | MAX Power (W) | MAX Power (dBm) |
|---|---|---|---|
| 2402 | 2480 | 0.0007 | -1.26 |

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