

# TEST REPORT

Report No.: BCTC2605417490E

Applicant: Kontakt Micro-Location Sp. z o.o.

Product Name: Dispensor Beacon ES10

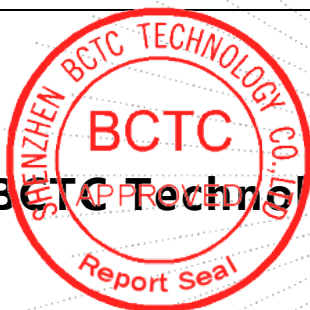
Test Model: KHWSN301F001

Tested Date: 2026-07-22 to 2026-07-31

Issued Date: 2026-08-19



Shenzhen BCTC Technology Co., Ltd.



**FCC ID:2ADAO-KHWSN301F001**

Product Name: Dispensor Beacon ES10

Trademark: Kontakt.io

Model/Type Ref.: KHWSN301F001

Prepared For: Kontakt Micro-Location Sp. z o.o.

Address: ul.Stoczniewcow 3, 30-709 Krakow, Poland

Manufacturer: Kontakt Micro-Location Sp. z o.o.

Address: ul.Stoczniewcow 3, 30-709 Krakow, Poland

Prepared By: Shenzhen BCTC Technology Co., Ltd.

Address: Room 101M, Unit 1, Building1, Pengyuan, No.18, Lilang Road, Shanglilang, Nanwan Subdistrict, Longgang District, Shenzhen, Guangdong, China.

Sample Received Date: 2026-07-22

Sample tested Date: 2026-07-22 to 2026-07-31

Report No.: BCTC2605417490E

Test Standards: FCC 47 CFR Part 15 Subpart C (clause 15.247)  
ANSI C63.10-2020

Test Results: PASS

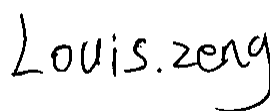
Remark: This is Bluetooth BLE radio test report.

Prepared by :



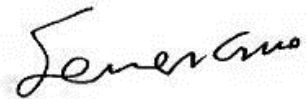
Mike Zheng

Reviewer by :



Louis Zeng

Approved by:



