

# TEST REPORT

**Product Name** : Mini Carbon Monoxide Smart Sensor  
**Brand Mark** : hwiote  
**Model No.** : Mini600-CO-TB  
**FCC ID** : 2BFDL-MINI600  
**Report Number** : BLA-EMC-202404-A1702  
**Date of Sample Receipt** : 2024/4/8  
**Date of Test** : 2024/4/8 to 2024/4/18  
**Date of Issue** : 2024/4/18  
**Test Standard** : 47 CFR Part 15, Subpart C 15.247  
**Test Result** : Pass

Prepared for:

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Date:

2024/4/18



## Report Revise Record

| Version No. | Date      | Description |
|-------------|-----------|-------------|
| 00          | 2024/4/18 | Original    |

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## 1 Test summary

| Test item                                             | Test Requirement                 | Test Method                                          | Class/Severity                               | Result |
|-------------------------------------------------------|----------------------------------|------------------------------------------------------|----------------------------------------------|--------|
| Conducted Emissions at AC Power Line (150kHz-30MHz)   | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 6.2                       | 47 CFR Part 15, Subpart C 15.207             | N/A    |
| Conducted Band Edges Measurement                      | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.8 & Section 11.13.3.2 | 47 CFR Part 15, Subpart C 15.247(d)          | Pass   |
| Radiated Spurious Emissions                           | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 6.4,6.5,6.6               | 47 CFR Part 15, Subpart C 15.209 & 15.247(d) | Pass   |
| Antenna Requirement                                   | 47 CFR Part 15, Subpart C 15.247 | N/A                                                  | 47 CFR Part 15, Subpart C 15.203 & 15.247(c) | Pass   |
| Radiated Emissions which fall in the restricted bands | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 6.10.5                    | 47 CFR Part 15, Subpart C 15.209 & 15.247(d) | Pass   |
| Conducted Spurious Emissions                          | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.6 & Section 11.11     | 47 CFR Part 15, Subpart C 15.247(d)          | Pass   |
| Power Spectrum Density                                | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 11.10.2                   | 47 CFR Part 15, Subpart C 15.247(e)          | Pass   |
| Conducted Peak Output Power                           | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.5                     | 47 CFR Part 15, Subpart C 15.247(b)(3)       | Pass   |
| Minimum 6dB Bandwidth                                 | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 11.8.1                    | 47 CFR Part 15, Subpart C 15.247a(2)         | Pass   |

N/A: Not Applicable

## 2 General information

|                       |                                                                                                                           |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------|
| <b>Applicant</b>      | Shenzhen Hanwei IoT Co., Ltd.                                                                                             |
| <b>Address</b>        | Unit 801, University Town Venture Park, No.10 Lishan Road, Taoyuan Street, Nanshan District, Shenzhen, Guangdong Province |
| <b>Manufacturer</b>   | Shenzhen Hanwei IoT Co., Ltd.                                                                                             |
| <b>Address</b>        | Unit 801, University Town Venture Park, No.10 Lishan Road, Taoyuan Street, Nanshan District, Shenzhen, Guangdong Province |
| <b>Factory</b>        | Shenzhen Hanwei IoT Co., Ltd.                                                                                             |
| <b>Address</b>        | Unit 801, University Town Venture Park, No.10 Lishan Road, Taoyuan Street, Nanshan District, Shenzhen, Guangdong Province |
| <b>Product Name</b>   | Mini Carbon Monoxide Smart Sensor                                                                                         |
| <b>Test Model No.</b> | Mini600-CO-TB                                                                                                             |

## 3 General description of EUT

|                            |                                  |
|----------------------------|----------------------------------|
| <b>Hardware Version</b>    | V1.0.0                           |
| <b>Software Version</b>    | V1.0.0                           |
| <b>Engineer sample no</b>  | DC5V                             |
| <b>Operation Frequency</b> | 2402MHz-2480MHz                  |
| <b>Modulation Type</b>     | GFSK                             |
| <b>Channel Spacing</b>     | 2MHz                             |
| <b>Number of Channels</b>  | 40                               |
| <b>Antenna Type</b>        | Ceramic Chip Antenna             |
| <b>Antenna Gain</b>        | 0.8dBi(Provided by the customer) |

#### 4 Operation frequency each of channel

BLE:

| Operation Frequency each of channel |           |         |           |         |           |         |           |
|-------------------------------------|-----------|---------|-----------|---------|-----------|---------|-----------|
| Channel                             | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
| 1                                   | 2402MHz   | 11      | 2422MHz   | 21      | 2442MHz   | 31      | 2462MHz   |
| 2                                   | 2404MHz   | 12      | 2424MHz   | 22      | 2444MHz   | 32      | 2464MHz   |
| ....                                | ....      | ....    | ....      | ....    | ....      | ....    | ....      |
| 9                                   | 2418MHz   | 19      | 2438MHz   | 29      | 2458MHz   | 39      | 2478MHz   |
| 10                                  | 2420MHz   | 20      | 2440MHz   | 30      | 2460MHz   | 40      | 2480MHz   |

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

| Channel             | Frequency |
|---------------------|-----------|
| The lowest channel  | 2402MHz   |
| The middle channel  | 2442MHz   |
| The Highest channel | 2480MHz   |

## 5 Test environment

| Environment | Temperature | Voltage |
|-------------|-------------|---------|
| Normal      | 25°C        | DC 5V   |

## 6 Test mode

| TEST MODE | TEST MODE DESCRIPTION                             |
|-----------|---------------------------------------------------|
| TX        | Keep the EUT in transmitting mode with modulation |

Remark: Only the data of the worst mode would be recorded in this report.

## 7 Measurement uncertainty

| Parameter                                      | Expanded Uncertainty (Confidence of 95%) |
|------------------------------------------------|------------------------------------------|
| Occupied Channel Bandwidth                     | ±5 %                                     |
| RF output power, conducted                     | ±1.5 dB                                  |
| Power Spectral Density, conducted              | ±3.0 dB                                  |
| Unwanted Emissions, conducted                  | ±3.0 dB                                  |
| Temperature                                    | ±3 °C                                    |
| Supply voltages                                | ±3 %                                     |
| Time                                           | ±5 %                                     |
| Radiated Emission(9kHz-30MHz)                  | ±4.34dB                                  |
| AC Power Line Conducted Emission(150kHz-30MHz) | ±3.45dB                                  |
| Unwanted Radiated Emission (30MHz ~ 1000MHz)   | ±4.35 dB                                 |
| Unwanted Radiated Emission (1GHz ~ 18GHz)      | ±4.44 dB                                 |

## 8 Description of support unit

| Device Type | Manufacturer | Model Name | Serial No. | Remark                             |
|-------------|--------------|------------|------------|------------------------------------|
| PC          | Lenovo       | E460C      | N/A        | From lab<br>(No.BLA-ZC-BS-2022005) |

## 9 Laboratory Location

All tests were performed at:  
BlueAsia of Technical Services(Shenzhen) Co., Ltd.  
Building C, No. 107, Shihuan Road, Shiyuan Sub-District, Baoan District, Shenzhen, Guangdong Province, China  
Telephone: TEL: +86-755-28682673 FAX: +86-755-28682673  
No tests were sub-contracted.

## 10 Test instruments list

| Test equipment of radiated spurious emissions |                 |                           |                  |            |            |
|-----------------------------------------------|-----------------|---------------------------|------------------|------------|------------|
| Equipment                                     | Manufacturer    | Model                     | S/N              | Cal.Date   | Cal.Due    |
| Chamber 1                                     | SKET            | 966                       | N/A              | 2023/11/16 | 2026/11/15 |
| Chamber 2                                     | SKET            | 966                       | N/A              | 2021/07/20 | 2024/7/19  |
| Spectrum                                      | R&S             | FSP40                     | 100817           | 2023/08/30 | 2024/08/29 |
| Receiver                                      | R&S             | ESR7                      | 101199           | 2023/08/30 | 2024/08/29 |
| Receiver                                      | R&S             | ESPI7                     | 101477           | 2023/07/07 | 2024/07/06 |
| broadband Antenna                             | Schwarzbeck     | VULB9168                  | 00836<br>P:00227 | 2022/10/12 | 2025/10/11 |
| Horn Antenna                                  | Schwarzbeck     | BBHA9120D                 | 01892<br>P:00331 | 2022/09/13 | 2025/09/12 |
| Horn Antenna                                  | Schwarzbeck     | BBHA 9170                 | 1106             | 2022/04/24 | 2024/04/23 |
| Amplifier                                     | SKET            | LNPA_30M01<br>G-30        | SK2021060801     | 2023/07/07 | 2024/07/06 |
| Amplifier                                     | SKET            | PA-000318G-4<br>5         | N/A              | 2023/08/30 | 2024/08/29 |
| Amplifier                                     | SKET            | LNPA_18G40<br>G-50        | SK2022071301     | 2023/07/14 | 2024/07/13 |
| Filter group                                  | SKET            | 2.4G/5G Filter<br>group r | N/A              | 2023/07/07 | 2024/07/06 |
| EMI software                                  | EZ              | EZ-EMC                    | EEMC-3A1         | N/A        | N/A        |
| Loop antenna                                  | SCHNARZBE<br>CK | FMZB1519B                 | 00102            | 2022/09/14 | 2025/09/13 |
| 1kHz calibration<br>audio source              | SKET            | MCS-ABT-C35               | N/A              | 2023/09/04 | 2024/09/03 |
| Free Field<br>Microphone                      | SKET            | MGS MP 663                | 0414             | 2023/09/04 | 2024/09/03 |
| Controller                                    | SKET            | N/A                       | N/A              | N/A        | N/A        |
| Coaxial Cable                                 | BlueAsia        | BLA-XC-02                 | N/A              | N/A        | N/A        |
| Coaxial Cable                                 | BlueAsia        | BLA-XC-03                 | N/A              | N/A        | N/A        |
| Coaxial Cable                                 | BlueAsia        | BLA-XC-01                 | N/A              | N/A        | N/A        |
| Signal Generator<br>DTV                       | ECREDIX         | DSG-1000                  | N/A              | N/A        | N/A        |

| Test equipment of RF conducted test |                 |           |                 |            |            |
|-------------------------------------|-----------------|-----------|-----------------|------------|------------|
| Equipment                           | Manufacturer    | Model     | S/N             | Cal.Date   | Cal.Due    |
| Spectrum                            | R&S             | FSP40     | 100817          | 2023/08/30 | 2024/08/29 |
| Spectrum                            | Agilent         | N9020A    | MY49100060      | 2023/08/30 | 2024/08/29 |
| Spectrum                            | Agilent         | N9020A    | MY54420161      | 2023/08/30 | 2024/08/29 |
| Signal Generator                    | Agilent         | N5182A    | MY47420955      | 2023/08/30 | 2024/08/29 |
| Signal Generator                    | Agilent         | N5181A    | MY46240904      | 2023/07/07 | 2024/07/06 |
| Signal Generator                    | R&S             | CMW500    | 132429          | 2023/08/30 | 2024/08/29 |
| BluetoothTester                     | Anritsu         | MT8852B   | 06262047872     | 2023/08/30 | 2024/08/29 |
| Power probe                         | DARE            | RPR3006W  | 14I00889SN042   | 2023/09/01 | 2024/08/31 |
| Power detection box                 | CDKMV           | MW100-PSB | MW201020JYT     | 2023/07/07 | 2024/07/06 |
| DC Power supply                     | zhaoxin         | KXN-305D  | 20K305D1221363  | 2023/08/30 | 2024/08/29 |
| DC Power supply                     | zhaoxin         | RXN-1505D | 19R1505D050168  | 2023/08/30 | 2024/08/29 |
| 2.4GHz/5GHz RF Test software        | MTS             | MTS 8310  | Version 2.0.0.0 | N/A        | N/A        |
| Audio Analyzer                      | Audio Precision | ATS-1     | ATS141094       | 2023/07/07 | 2024/07/06 |

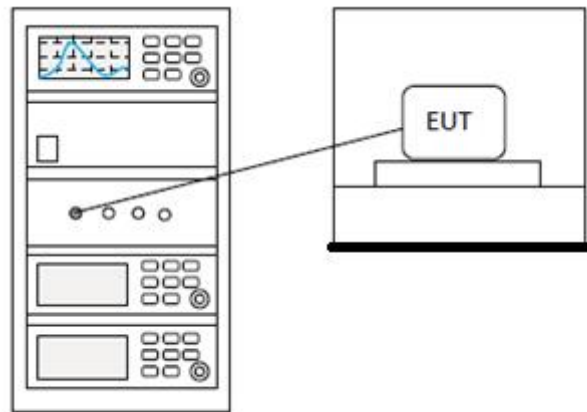
## 11 Conducted band edges measurement

|                               |                                                      |
|-------------------------------|------------------------------------------------------|
| <b>Test Standard</b>          | 47 CFR Part 15, Subpart C 15.247                     |
| <b>Test Method</b>            | ANSI C63.10 (2013) Section 7.8.8 & Section 11.13.3.2 |
| <b>Test Mode (Pre-Scan)</b>   | TX                                                   |
| <b>Test Mode (Final Test)</b> | TX                                                   |
| <b>Tester</b>                 | Charlie                                              |
| <b>Temperature</b>            | 25°C                                                 |
| <b>Humidity</b>               | 60%                                                  |

### 11.1 Limits

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Limit:</b> | <p>In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).</p> |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 11.2 Test setup



## 11.3 Test data

**Pass: Please Refer To Appendix: Appendix1 For Details**

## 12 Radiated spurious emissions

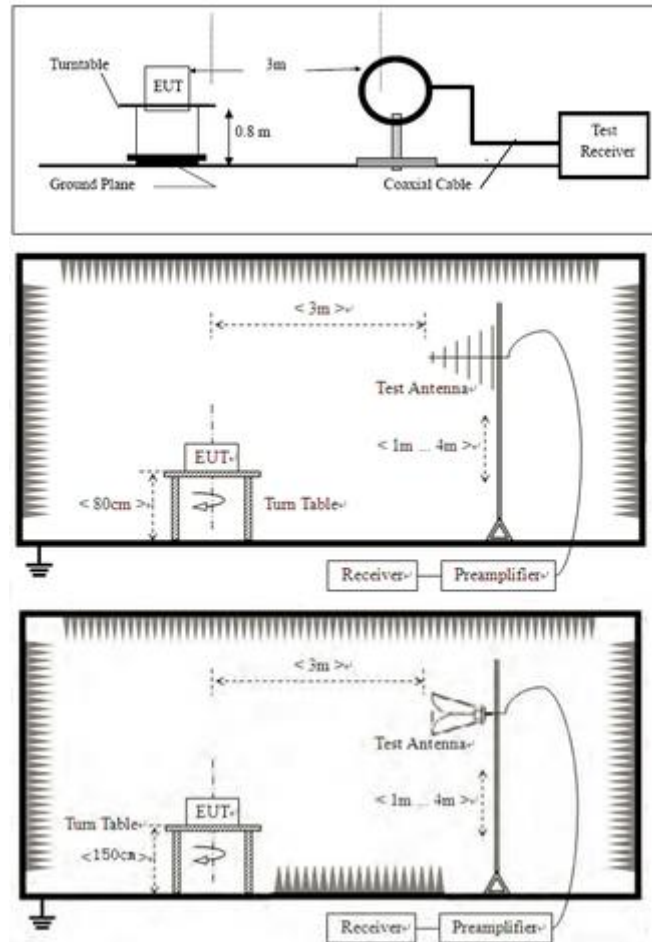
|                               |                                        |
|-------------------------------|----------------------------------------|
| <b>Test Standard</b>          | 47 CFR Part 15, Subpart C 15.247       |
| <b>Test Method</b>            | ANSI C63.10 (2013) Section 6.4,6.5,6.6 |
| <b>Test Mode (Pre-Scan)</b>   | TX                                     |
| <b>Test Mode (Final Test)</b> | TX                                     |
| <b>Tester</b>                 | Charlie                                |
| <b>Temperature</b>            | 25℃                                    |
| <b>Humidity</b>               | 60%                                    |