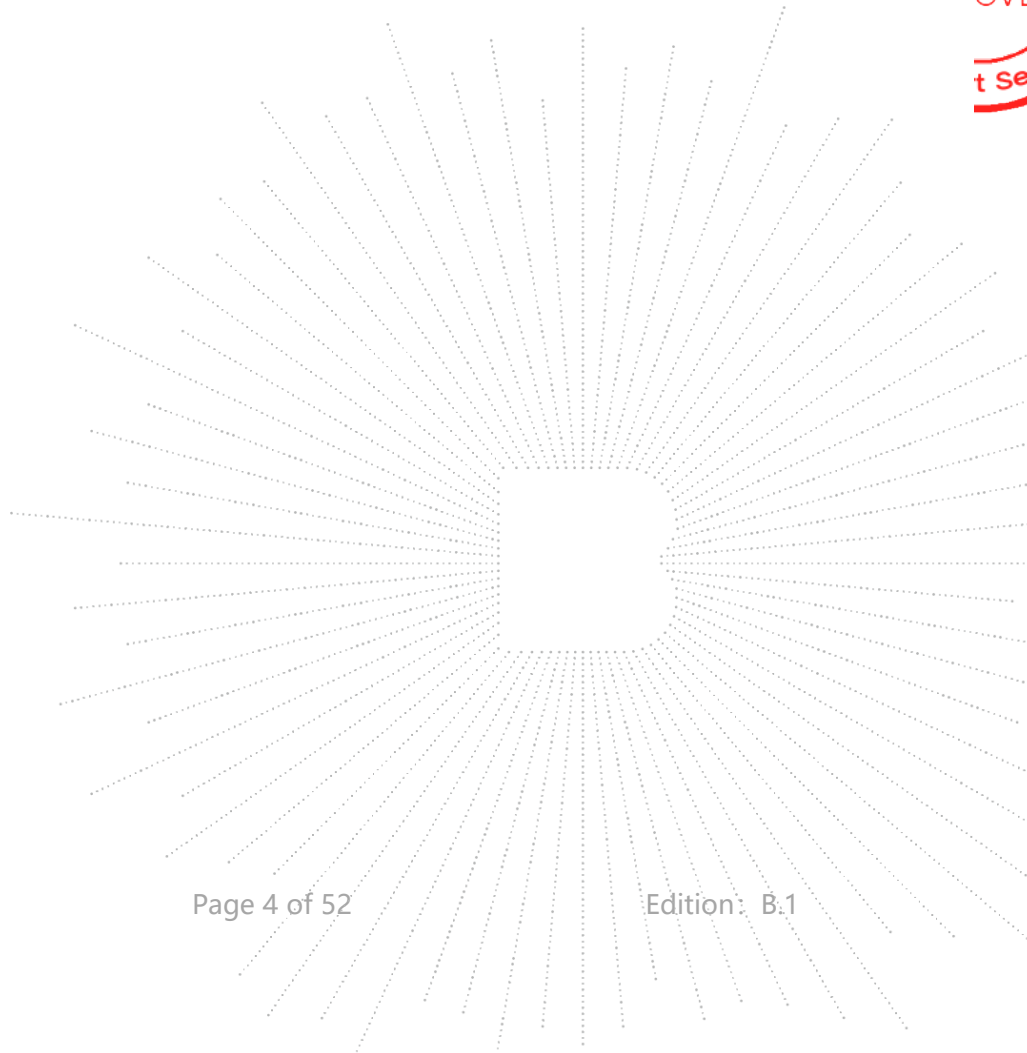
Sewen Guo

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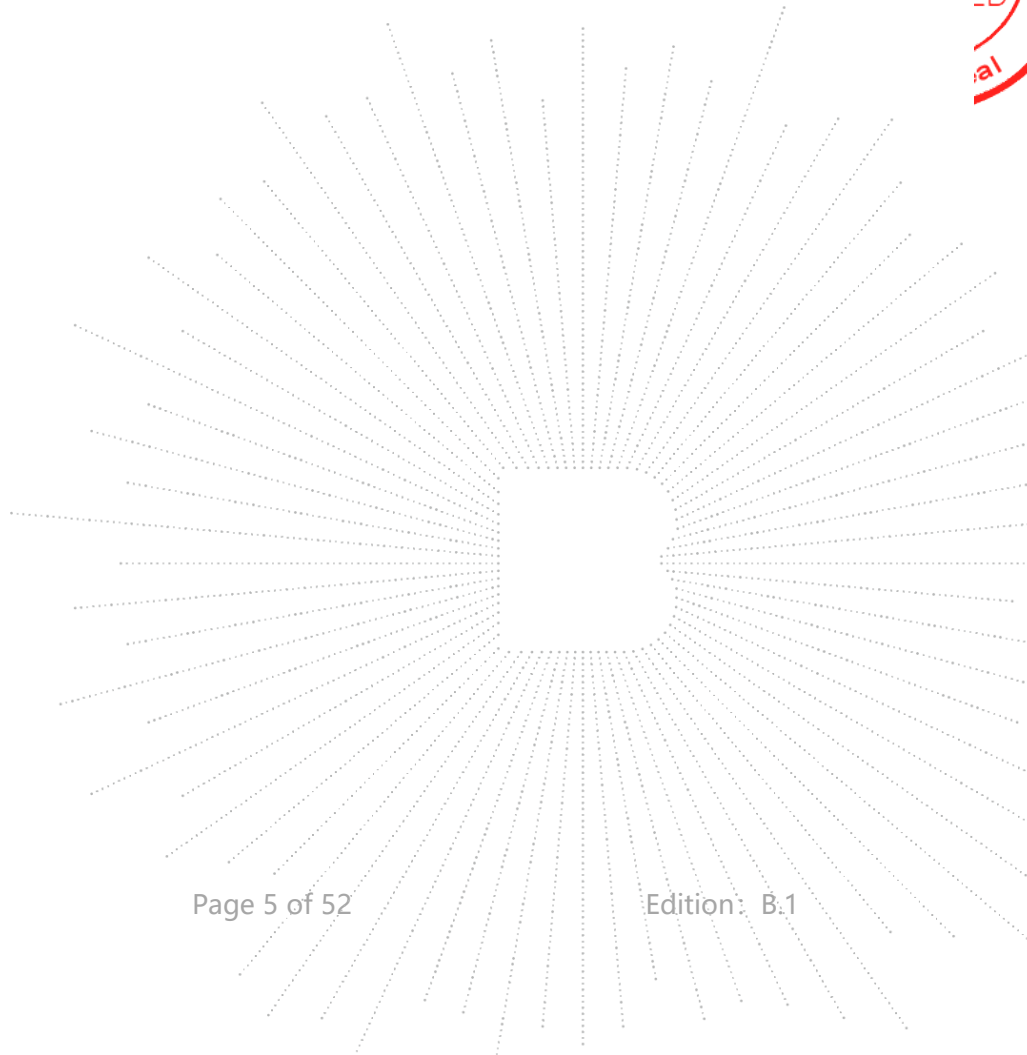
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**1. Version**

| Report No.      | Issue Date | Description | Approved |
|-----------------|------------|-------------|----------|
| BCTC2605417490E | 2026-08-19 | Original    | Valid    |
|                 |            |             |          |



## 2. Test Summary

The Product has been tested according to the following specifications:

| No. | Test Parameter                    | Clause No.         | Results          |
|-----|-----------------------------------|--------------------|------------------|
| 1   | Conducted Emission                | 15.207             | N/A <sup>1</sup> |
| 2   | 6dB Bandwidth                     | 15.247 (a)(2)      | PASS*            |
| 3   | Peak Output Power                 | 15.247 (b)         | PASS*            |
| 4   | Radiated Spurious Emission        | 15.247 (d), 15.205 | PASS*            |
| 5   | Power Spectral Density            | 15.247 (e)         | PASS*            |
| 6   | Restricted Band of Operation      | 15.205             | PASS*            |
| 7   | Band Edge (Out of Band Emissions) | 15.247(d)          | PASS*            |
| 8   | Antenna Requirement               | 15.203             | PASS             |

NOTE1: N/A (Not Applicable)

NOTE2: According to FCC OET KDB 558074, the report use radiated measurements in the restricted frequency bands. In addition, the radiated test is also performed to ensure the emissions emanating from the device cabinet also comply with the applicable limits.

NOTE3: "\*" indicates that the test results are determined base on FCC 47 CFR Part 15 Subpart C (clause 15.247). And the test results are took into account measurement uncertainty(see section 3 for measurement uncertainty information)

NOTE: "N/A<sup>1</sup>" This equipment is a DC product and is not applicable to this test.

BCTC CO., LTD

### 3. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2:2011/AMD2:2018. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

| No. | Item                                               | Uncertainty |
|-----|----------------------------------------------------|-------------|
| 1   | 3m chamber Radiated spurious emission(9kHz-30MHz)  | U=3.7dB     |
| 2   | 3m chamber Radiated spurious emission(30MHz-1GHz)  | U=4.8dB     |
| 3   | 3m chamber Radiated spurious emission(1GHz-18GHz)  | U=5.5dB     |
| 4   | 3m chamber Radiated spurious emission(18GHz-40GHz) | U=5.0dB     |
| 5   | Conducted Emission(150kHz-30MHz)                   | U=3.0dB     |
| 6   | Power Spectral Density                             | U=3.46dB    |
| 7   | Peak Power                                         | U=0.31dB    |
| 8   | Occupied Bandwidth/Frequency Range                 | U=3.46%     |
| 9   | Conducted output power uncertainty                 | U=0.55dB    |
| 10  | Frequency Error                                    | U= 53.50 Hz |
| 11  | Frequency Drift                                    | U=0.64 KHz  |
| 12  | Temperature                                        | U= 0.59 °C  |
| 13  | Humidity                                           | U= 5.3 %    |