### 12.1 Limits

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

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

## 12.2 Test setup



## 12.3 Procedure

- For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

- h. Test the EUT in the lowest channel, the middle channel, the highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

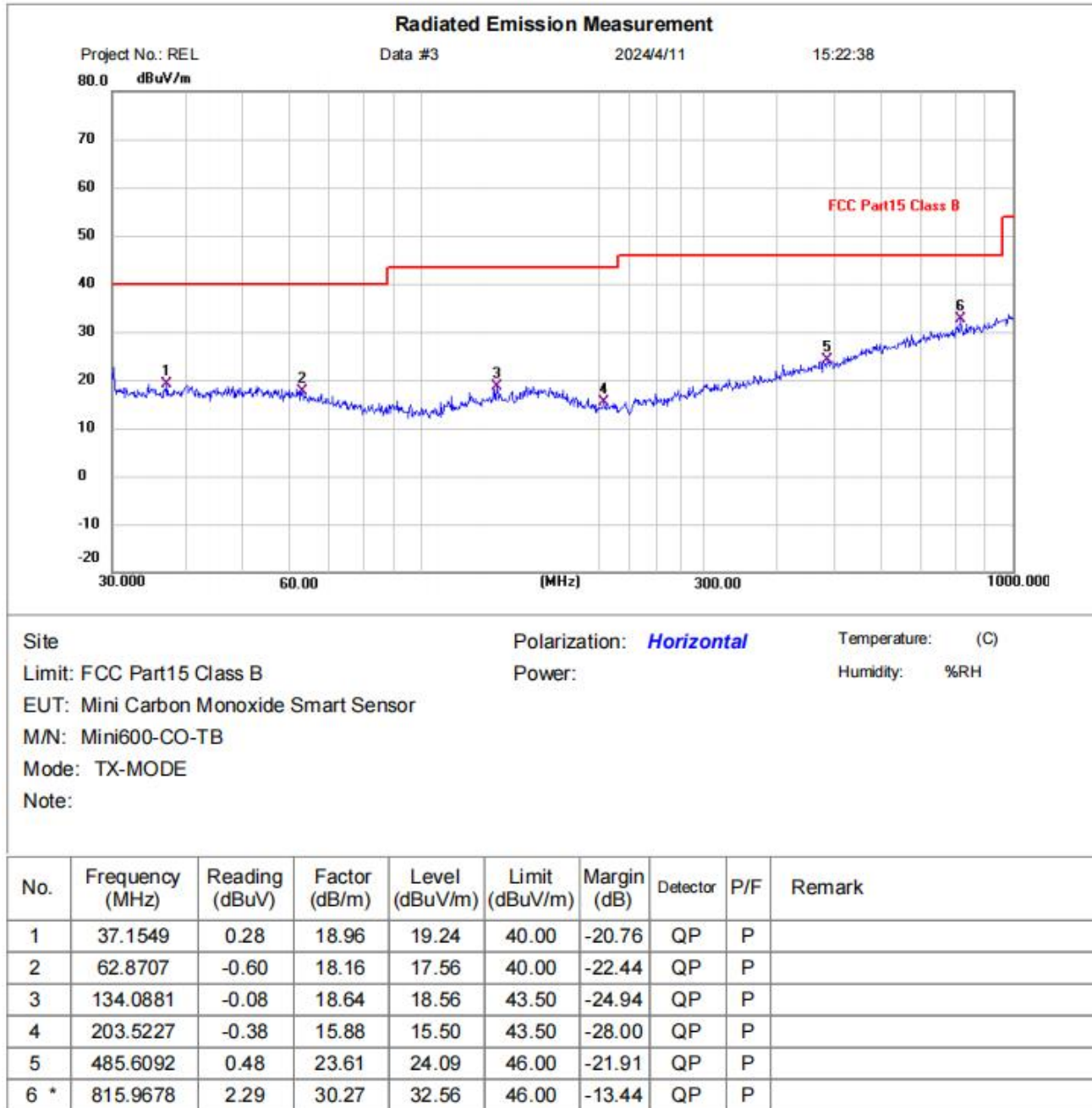
Remark:

- 1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:  
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor - Preamplifier Factor
- 3) Scan from 9 kHz to 25GHz, the disturbance above 12.75GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported. Fundamental frequency is blocked by filter, and only spurious emission is shown.
- 4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

## 12.4 Test data

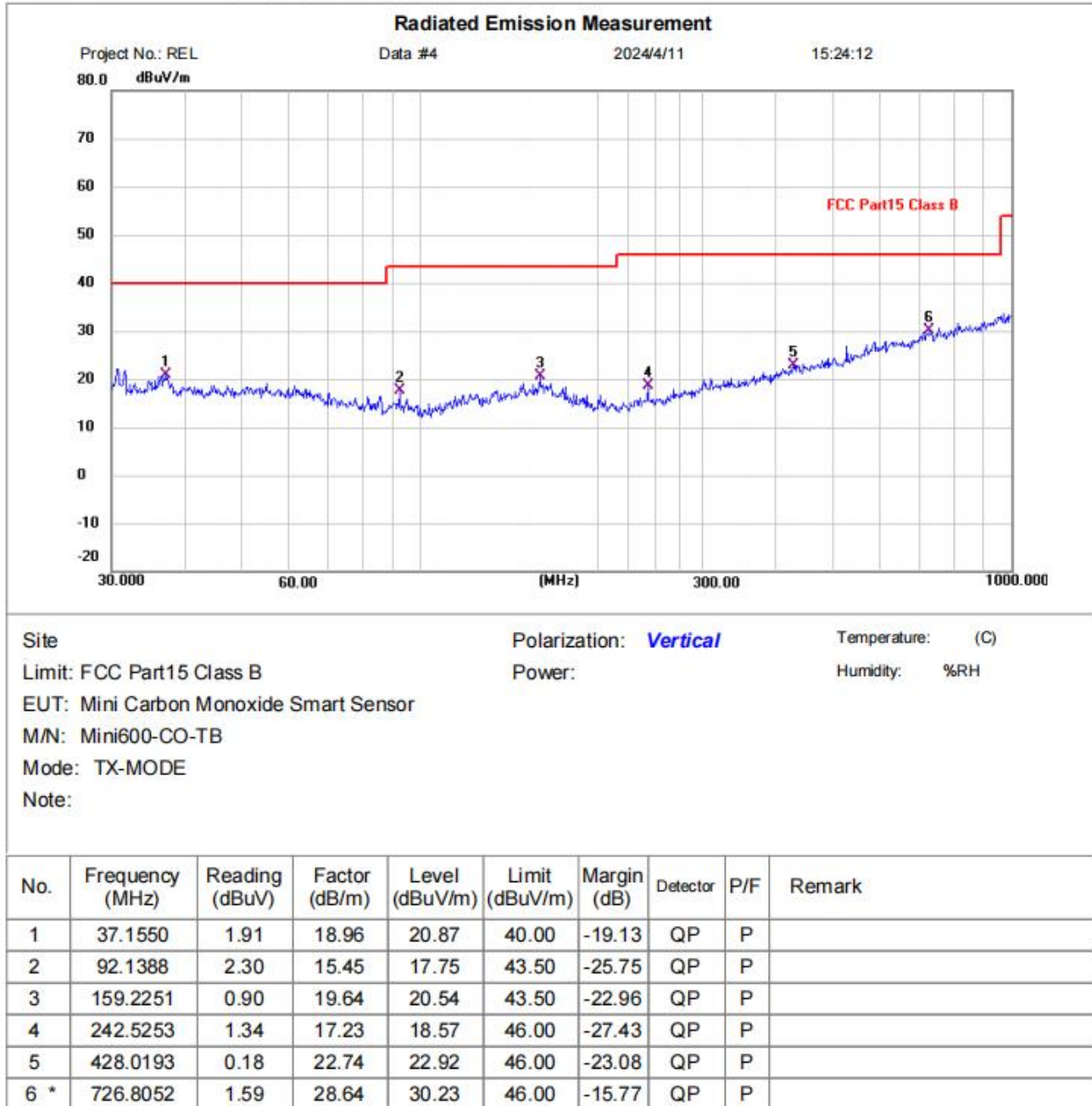
Below 1GHz

[TestMode: TX]; [Polarity: Horizontal]



**Test Result: Pass**

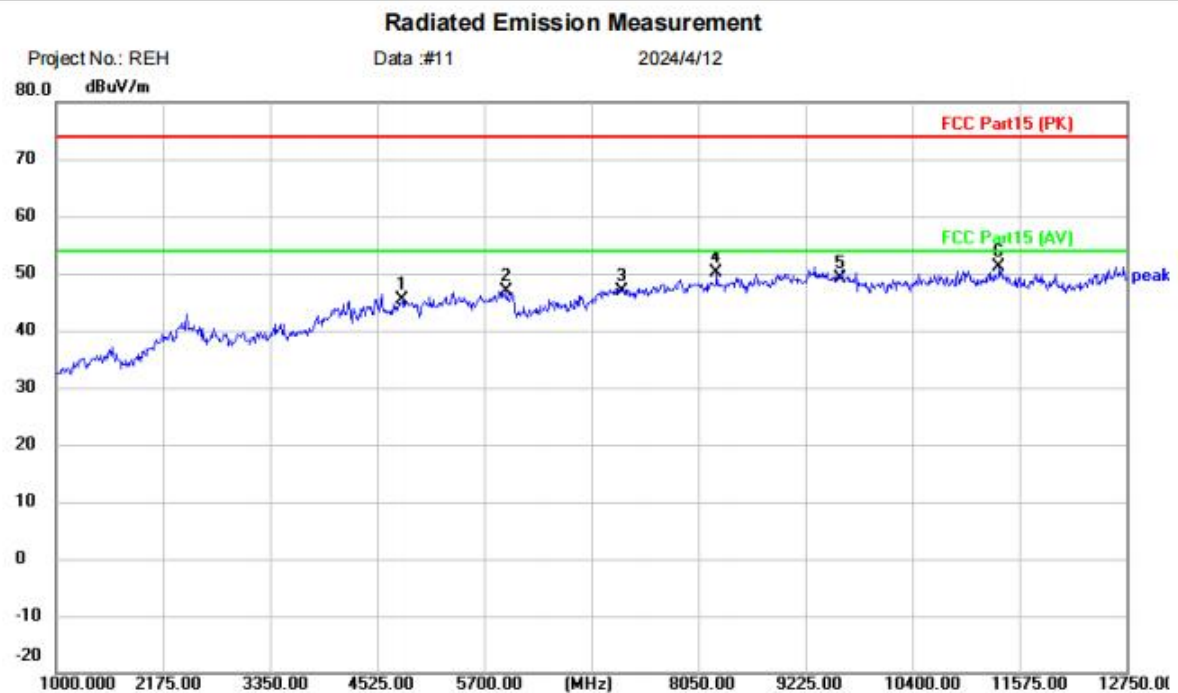
[TestMode: TX]; [Polarity: Vertical]



**Test Result: Pass**

Above 1GHz:

[TestMode: TX low channel]; [Polarity: Horizontal]

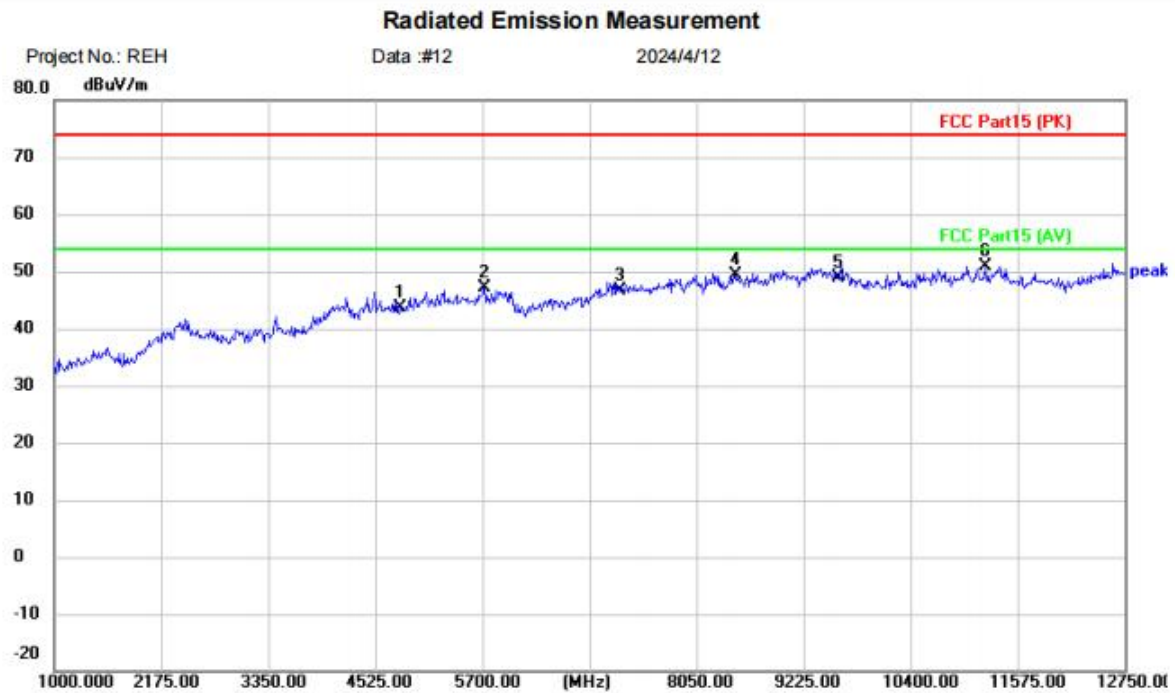


Site:      Polarization: **Horizontal**      Temperature: (C)  
Limit: FCC Part15 (PK)      Power:      Humidity: %RH  
EUT: Mini Carbon Monoxide Smart Sensor  
M/N: Mini600-CO-TB  
Mode: TX-2402  
Note:

| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector | Comment |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|---------|
| 1   |     | 4804.000     | 39.86                    | 5.64                    | 45.50                      | 74.00           | -28.50     | peak     |         |
| 2   |     | 5946.750     | 38.22                    | 8.71                    | 46.93                      | 74.00           | -27.07     | peak     |         |
| 3   |     | 7206.000     | 37.65                    | 9.24                    | 46.89                      | 74.00           | -27.11     | peak     |         |
| 4   |     | 8249.750     | 40.34                    | 9.86                    | 50.20                      | 74.00           | -23.80     | peak     |         |
| 5   |     | 9608.000     | 36.84                    | 12.31                   | 49.15                      | 74.00           | -24.85     | peak     |         |
| 6   | *   | 11351.75     | 38.48                    | 12.65                   | 51.13                      | 74.00           | -22.87     | peak     |         |