## 4. Product Information And Test Setup

### 4.1 Product Information

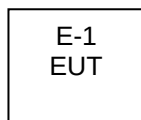
|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Model/Type reference: | KHWSN301F001                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Model differences:    | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Bluetooth Version::   | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Hardware Version:     | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Software Version:     | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Operation Frequency:  | Bluetooth: 2402-2480MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Type of Modulation:   | Bluetooth: GFSK,1Mbps,2Mbps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Number Of Channel:    | 40channel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Antenna installation: | PCB antenna                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Antenna Gain:         | 3.24dBi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                       | Remark:<br><input checked="" type="checkbox"/> The antenna gain of the product comes from the antenna report provided by the customer, and the test data is affected by the customer information. Antenna gain information is provided by the client and the laboratory is not responsible for its authenticity<br><input type="checkbox"/> The antenna gain of the product is provided by the customer, and the test data is affected by the customer information. Antenna gain information is provided by the client and the laboratory is not responsible for its authenticity |
| Power Rating:         | DC 3.6V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |



## 4.2 Test Setup Configuration

See test photographs attached in eut test setup photographs for the actual connections between product and support equipment.

Radiated Spurious Emission:



## 4.3 Support Equipment

| No. | Device Type           | Brand      | Model        | Series No. | Note |
|-----|-----------------------|------------|--------------|------------|------|
| E-1 | Dispensor Beacon ES10 | Kontakt.io | KHWSN301F001 | N/A        | EUT  |
| E-2 | N/A                   | N/A        | N/A          | N/A        | N/A  |

| Item | Shielded Type | Ferrite Core | Length | Note |
|------|---------------|--------------|--------|------|
| C-1  | N/A           | N/A          | N/A    | N/A  |

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

#### 4.4 Channel List

| Channel List |                 |         |                 |         |                 |
|--------------|-----------------|---------|-----------------|---------|-----------------|
| Channel      | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 01           | 2402            | 11      | 2422            | 21      | 2442            |
| 02           | 2404            | 12      | 2424            | 22      | 2444            |
| 03           | 2406            | 13      | 2426            | 23      | 2446            |
| ~            | ~               | ~       | ~               | ~       | ~               |
| 09           | 2418            | 19      | 2438            | 39      | 2478            |
| 10           | 2420            | 20      | 2440            | 40      | 2480            |

#### 4.5 Test Mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

| For All Mode | Description                       | Modulation Type |
|--------------|-----------------------------------|-----------------|
| Mode 1       | CH01                              | GFSK 1M/2M      |
| Mode 2       | CH20                              |                 |
| Mode 3       | CH40                              |                 |
| Mode 4       | Transmit mode (Radiated emission) |                 |

Note:

(1) The measurements are performed at the highest, middle, lowest available channels.

#### 4.6 Table Of Parameters Of Text Software Setting

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters

| RF Function | Mode Or Modulation type | Power Class | Software For Testing |
|-------------|-------------------------|-------------|----------------------|
| BLE         | GFSK 1Mbps              | 4           | nRF_DTM.exe          |
|             | GFSK 2Mbps              |             |                      |

## 5. Test Facility And Test Instrument Used

### 5.1 Test Facility

All measurement facilities used to collect the measurement data are located at Shenzhen BCTC Technology Co., Ltd.

Address: Room 101M, Unit 1, Building1, Pengyuan, No.18, Lilang Road, Shanglilang, Nanwan Subdistrict, Longgang District, Shenzhen, Guangdong, China.

The site and apparatus are constructed in conformance with the requirements of ANSI C63.4a-2017 and CISPR 16-1-1:2019 other equivalent standards.

FCC Test Firm Registration Number: 754702

ANAB certificate registration number is: CN3479

### 5.2 Test Instrument Used

| Conducted emissions Test |              |                 |         |            |            |
|--------------------------|--------------|-----------------|---------|------------|------------|
| Equipment                | Manufacturer | Model#          | Serial# | Last Cal.  | Next Cal.  |
| Receiver                 | R&S          | ESCI            | 101421  | 2025.08.30 | 2026.08.29 |
| AMN                      | SCHWHRZBECK  | NSLK8128        | 05152   | 2026.01.22 | 2027.01.21 |
| AMN                      | SCHWHRZBECK  | NSLK8127        | 8127739 | 2025.09.16 | 2026.09.15 |
| Pulse Limiter            | SCHWHRZBECK  | VTSD 9561-F-N   | 00547   | 2025.08.30 | 2026.08.29 |
| Temperature & Humidity   | Wetest       | HTC-1           | /       | 2025.09.01 | 2026.08.31 |
| Software                 | EZ-EMC       | Ver.EMC-CON 3A1 | /       | /          | /          |

| Radiated disturbance 2#       |              |             |         |            |            |
|-------------------------------|--------------|-------------|---------|------------|------------|
| Equipment                     | Manufacturer | Model#      | Serial# | Last Cal.  | Next Cal.  |
| Shielded room                 | ChengYu      | 9*6*6       | /       | 2023.09.25 | 2026.09.24 |
| Loop Antenna                  | Schwarzbeck  | FMZB1519B   | 00014   | 2026.01.05 | 2027.01.04 |
| Broadband antenna             | SCHWHRZBECK  | VULB9168    | 01620   | 2025.08.29 | 2026.08.28 |
| Horn antenna( 1 GHz -18GHz)   | SCHWARZBECK  | BBHA 9120 D | 2792    | 2025.08.29 | 2026.08.28 |
| Horn antenna ( 18 GHz -40GHz) | SCHWARZBECK  | BBHA9170    | 00822   | 2025.12.29 | 2026.12.28 |
| Receiver                      | R&S          | ESR         | 1316    | 2025.08.30 | 2026.08.29 |
| Spectrum Analyzer             | R&S          | FSV40       | 101328  | 2026.01.22 | 2027.01.21 |
| Amplifier                     | SCHWHRZBECK  | BBV9744     | 568     | 2025.08.30 | 2026.08.29 |