**Test Result: Pass**

[TestMode: TX low channel]; [Polarity: Vertical]



Site:      Polarization: **Vertical**      Temperature: (C)

Limit: FCC Part15 (PK)      Power:      Humidity: %RH

EUT: Mini Carbon Monoxide Smart Sensor

M/N: Mini600-CO-TB

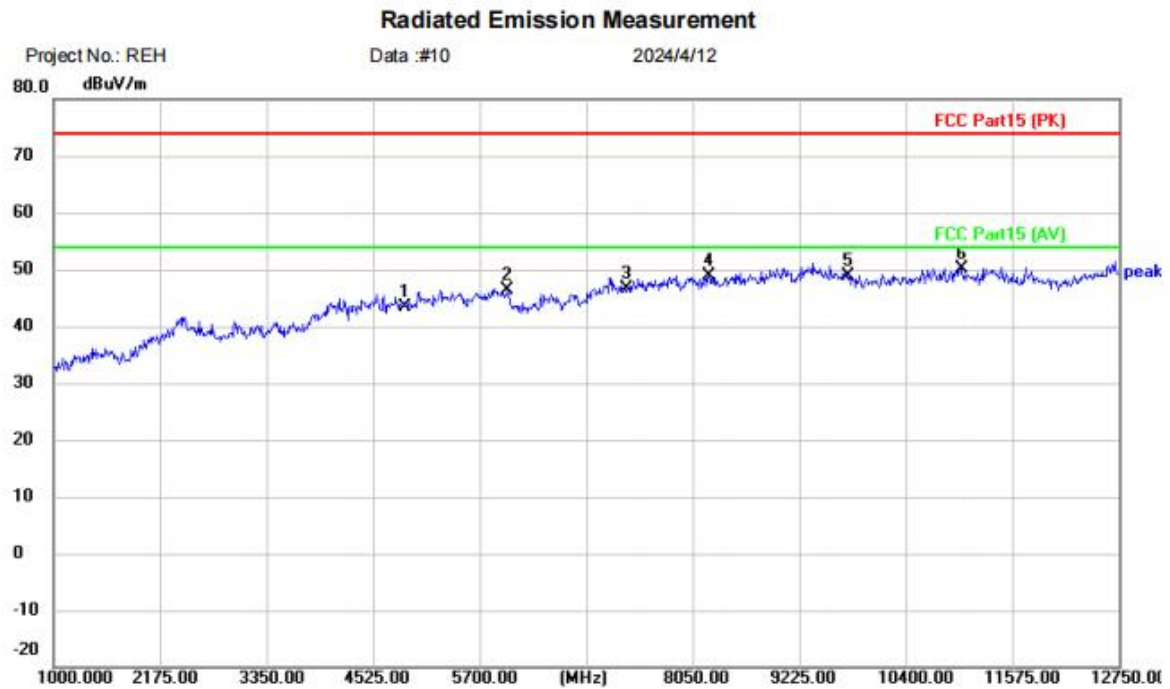
Mode: TX-2402

Note:

| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector | Comment |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|---------|
| 1   |     | 4804.000     | 38.01                    | 5.64                    | 43.65                      | 74.00           | -30.35     | peak     |         |
| 2   |     | 5723.500     | 39.17                    | 8.08                    | 47.25                      | 74.00           | -26.75     | peak     |         |
| 3   |     | 7206.000     | 37.48                    | 9.24                    | 46.72                      | 74.00           | -27.28     | peak     |         |
| 4   |     | 8473.000     | 38.63                    | 10.77                   | 49.40                      | 74.00           | -24.60     | peak     |         |
| 5   |     | 9608.000     | 36.60                    | 12.31                   | 48.91                      | 74.00           | -25.09     | peak     |         |
| 6   | *   | 11222.50     | 38.11                    | 12.70                   | 50.81                      | 74.00           | -23.19     | peak     |         |

**Test Result: Pass**

[TestMode: TX middle channel]; [Polarity: Horizontal]

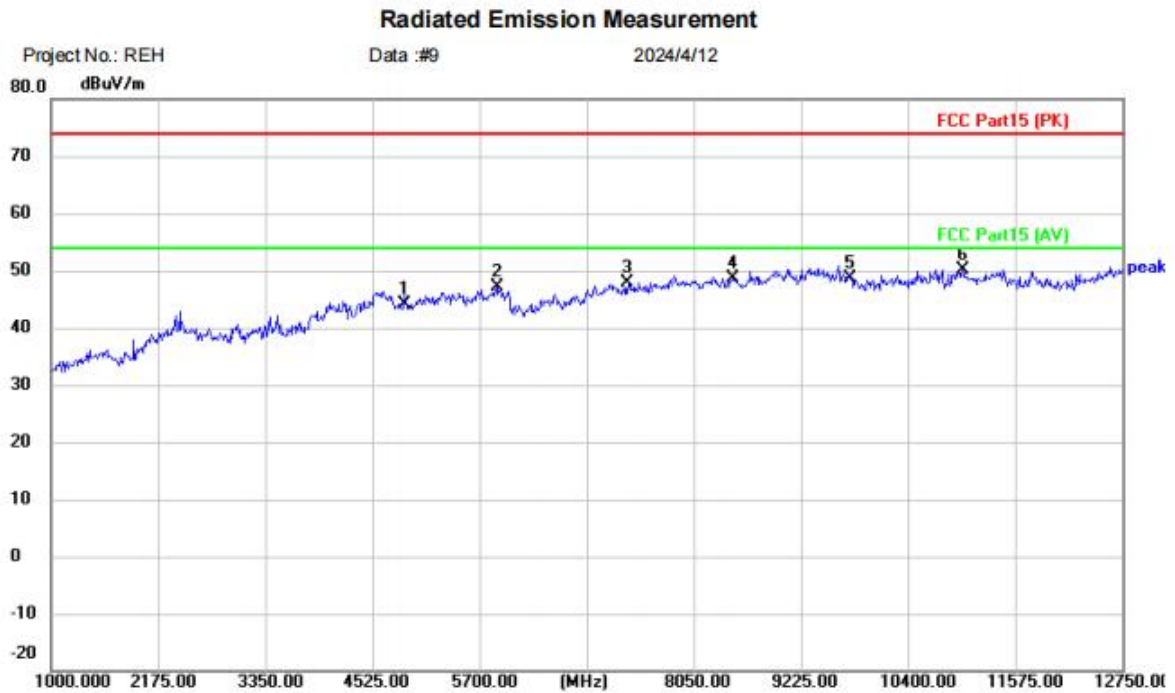


Site: Polarization: **Horizontal** Temperature: (C)  
Limit: FCC Part15 (PK) Power: Humidity: %RH  
EUT: Mini Carbon Monoxide Smart Sensor  
M/N: Mini600-CO-TB  
Mode: TX-2442  
Note:

| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector | Comment |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|---------|
| 1   |     | 4884.000     | 37.68                    | 5.75                    | 43.43                      | 74.00           | -30.57     | peak     |         |
| 2   |     | 6005.500     | 40.79                    | 5.61                    | 46.40                      | 74.00           | -27.60     | peak     |         |
| 3   |     | 7326.000     | 37.29                    | 9.43                    | 46.72                      | 74.00           | -27.28     | peak     |         |
| 4   |     | 8226.250     | 38.89                    | 9.87                    | 48.76                      | 74.00           | -25.24     | peak     |         |
| 5   |     | 9768.000     | 36.70                    | 12.22                   | 48.92                      | 74.00           | -25.08     | peak     |         |
| 6   | *   | 11011.00     | 36.79                    | 13.40                   | 50.19                      | 74.00           | -23.81     | peak     |         |

**Test Result: Pass**

[TestMode: TX middle channel]; [Polarity: Vertical]

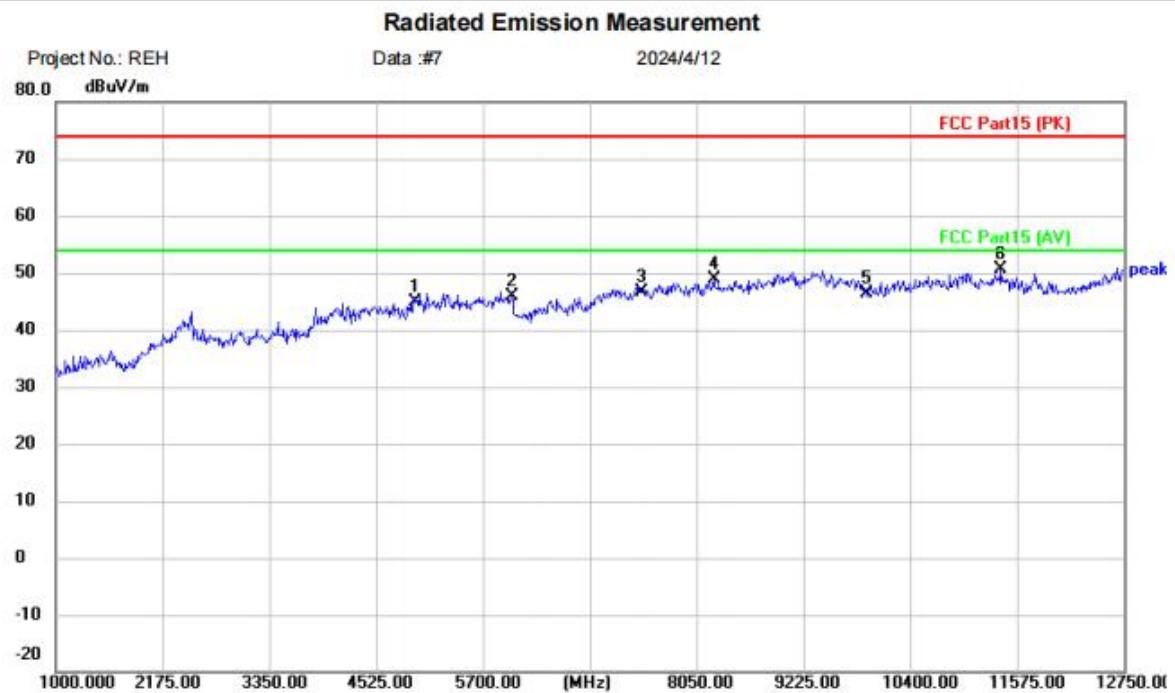


Site:      Polarization: **Vertical**      Temperature: (C)  
Limit: FCC Part15 (PK)      Power:      Humidity: %RH  
EUT: Mini Carbon Monoxide Smart Sensor  
M/N: Mini600-CO-TB  
Mode: TX-2442  
Note:

| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector | Comment |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|---------|
| 1   |     | 4884.000     | 38.47                    | 5.75                    | 44.22                      | 74.00           | -29.78     | peak     |         |
| 2   |     | 5888.000     | 38.56                    | 8.60                    | 47.16                      | 74.00           | -26.84     | peak     |         |
| 3   |     | 7326.000     | 38.34                    | 9.43                    | 47.77                      | 74.00           | -26.23     | peak     |         |
| 4   |     | 8473.000     | 37.87                    | 10.77                   | 48.64                      | 74.00           | -25.36     | peak     |         |
| 5   |     | 9768.000     | 36.41                    | 12.22                   | 48.63                      | 74.00           | -25.37     | peak     |         |
| 6   | *   | 10999.25     | 36.62                    | 13.48                   | 50.10                      | 74.00           | -23.90     | peak     |         |

**Test Result: Pass**

[TestMode: TX High channel]; [Polarity: Horizontal]

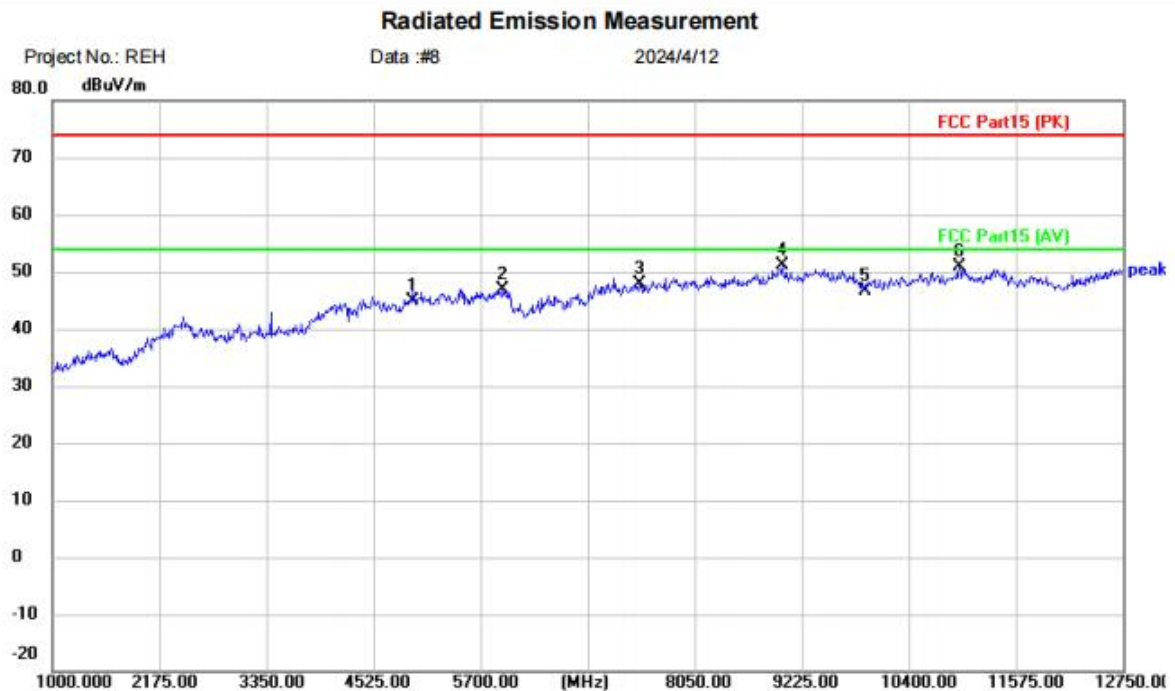


Site:      Polarization: **Horizontal**      Temperature: (C)  
Limit: FCC Part15 (PK)      Power:      Humidity: %RH  
EUT: Mini Carbon Monoxide Smart Sensor  
M/N: Mini600-CO-TB  
Mode: TX-2480  
Note:

| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector | Comment |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|---------|
| 1   |     | 4960.000     | 38.28                    | 6.60                    | 44.88                      | 74.00           | -29.12     | peak     |         |
| 2   |     | 6017.250     | 40.28                    | 5.63                    | 45.91                      | 74.00           | -28.09     | peak     |         |
| 3   |     | 7440.000     | 36.90                    | 9.64                    | 46.54                      | 74.00           | -27.46     | peak     |         |
| 4   |     | 8238.000     | 39.03                    | 9.86                    | 48.89                      | 74.00           | -25.11     | peak     |         |
| 5   |     | 9920.000     | 34.17                    | 12.14                   | 46.31                      | 74.00           | -27.69     | peak     |         |
| 6   | *   | 11398.75     | 38.10                    | 12.61                   | 50.71                      | 74.00           | -23.29     | peak     |         |