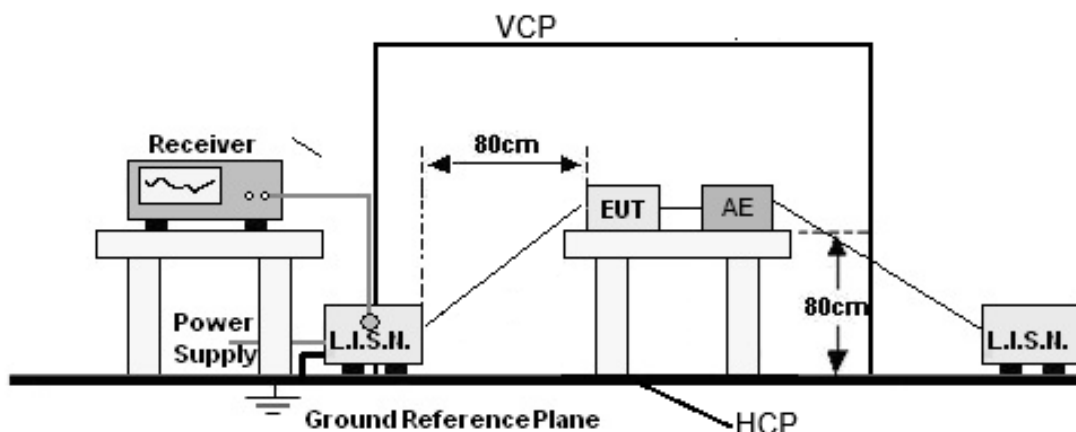
|                            |                             |                |             |            |            |
|----------------------------|-----------------------------|----------------|-------------|------------|------------|
| Amplifier                  | EMC INSTRUMENTS CORPORATION | EMC0518A45SE E | EMT-SZ2 233 | 2025.08.30 | 2026.08.29 |
| Amplifier (18GHz-40GHz)    | MITEQ                       | TTA1840-35-HG  | 2034381     | 2026.05.09 | 2027.05.08 |
| RF cable 3# ( 9kHz-6GHz )  | Yunyi                       | 10M            | /           | 2025.08.30 | 2026.08.29 |
| RF cable 9# (9kHz-1GHz)    | Yunyi                       | 2M             | /           | 2025.10.28 | 2026.10.27 |
| RF cable 5# (1GHz -18GHz)  | SKET                        | 9M             | 18038626    | 2025.08.30 | 2026.08.29 |
| RF cable 6# (1GHz -18GHz)  | SKET                        | 5M             | #10         | 2025.09.05 | 2026.09.04 |
| RF cable 10# (18GHz-40GHz) | /                           | 2M             | 2M          | 2026.05.09 | 2027.05.08 |
| RF cable 11# (18GHz-40GHz) | /                           | 2.5M           | 2.5M        | 2026.05.09 | 2027.05.08 |
| Temperature & Humidity     | Wetest                      | HTC-1          | /           | 2025.09.05 | 2026.09.04 |
| Software                   | EZ-EMC                      | Ver.FA-03A2    | /           | /          | /          |

| RF Conducted Test           |                                |                 |            |            |            |
|-----------------------------|--------------------------------|-----------------|------------|------------|------------|
| Equipment                   | Manufacturer                   | Model#          | Serial#    | Last Cal.  | Next Cal.  |
| Spectrum Analyzer           | Keysight                       | N9020A          | MY51287403 | 2025.08.30 | 2026.08.29 |
| Signal Generator            | Keysight                       | N5182A          | MY50144088 | 2025.08.30 | 2026.08.29 |
| Power Sensor                | Keysight                       | U2001           | MY51250006 | 2025.10.28 | 2026.10.27 |
| Temperature & Humidity      | Wetest                         | HTC-1           | /          | 2025.09.01 | 2026.08.31 |
| Communication test set      | R&S                            | CMW500          | 157483     | 2025.08.30 | 2026.08.29 |
| Radio frequency control box | MWRFTest                       | MW100-RFCB      | \          | \          | \          |
| Software                    | MWRFTest                       | MTS 8310        | V 3.0.0.0  | \          | \          |
| D.C. Power Supply           | Elektro-Automatik GmbH & Co.KG | D-41747 Viersen | 6230316    | 2025.09.30 | 2026.08.29 |



## 6. Conducted Emissions

### 6.1 Block Diagram Of Test Setup



### 6.2 Limit

| Frequency (MHz) | Limit (dBuV) |           |
|-----------------|--------------|-----------|
|                 | Quas-peak    | Average   |
| 0.15 -0.5       | 66 - 56 *    | 56 - 46 * |
| 0.50 -5.0       | 56.00        | 46.00     |
| 5.0 -30.0       | 60.00        | 50.00     |

Notes:  
1. \*Decreasing linearly with logarithm of frequency.  
2. The lower limit shall apply at the transition frequencies.