**Test Result: Pass**

[TestMode: TX High channel]; [Polarity: Vertical]



Site: Polarization: **Vertical**      Temperature: (C)

Limit: FCC Part15 (PK)      Power:      Humidity: %RH

EUT: Mini Carbon Monoxide Smart Sensor

M/N: Mini600-CO-TB

Mode: TX-2480

Note:

| No. | Mk. | Freq.    | Reading Level | Correct Factor | Measurement | Limit  | Over   |          |         |
|-----|-----|----------|---------------|----------------|-------------|--------|--------|----------|---------|
|     |     | MHz      | dBuV          | dB             | dBuV/m      | dBuV/m | dB     | Detector | Comment |
| 1   |     | 4960.000 | 38.39         | 6.60           | 44.99       | 74.00  | -29.01 | peak     |         |
| 2   |     | 5946.750 | 38.13         | 8.71           | 46.84       | 74.00  | -27.16 | peak     |         |
| 3   |     | 7440.000 | 38.28         | 9.64           | 47.92       | 74.00  | -26.08 | peak     |         |
| 4   | *   | 9013.500 | 38.82         | 12.35          | 51.17       | 74.00  | -22.83 | peak     |         |
| 5   |     | 9920.000 | 34.58         | 12.14          | 46.72       | 74.00  | -27.28 | peak     |         |
| 6   |     | 10952.25 | 37.70         | 13.30          | 51.00       | 74.00  | -23.00 | peak     |         |

**Test Result: Pass**

### 13 Antenna requirement

|               |                                  |
|---------------|----------------------------------|
| Test Standard | 47 CFR Part 15, Subpart C 15.247 |
| Test Method   | N/A                              |

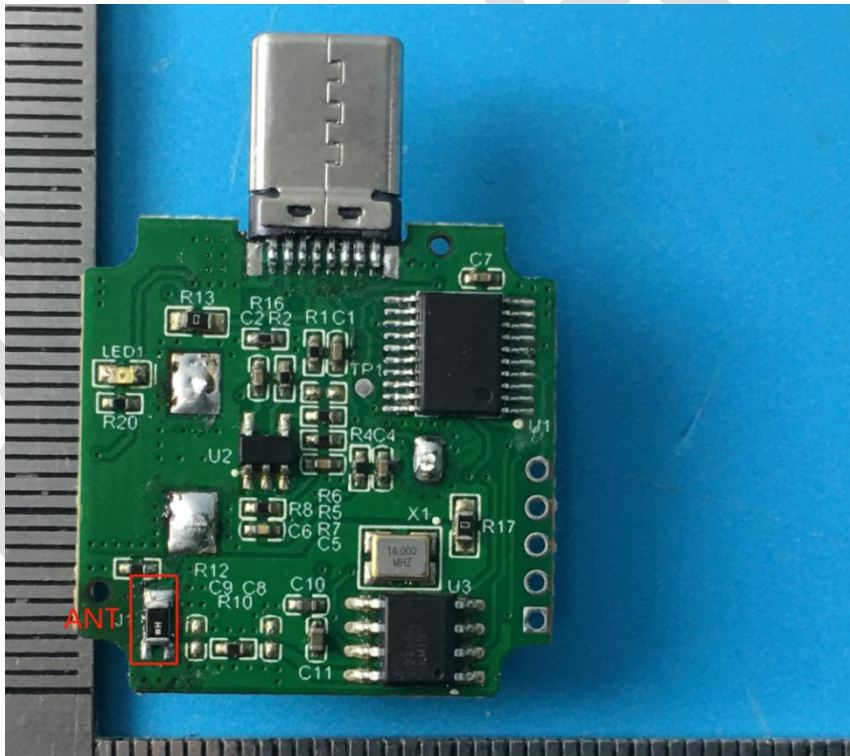
#### 13.1 Conclusion

Standard Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit permanently attached antenna or of a so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

EUT Antenna:

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 0.8dBi.



## 14 Radiated emissions which fall in the restricted bands

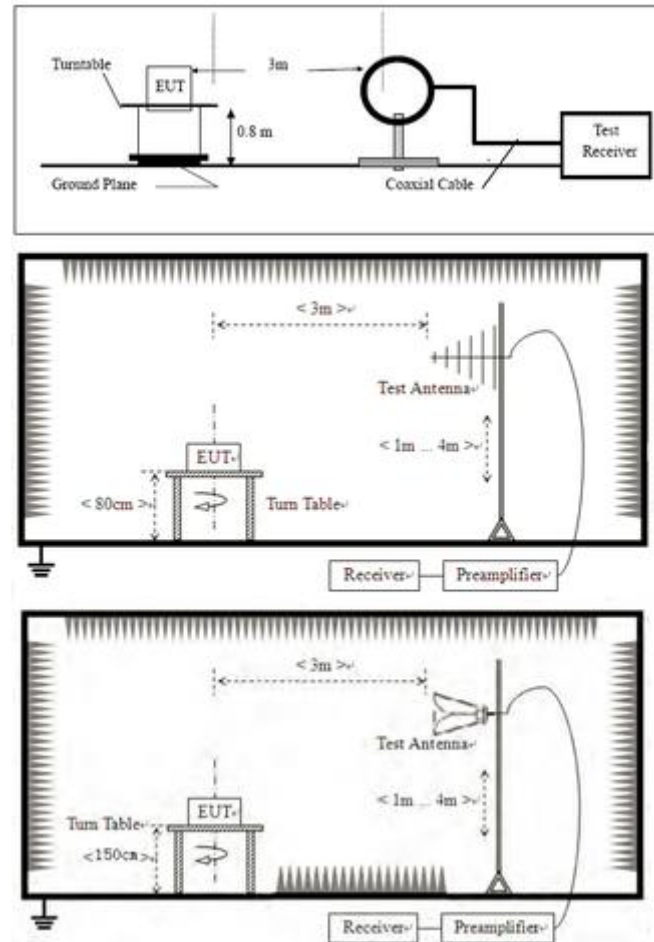
|                               |                                   |
|-------------------------------|-----------------------------------|
| <b>Test Standard</b>          | 47 CFR Part 15, Subpart C 15.247  |
| <b>Test Method</b>            | ANSI C63.10 (2013) Section 6.10.5 |
| <b>Test Mode (Pre-Scan)</b>   | TX                                |
| <b>Test Mode (Final Test)</b> | TX                                |
| <b>Tester</b>                 | Charlie                           |
| <b>Temperature</b>            | 25℃                               |
| <b>Humidity</b>               | 60%                               |

### 14.1 Limits

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

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

## 14.2 Test setup



## 14.3 PROCEDURE

- For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

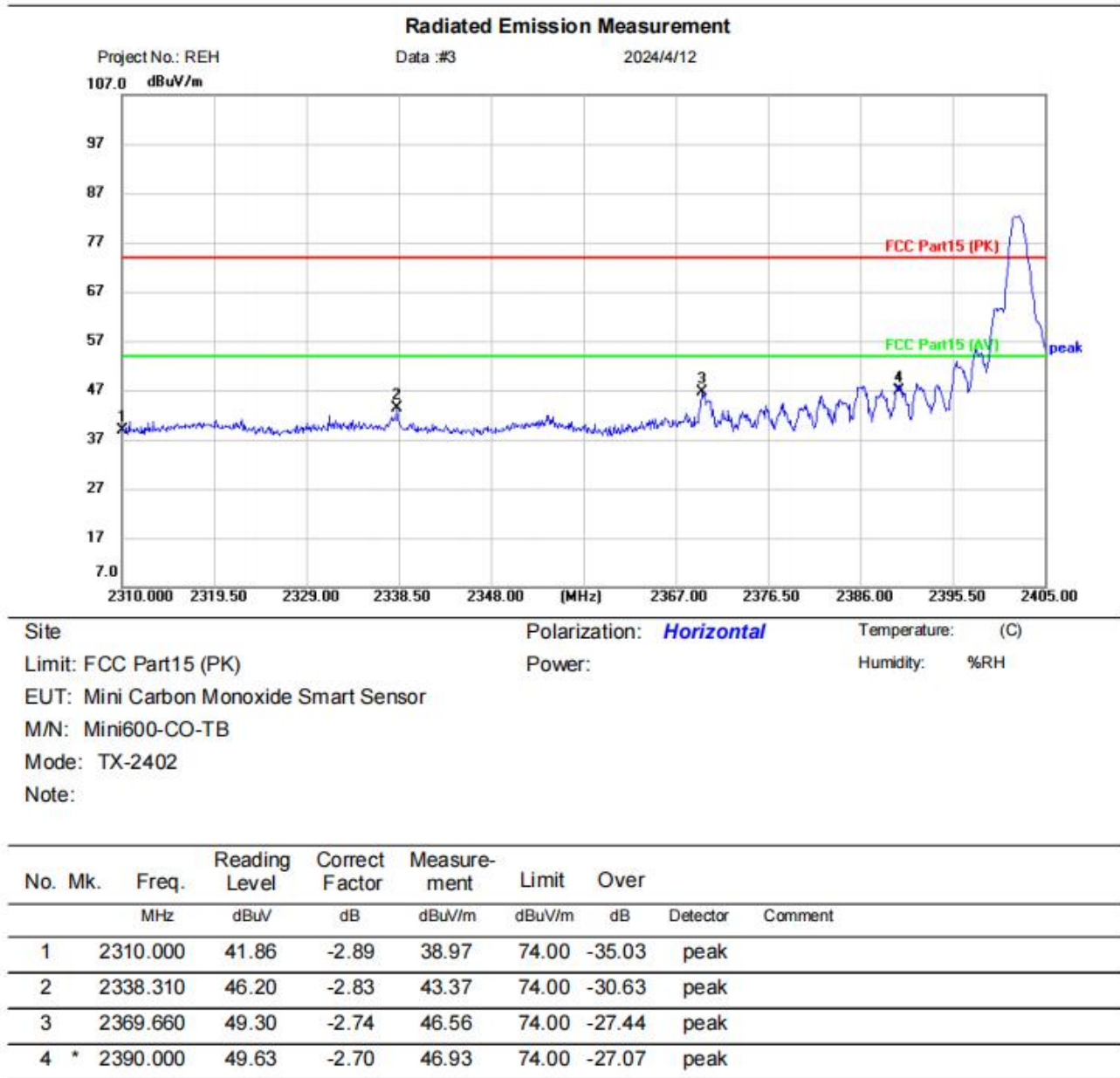
- h. Test the EUT in the lowest channel, the middle channel, the highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark 1:  $\text{Level} = \text{Read Level} + \text{Cable Loss} + \text{Antenna Factor} - \text{Preamp Factor}$

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

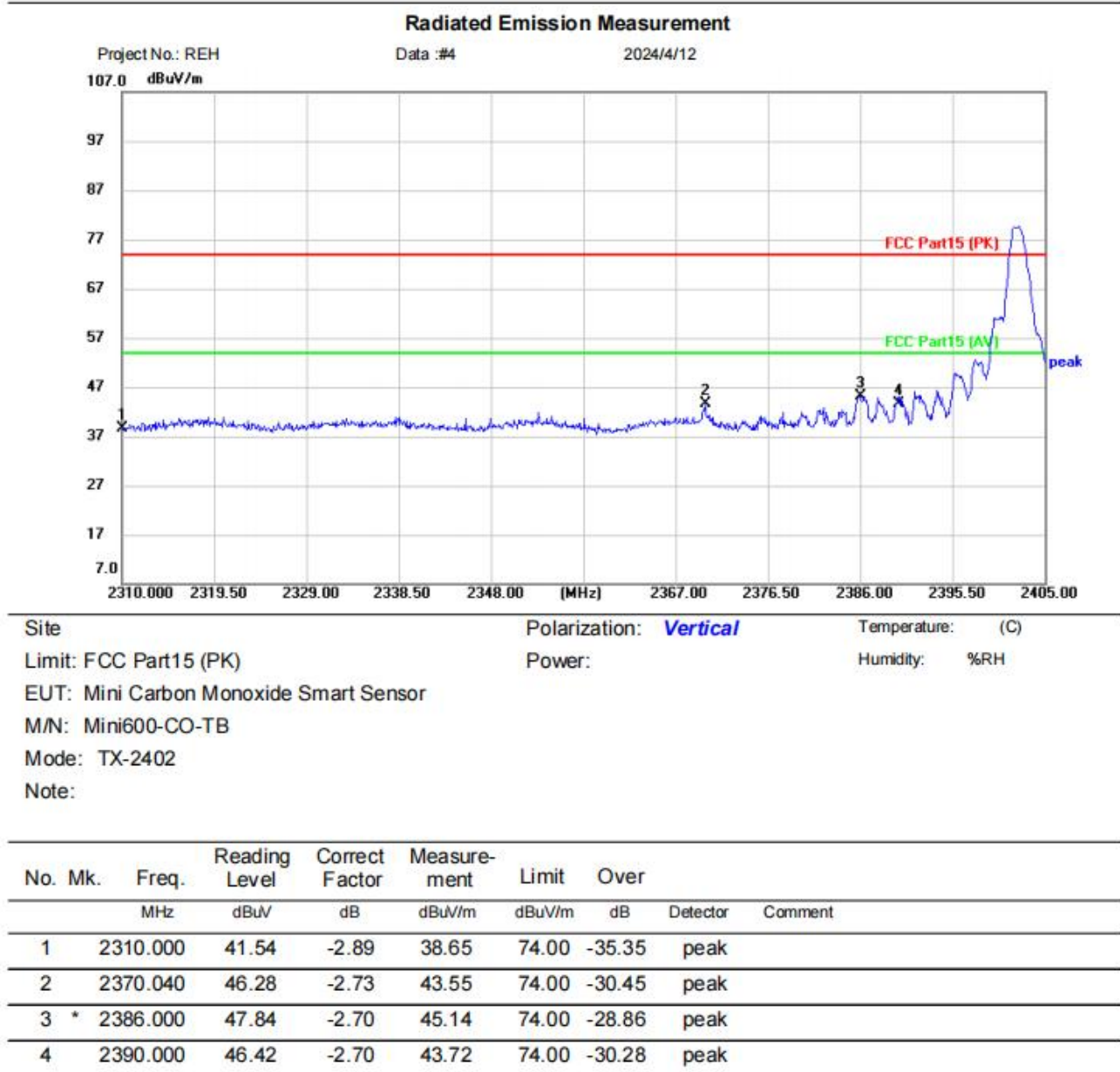
#### 14.4 Test data

[TestMode: TX low channel]; [Polarity: Horizontal]



**Test Result: Pass**

[TestMode:TX low channel]; [Polarity: Vertical]



**Test Result: Pass**

[TestMode: TX High channel]; [Polarity: Horizontal]

### Radiated Emission Measurement

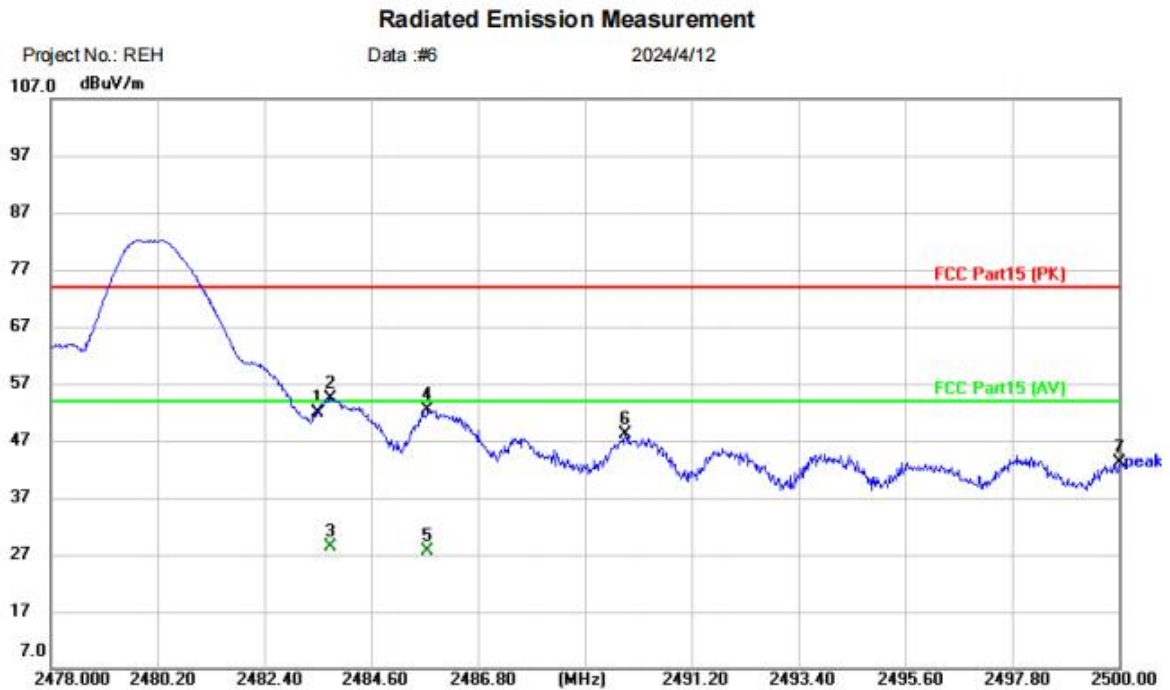


Site Polarization: **Horizontal** Temperature: (C)  
Limit: FCC Part15 (PK) Power: Humidity: %RH  
EUT: Mini Carbon Monoxide Smart Sensor  
M/N: Mini600-CO-TB  
Mode: TX-2480  
Note:

| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector | Comment |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|---------|
| 1   |     | 2483.500     | 54.98                    | -2.91                   | 52.07                      | 74.00           | -21.93     | peak     |         |
| 2   | *   | 2483.764     | 57.47                    | -2.91                   | 54.56                      | 74.00           | -19.44     | peak     |         |
| 3   |     | 2483.764     | 31.77                    | -2.91                   | 28.86                      | 54.00           | -25.14     | AVG      |         |
| 4   |     | 2485.964     | 55.15                    | -2.92                   | 52.23                      | 74.00           | -21.77     | peak     |         |
| 5   |     | 2485.964     | 30.75                    | -2.92                   | 27.83                      | 54.00           | -26.17     | AVG      |         |
| 6   |     | 2490.188     | 51.65                    | -2.95                   | 48.70                      | 74.00           | -25.30     | peak     |         |
| 7   |     | 2500.000     | 46.78                    | -3.00                   | 43.78                      | 74.00           | -30.22     | peak     |         |

**Test Result: Pass**

[TestMode:TX High channel]; [Polarity: Vertical]



Site      Polarization: **Vertical**      Temperature: (C)  
Limit: FCC Part15 (PK)      Power:      Humidity: %RH  
EUT: Mini Carbon Monoxide Smart Sensor  
M/N: Mini600-CO-TB  
Mode: TX-2480  
Note:

| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector | Comment |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|---------|
| 1   |     | 2483.500     | 54.89                    | -2.91                   | 51.98                      | 74.00           | -22.02     | peak     |         |
| 2   | *   | 2483.764     | 57.37                    | -2.91                   | 54.46                      | 74.00           | -19.54     | peak     |         |
| 3   |     | 2483.764     | 31.33                    | -2.91                   | 28.42                      | 54.00           | -25.58     | AVG      |         |
| 4   |     | 2485.766     | 55.39                    | -2.92                   | 52.47                      | 74.00           | -21.53     | peak     |         |
| 5   |     | 2485.766     | 30.66                    | -2.92                   | 27.74                      | 54.00           | -26.26     | AVG      |         |
| 6   |     | 2489.836     | 51.03                    | -2.95                   | 48.08                      | 74.00           | -25.92     | peak     |         |
| 7   |     | 2500.000     | 46.18                    | -3.00                   | 43.18                      | 74.00           | -30.82     | peak     |         |

**Test Result: Pass**

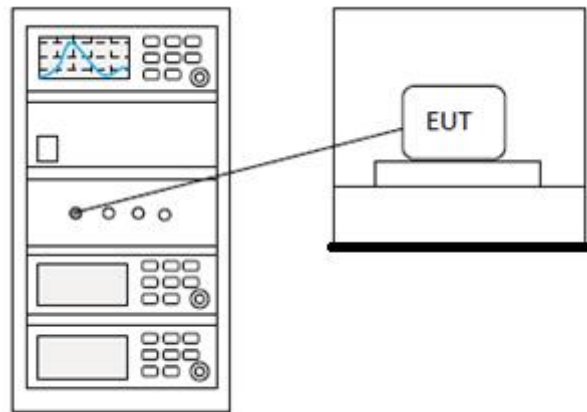
## 15 Conducted spurious emissions

|                               |                                                  |
|-------------------------------|--------------------------------------------------|
| <b>Test Standard</b>          | 47 CFR Part 15, Subpart C 15.247                 |
| <b>Test Method</b>            | ANSI C63.10 (2013) Section 7.8.6 & Section 11.11 |
| <b>Test Mode (Pre-Scan)</b>   | TX                                               |
| <b>Test Mode (Final Test)</b> | TX                                               |
| <b>Tester</b>                 | Charlie                                          |
| <b>Temperature</b>            | 25°C                                             |
| <b>Humidity</b>               | 60%                                              |

### 15.1 Limits

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Limit:</b> | <p>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 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).</p> |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 15.2 Test setup



## 15.3 Test data

**Pass: Please Refer To Appendix: Appendix1 For Details**

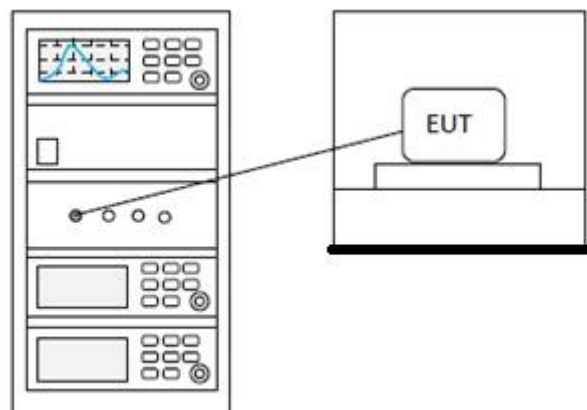
## 16 Power spectrum density

|                        |                                    |
|------------------------|------------------------------------|
| Test Standard          | 47 CFR Part 15, Subpart C 15.247   |
| Test Method            | ANSI C63.10 (2013) Section 11.10.2 |
| Test Mode (Pre-Scan)   | TX                                 |
| Test Mode (Final Test) | TX                                 |
| Tester                 | Charlie                            |
| Temperature            | 25°C                               |
| Humidity               | 60%                                |

### 16.1 Limits

|               |                                                                             |
|---------------|-----------------------------------------------------------------------------|
| <b>Limit:</b> | ≤8dBm in any 3 kHz band during any time interval of continuous transmission |
|---------------|-----------------------------------------------------------------------------|

### 16.2 Test setup



### 16.3 Test data

**Pass: Please Refer To Appendix: Appendix1 For Details**

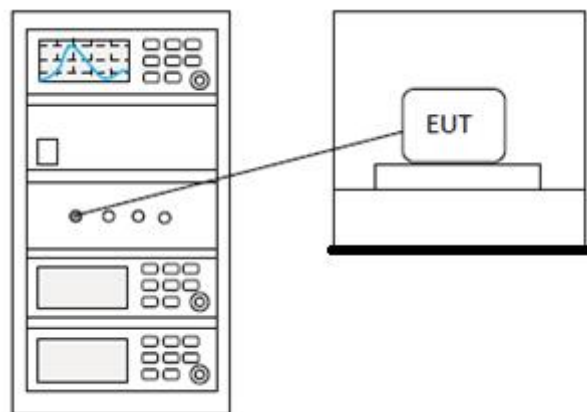
## 17 Conducted peak output power

|                        |                                  |
|------------------------|----------------------------------|
| Test Standard          | 47 CFR Part 15, Subpart C 15.247 |
| Test Method            | ANSI C63.10 (2013) Section 7.8.5 |
| Test Mode (Pre-Scan)   | TX                               |
| Test Mode (Final Test) | TX                               |
| Tester                 | Charlie                          |
| Temperature            | 25°C                             |
| Humidity               | 60%                              |

### 17.1 Limits

| Frequency range(MHz) | Output power of the intentional radiator(watt)         |
|----------------------|--------------------------------------------------------|
| 902-928              | 1 for $\geq 50$ hopping channels                       |
|                      | 0.25 for $25 \leq$ hopping channels $< 50$             |
|                      | 1 for digital modulation                               |
| 2400-2483.5          | 1 for $\geq 75$ non-overlapping hopping channels       |
|                      | 0.125 for all other frequency hopping systems          |
|                      | 1 for digital modulation                               |
| 5725-5850            | 1 for frequency hopping systems and digital modulation |

### 17.2 Test setup



### 17.3 Test data

**Pass: Please Refer To Appendix: Appendix1 For Details**

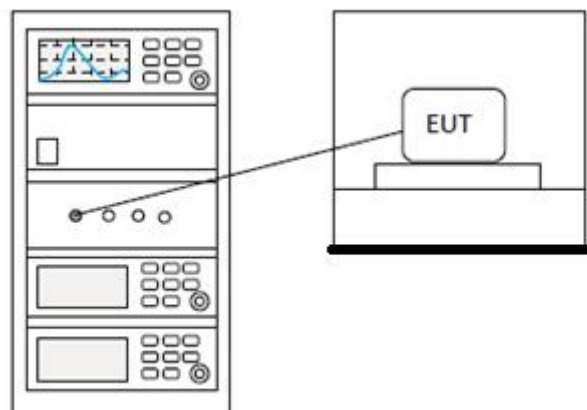
## 18 Minimum 6dB bandwidth

|                        |                                   |
|------------------------|-----------------------------------|
| Test Standard          | 47 CFR Part 15, Subpart C 15.247  |
| Test Method            | ANSI C63.10 (2013) Section 11.8.1 |
| Test Mode (Pre-Scan)   | TX                                |
| Test Mode (Final Test) | TX                                |
| Tester                 | Charlie                           |
| Temperature            | 25°C                              |
| Humidity               | 60%                               |

### 18.1 Limits

|        |          |
|--------|----------|
| Limit: | ≥500 kHz |
|--------|----------|

### 18.2 Test setup



### 18.3 Test data

**Pass: Please Refer To Appendix: Appendix1 For Details**

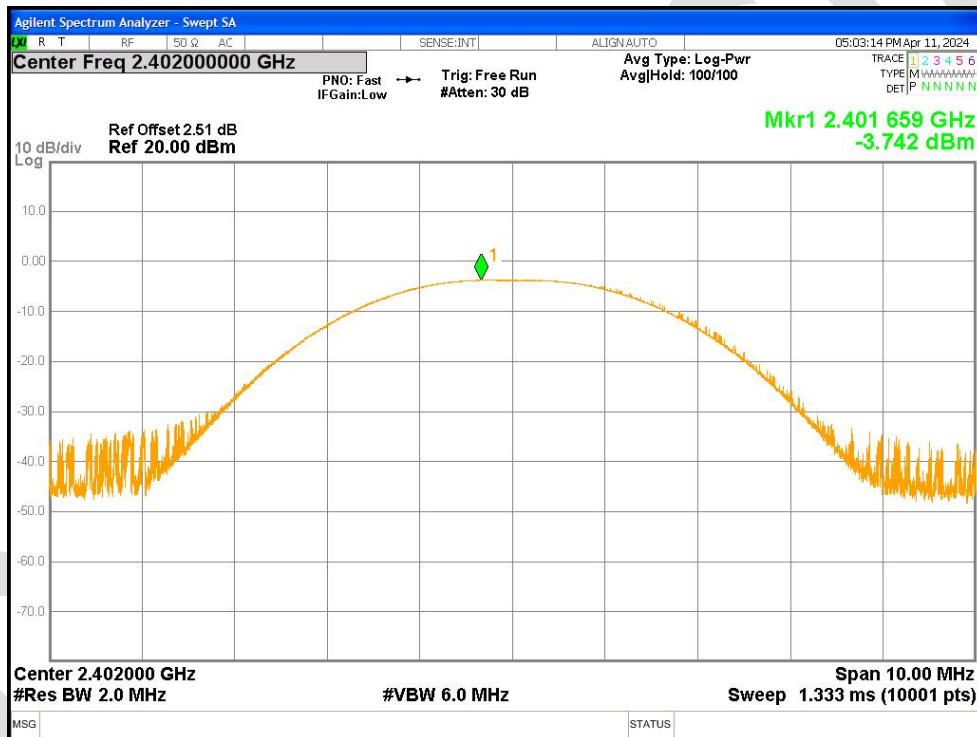
## 19 Appendix

### Appendix1

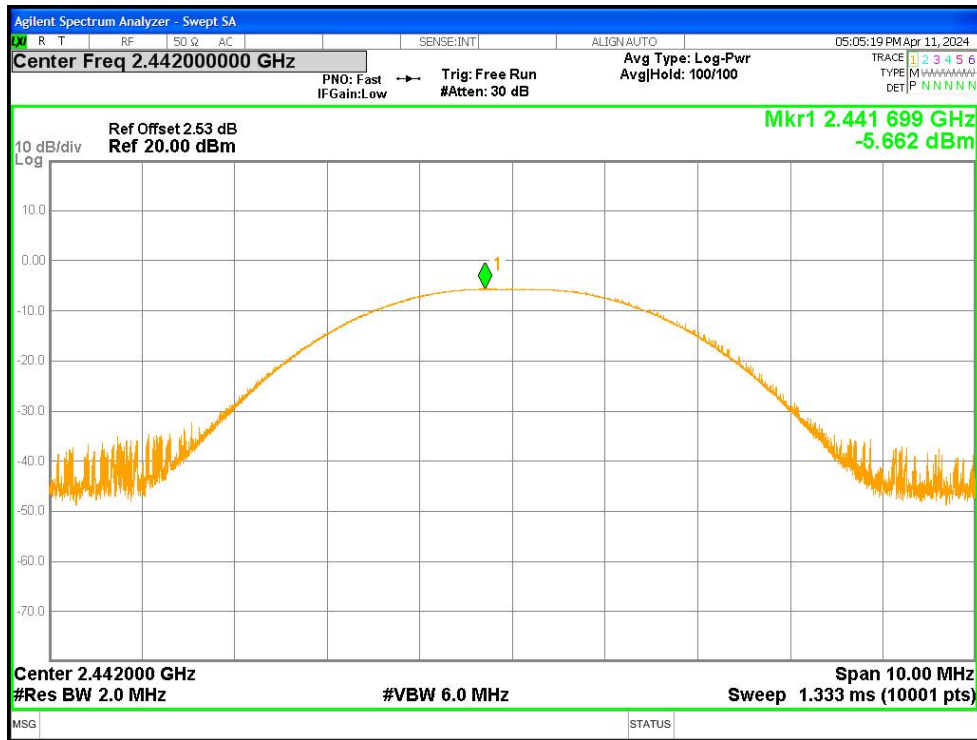
#### 19.1 Maximum Conducted Output Power

| Condition | Mode   | Frequency<br>(MHz) | Antenna | Conducted Power (dBm) | Limit (dBm) | Verdict |
|-----------|--------|--------------------|---------|-----------------------|-------------|---------|
| NVNT      | BLE 1M | 2402               | Ant1    | -3.742                | 30          | Pass    |
| NVNT      | BLE 1M | 2442               | Ant1    | -5.662                | 30          | Pass    |
| NVNT      | BLE 1M | 2480               | Ant1    | -5.902                | 30          | Pass    |

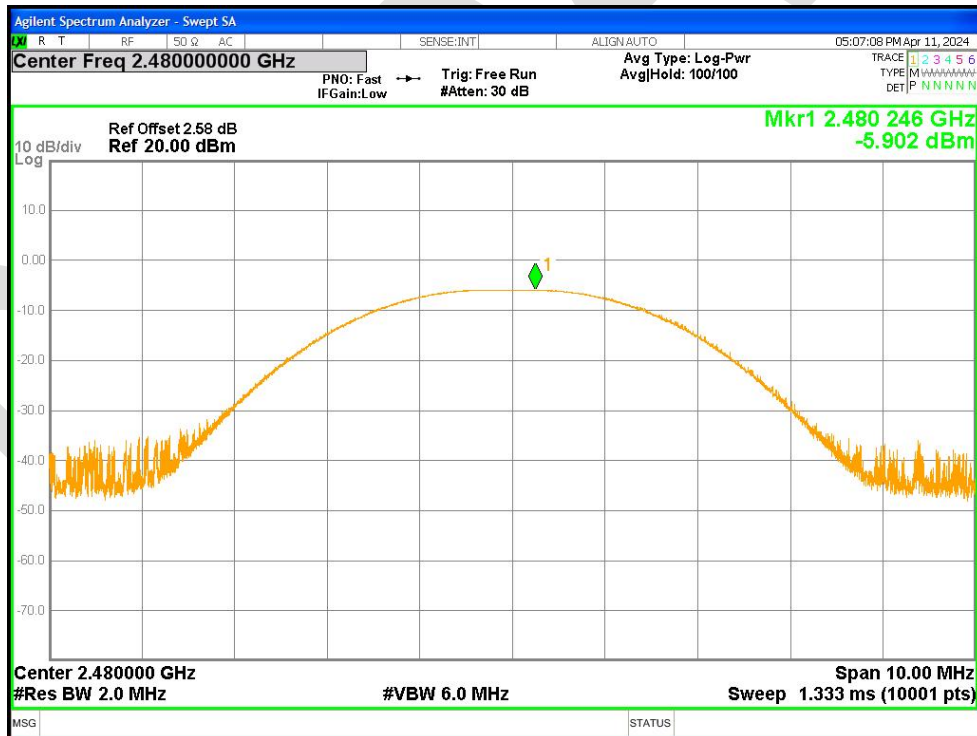
Power NVNT BLE 1M 2402MHz Ant1



Power NVNT BLE 1M 2442MHz Ant1



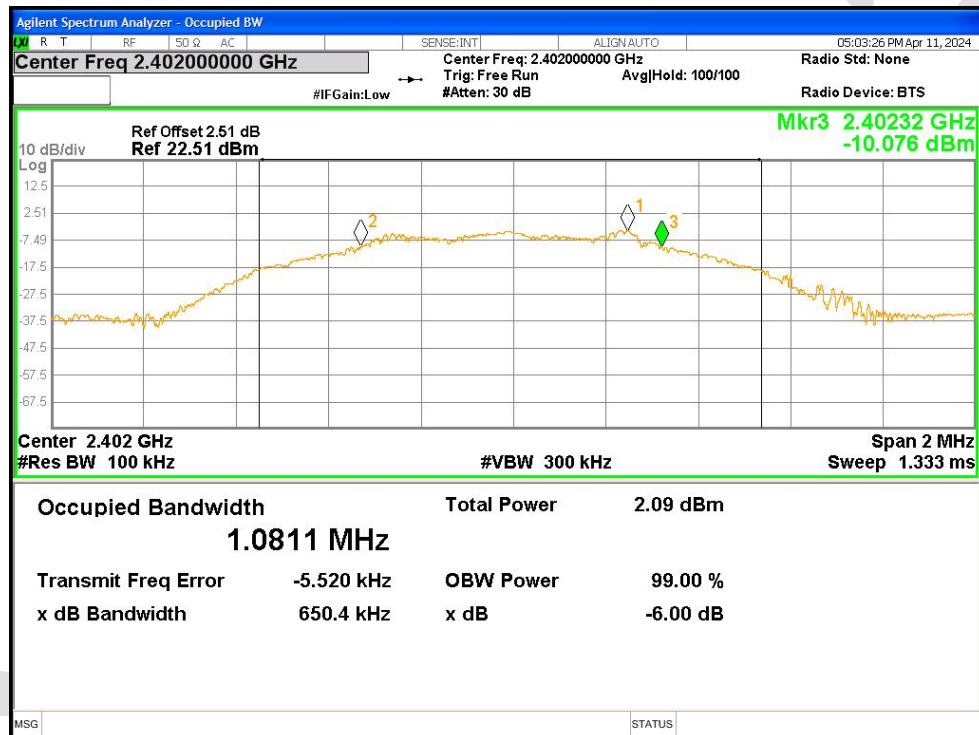
Power NVNT BLE 1M 2480MHz Ant1



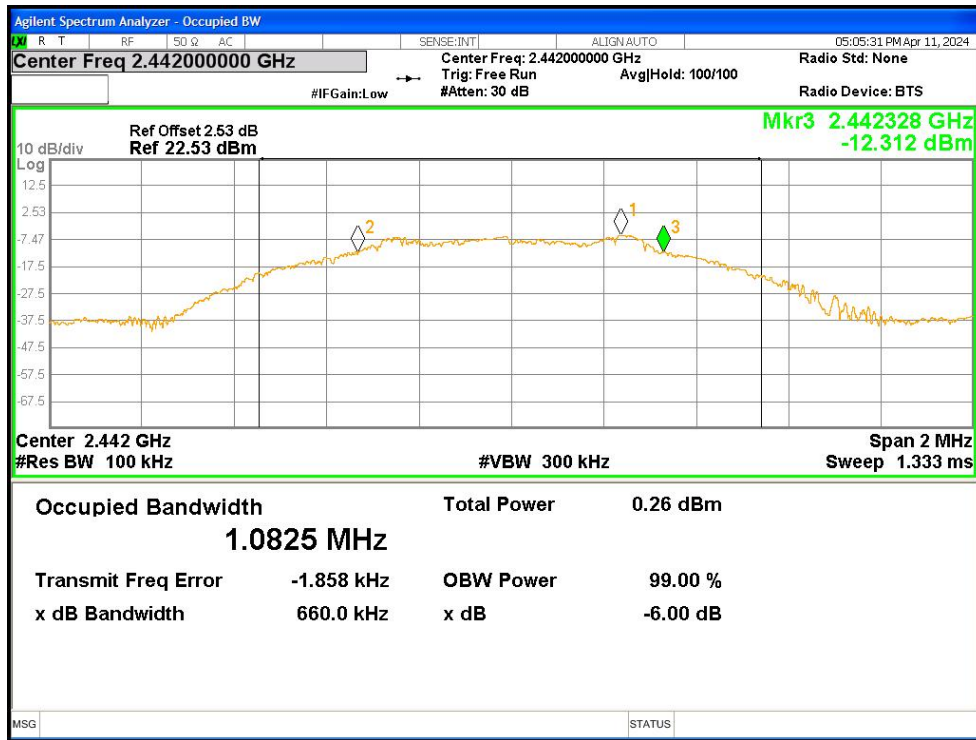
## 19.2 -6dB Bandwidth

| Condition | Mode   | Frequency (MHz) | Antenna | -6 dB Bandwidth (MHz) | Limit -6 dB Bandwidth (MHz) | Verdict |
|-----------|--------|-----------------|---------|-----------------------|-----------------------------|---------|
| NVNT      | BLE 1M | 2402            | Ant1    | 0.65                  | 0.5                         | Pass    |
| NVNT      | BLE 1M | 2442            | Ant1    | 0.66                  | 0.5                         | Pass    |
| NVNT      | BLE 1M | 2480            | Ant1    | 0.687                 | 0.5                         | Pass    |

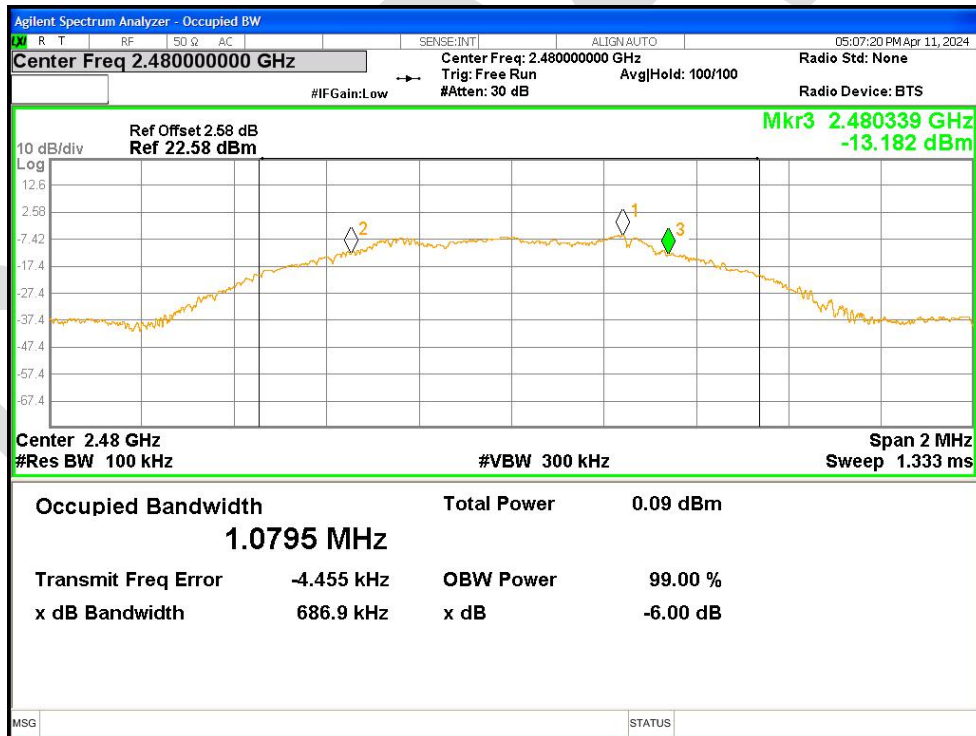
-6dB Bandwidth NVNT BLE 1M 2402MHz Ant1



-6dB Bandwidth NVNT BLE 1M 2442MHz Ant1



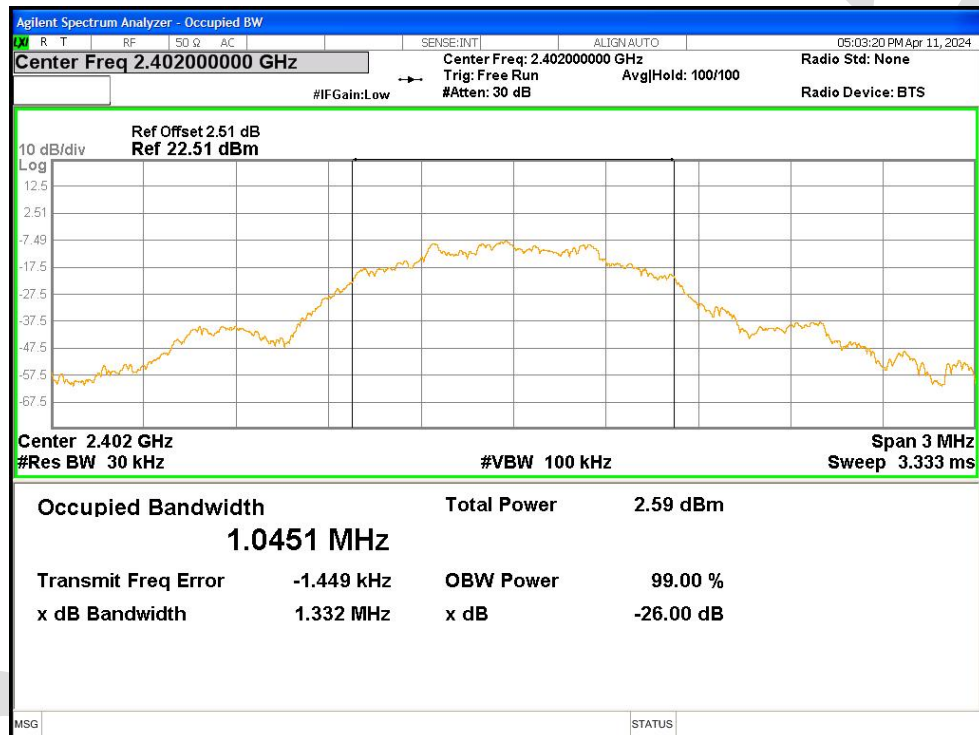
-6dB Bandwidth NVNT BLE 1M 2480MHz Ant1



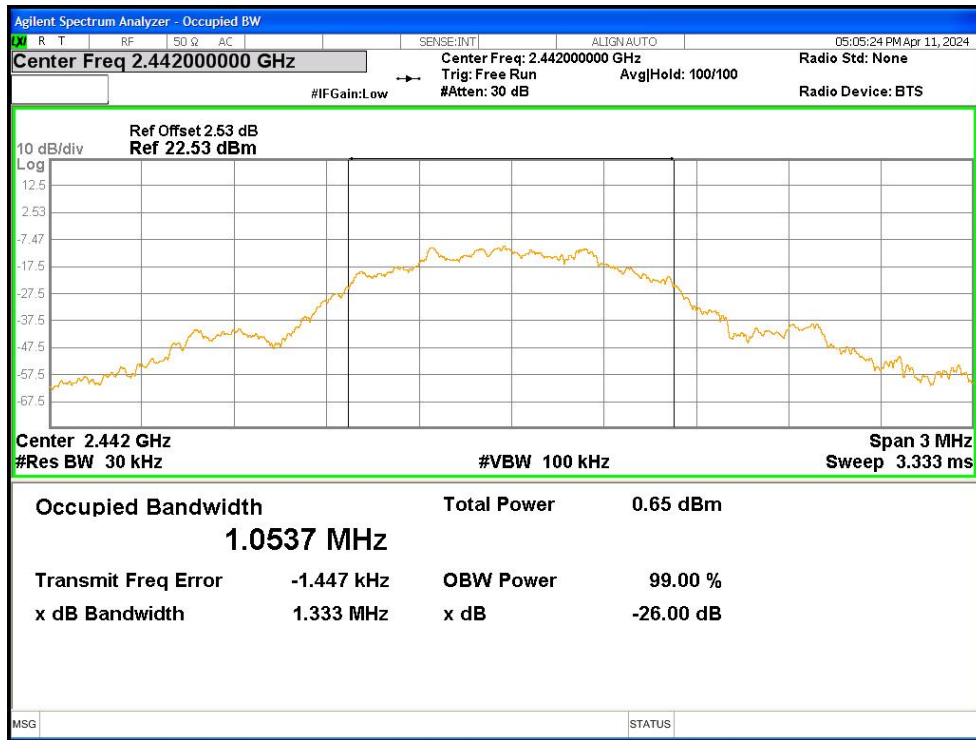
### 19.3 Occupied Channel Bandwidth

| Condition | Mode   | Frequency (MHz) | Antenna | 99% OBW (MHz) |
|-----------|--------|-----------------|---------|---------------|
| NVNT      | BLE 1M | 2402            | Ant1    | 1.0451        |
| NVNT      | BLE 1M | 2442            | Ant1    | 1.0537        |
| NVNT      | BLE 1M | 2480            | Ant1    | 1.0536        |

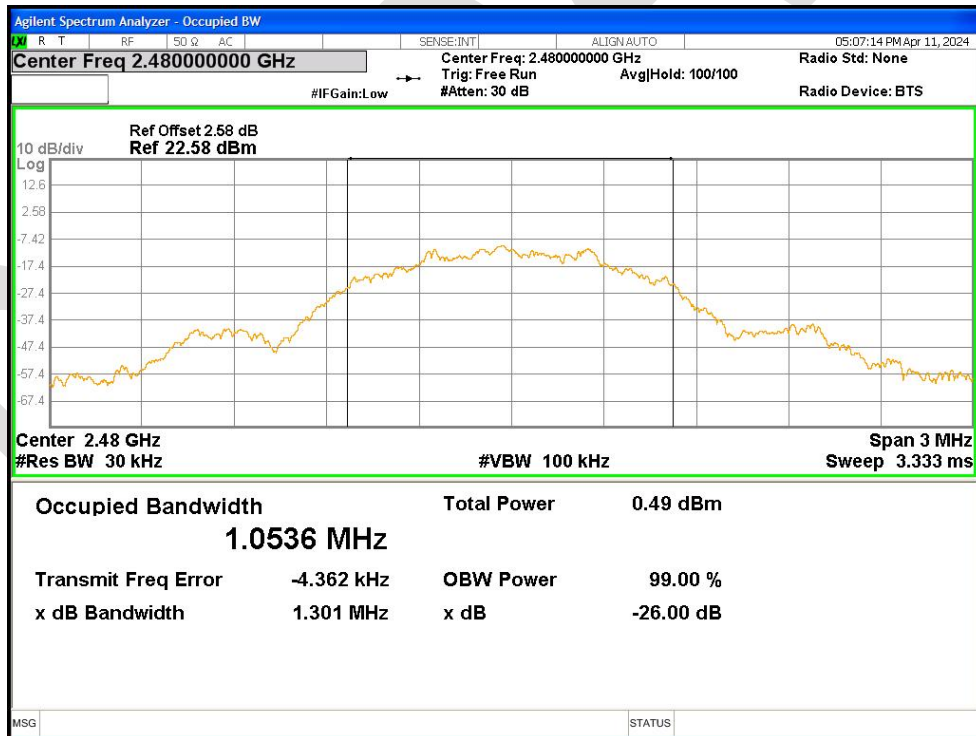
OBW NVNT BLE 1M 2402MHz Ant1



OBW NVNT BLE 1M 2442MHz Ant1



OBW NVNT BLE 1M 2480MHz Ant1



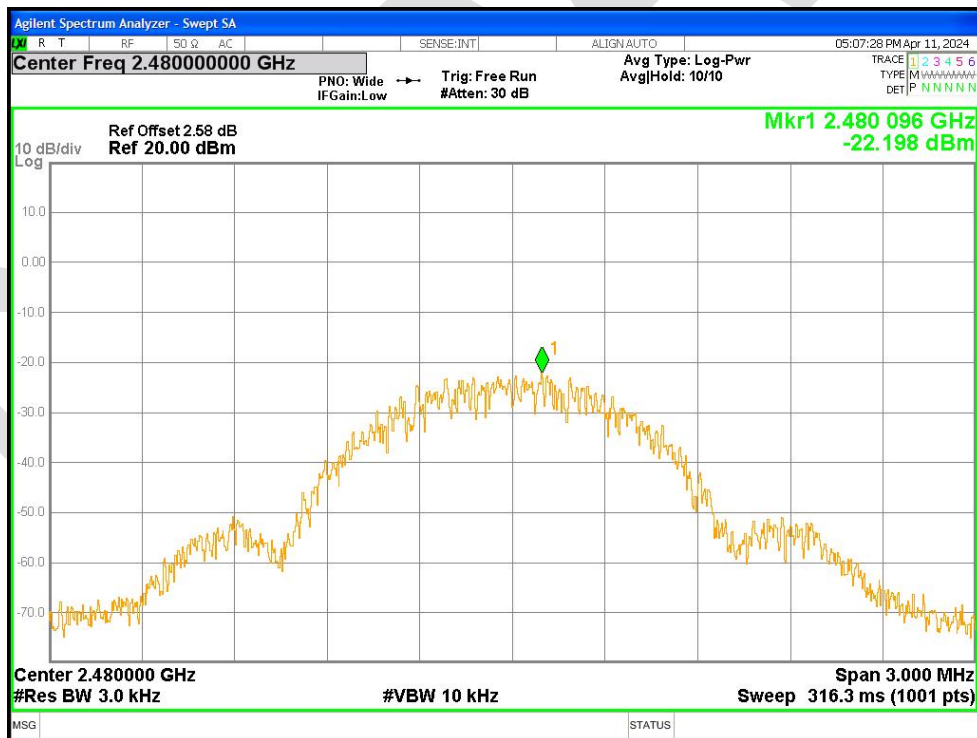
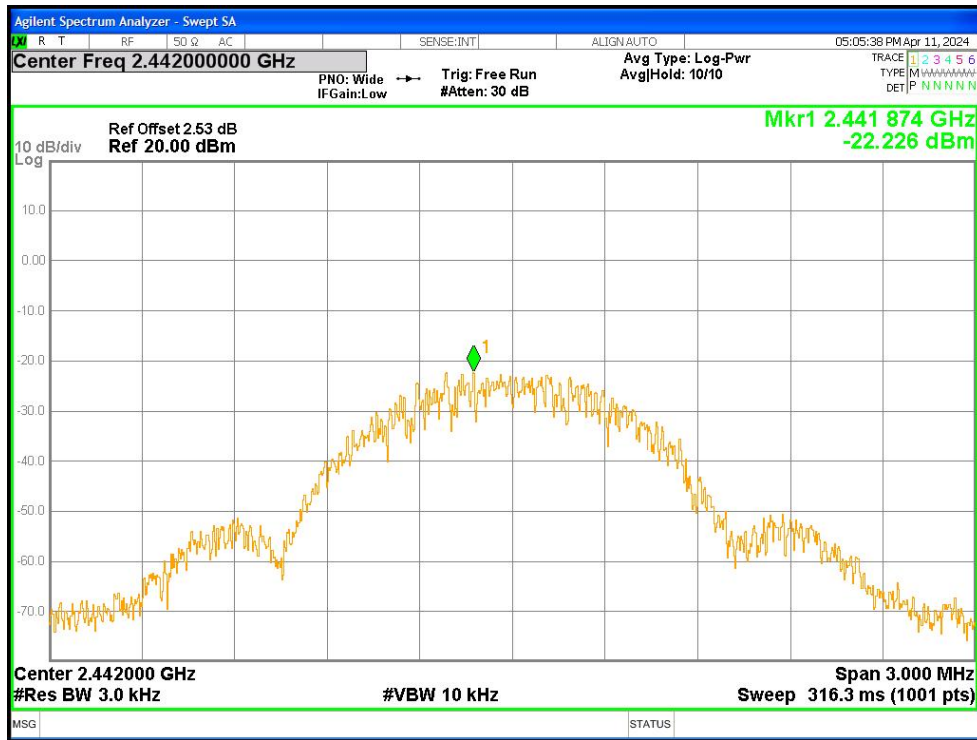
#### 19.4 Maximum Power Spectral Density Level

| Condition | Mode   | Frequency (MHz) | Antenna | Max PSD (dBm) | Limit (dBm) | Verdict |
|-----------|--------|-----------------|---------|---------------|-------------|---------|
| NVNT      | BLE 1M | 2402            | Ant1    | -20.03        | 8           | Pass    |
| NVNT      | BLE 1M | 2442            | Ant1    | -22.226       | 8           | Pass    |
| NVNT      | BLE 1M | 2480            | Ant1    | -22.198       | 8           | Pass    |

PSD NVNT BLE 1M 2402MHz Ant1



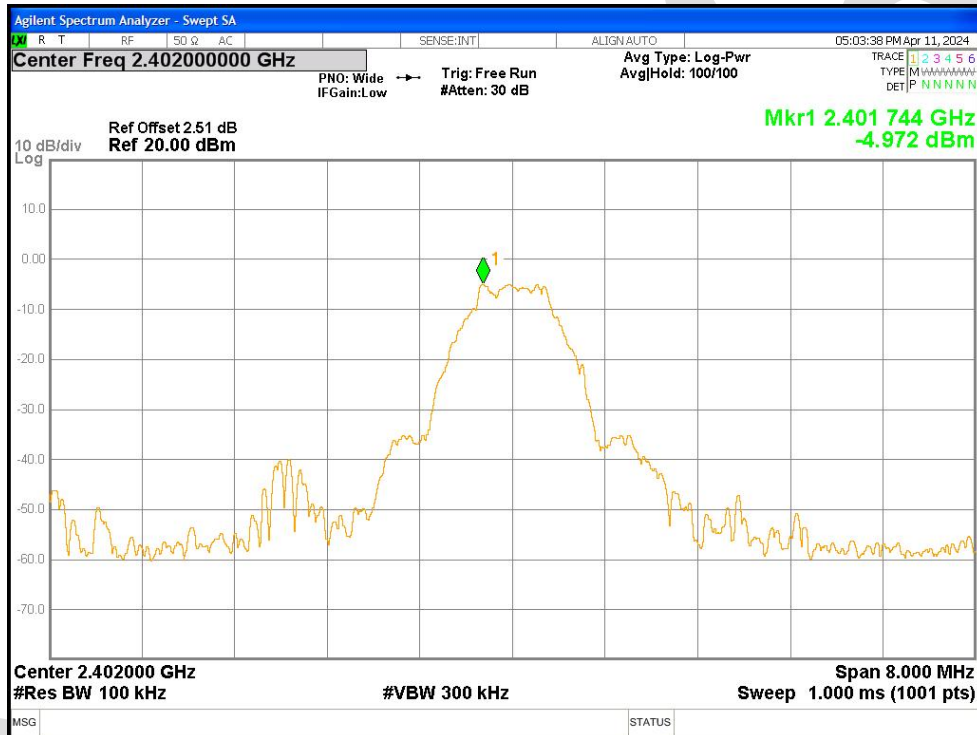
PSD NVNT BLE 1M 2442MHz Ant1



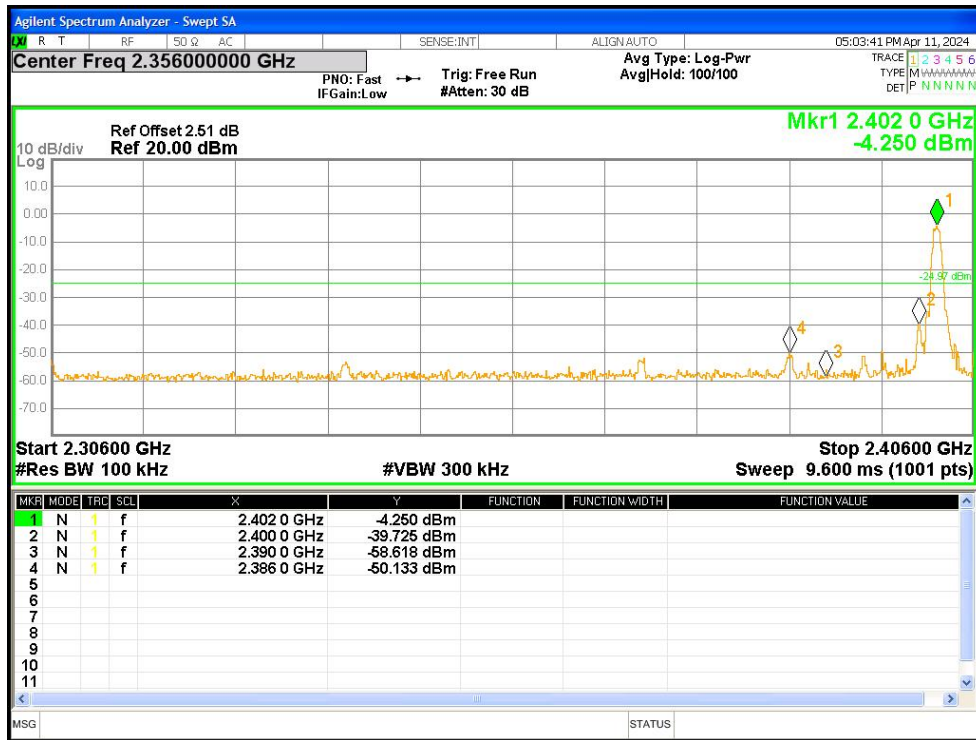
## 19.5 Band Edge

| Condition | Mode   | Frequency (MHz) | Antenna | Max Value (dBc) | Limit (dBc) | Verdict |
|-----------|--------|-----------------|---------|-----------------|-------------|---------|
| NVNT      | BLE 1M | 2402            | Ant1    | -45.16          | -20         | Pass    |
| NVNT      | BLE 1M | 2480            | Ant1    | -43.75          | -20         | Pass    |

Band Edge NVNT BLE 1M 2402MHz Ant1 Ref



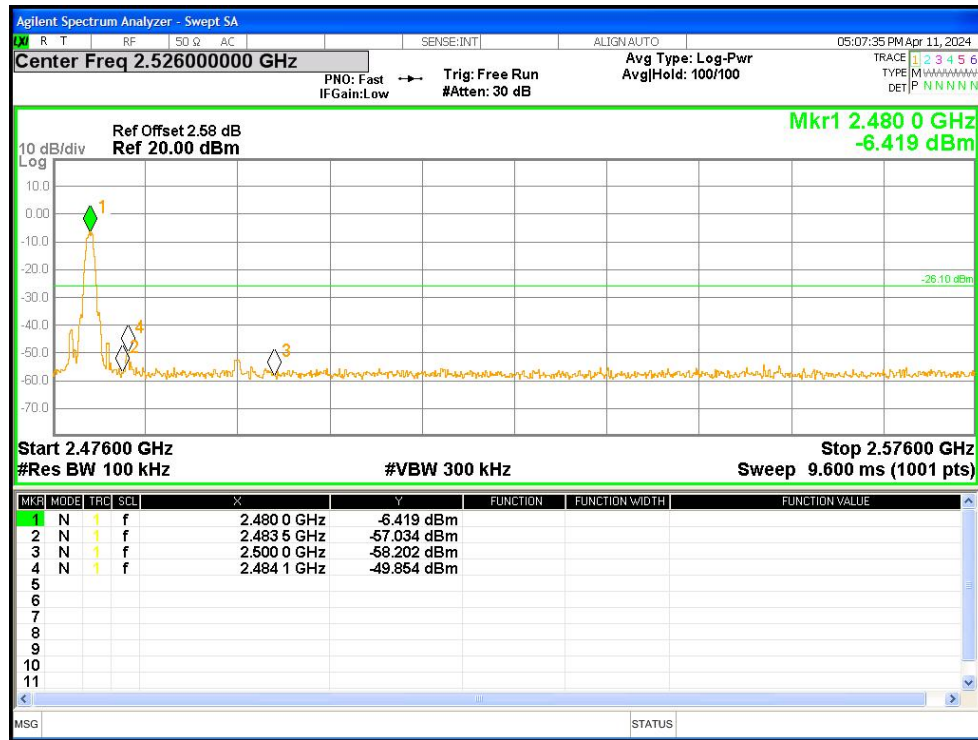
Band Edge NVNT BLE 1M 2402MHz Ant1 Emission



Band Edge NVNT BLE 1M 2480MHz Ant1 Ref



Band Edge NVNT BLE 1M 2480MHz Ant1 Emission



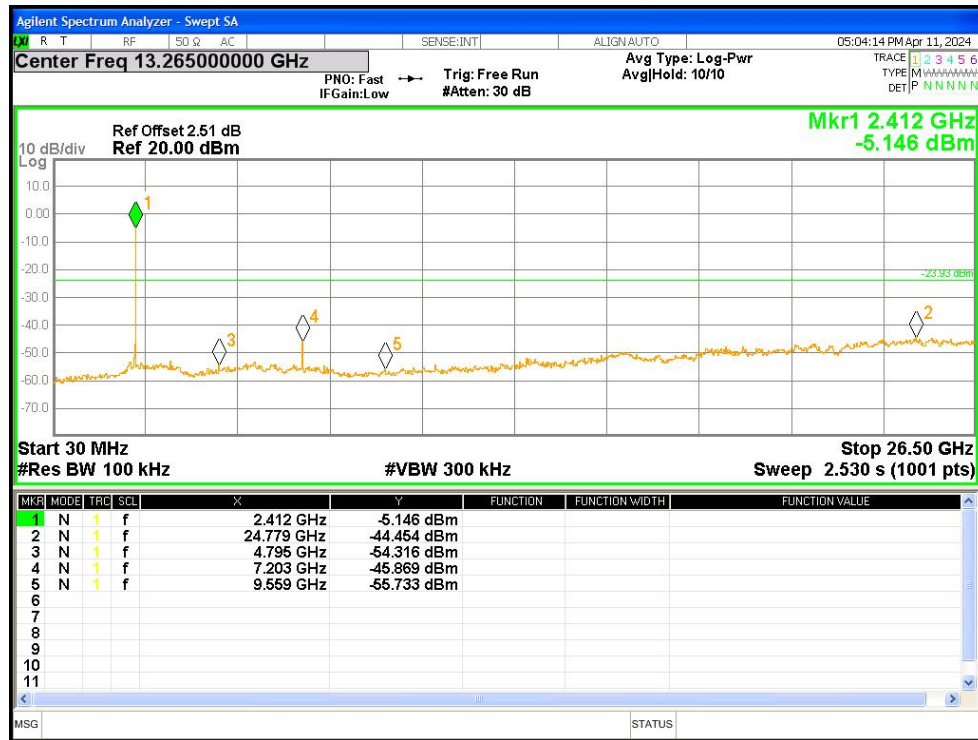
### 19.6 Conducted RF Spurious Emission

| Condition | Mode   | Frequency (MHz) | Antenna | Max Value (dBc) | Limit (dBc) | Verdict |
|-----------|--------|-----------------|---------|-----------------|-------------|---------|
| NVNT      | BLE 1M | 2402            | Ant1    | -40.52          | -20         | Pass    |
| NVNT      | BLE 1M | 2442            | Ant1    | -35.59          | -20         | Pass    |
| NVNT      | BLE 1M | 2480            | Ant1    | -38.79          | -20         | Pass    |

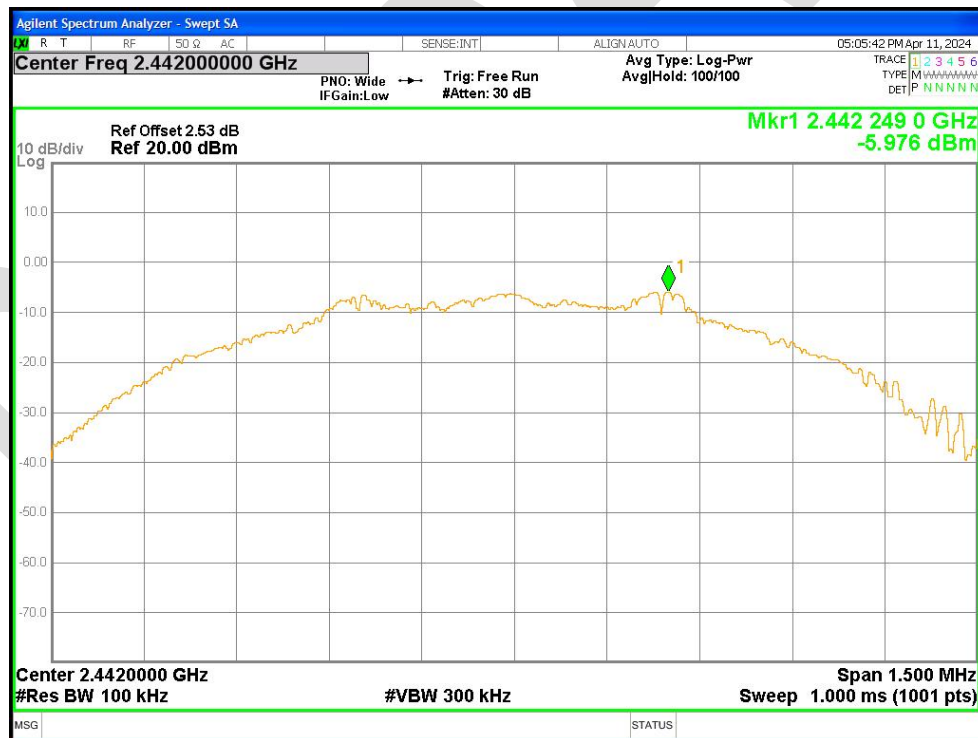
Tx. Spurious NVNT BLE 1M 2402MHz Ant1 Ref



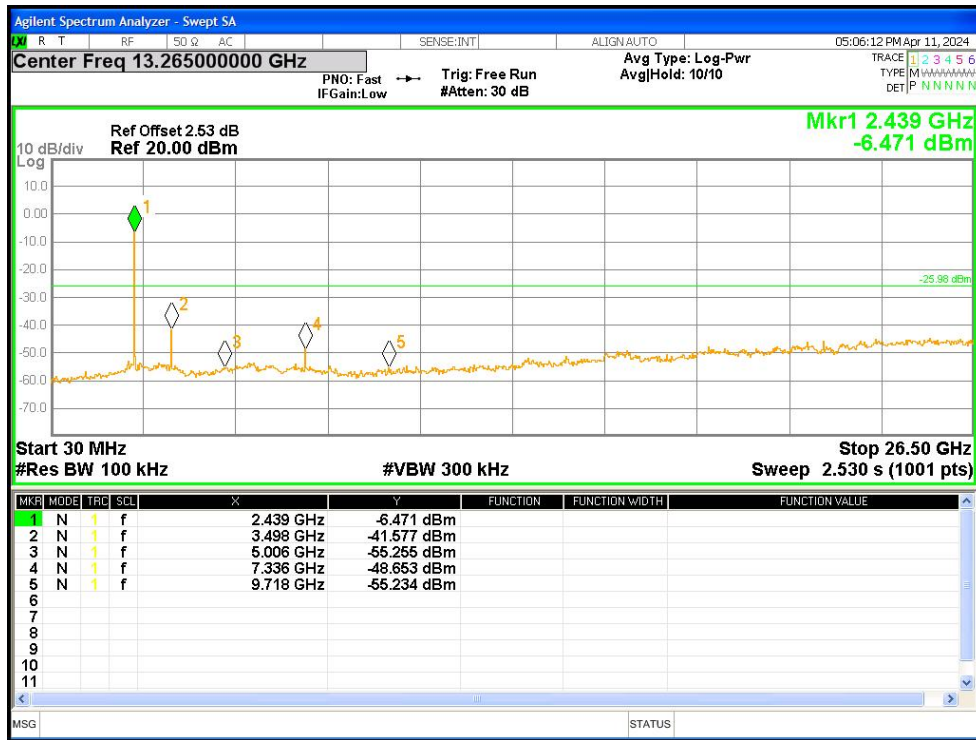
Tx. Spurious NVNT BLE 1M 2402MHz Ant1 Emission



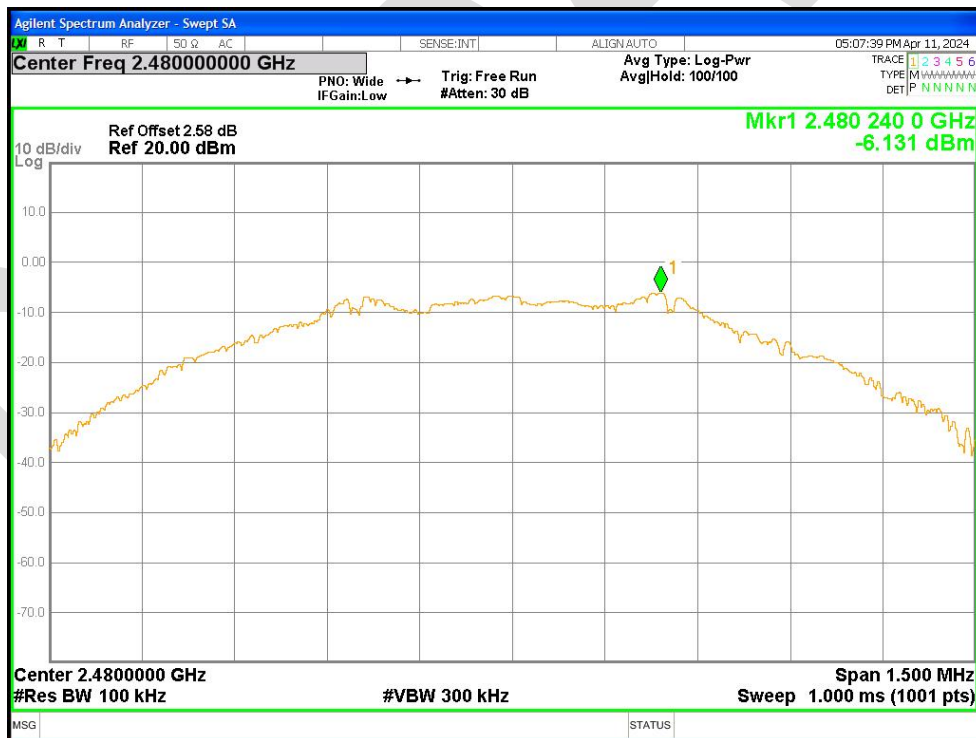
Tx. Spurious NVNT BLE 1M 2442MHz Ant1 Ref



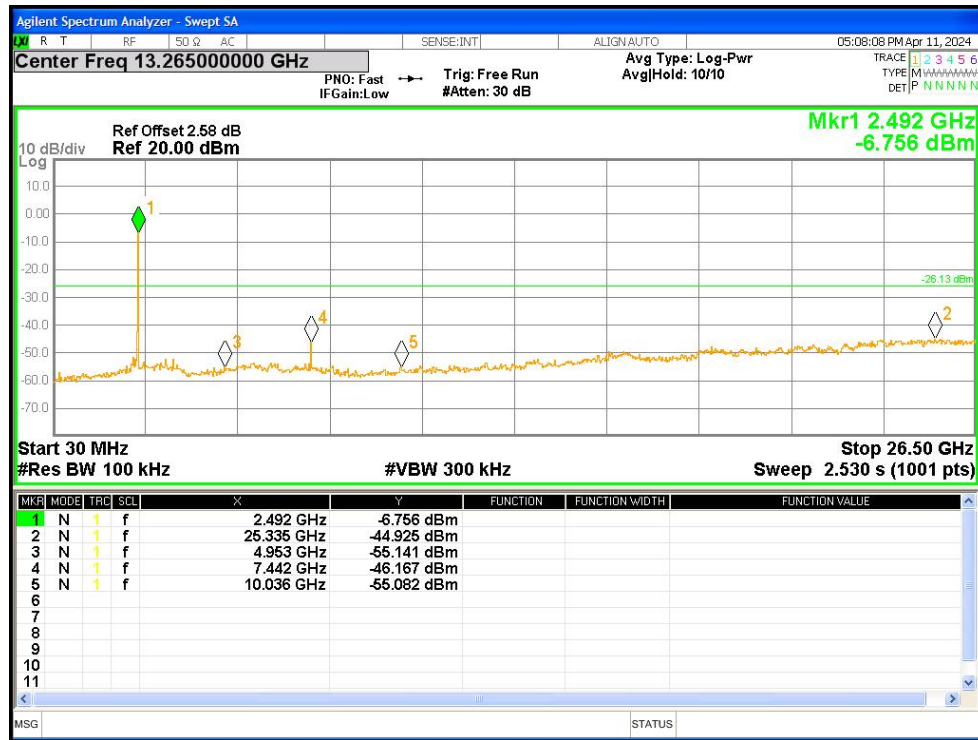
Tx. Spurious NVNT BLE 1M 2442MHz Ant1 Emission



Tx. Spurious NVNT BLE 1M 2480MHz Ant1 Ref



Tx. Spurious NVNT BLE 1M 2480MHz Ant1 Emission



## APPENDIX A: PHOTOGRAPHS OF TEST SETUP

**Radiated Spurious Emissions**



**APPENDIX B: PHOTOGRAPHS OF EUT**

Reference to the test report No. BLA-EMC-202404-A1701

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

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