### 6.3 Test procedure

| Receiver Parameters | Setting  |
|---------------------|----------|
| Attenuation         | 10 dB    |
| Start Frequency     | 0.15 MHz |
| Stop Frequency      | 30 MHz   |
| IF Bandwidth        | 9 kHz    |

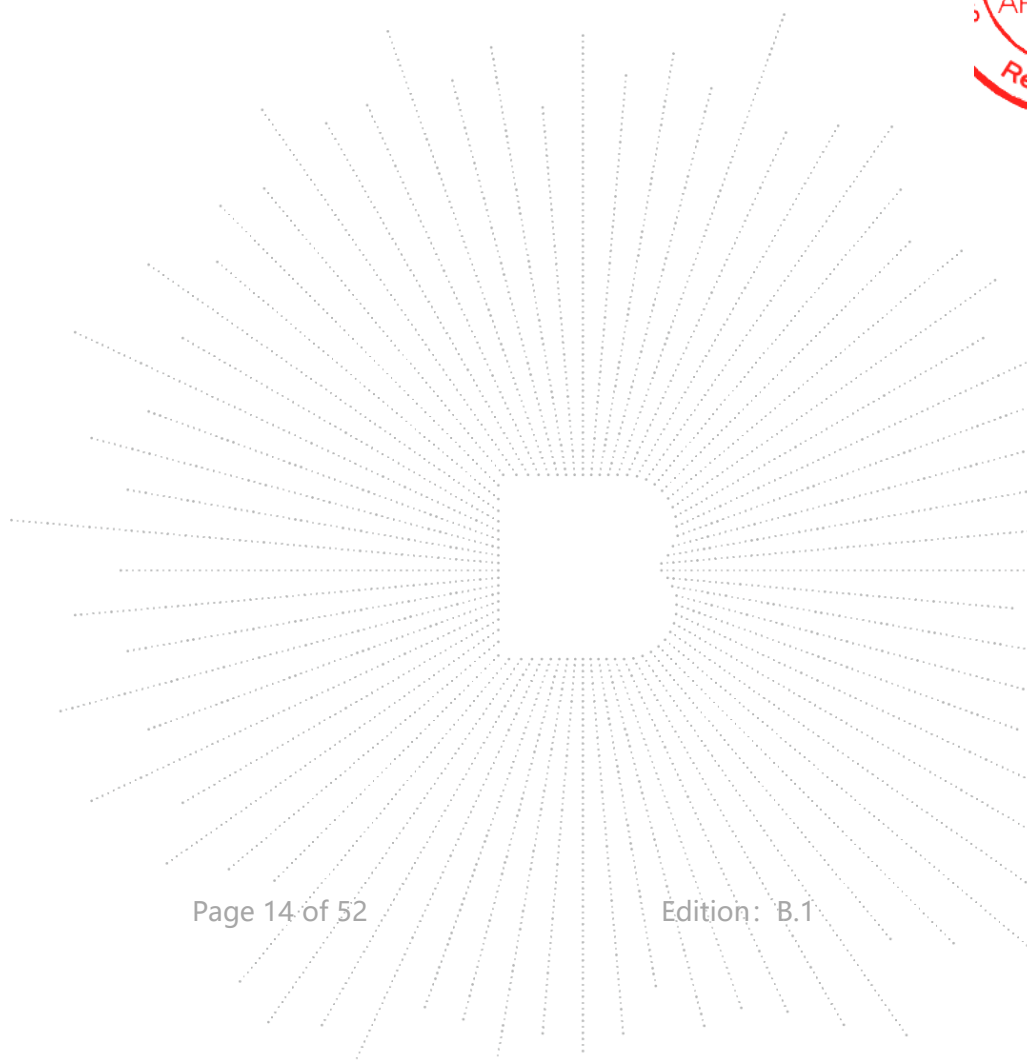
- The Product was placed on a nonconductive table 0.8 m above the horizontal ground reference plane, and 0.4 m from the vertical ground reference plane, and connected to the main through Line Impedance Stability Network (L.I.S.N).
- The RBW of the receiver was set at 9 kHz in 150 kHz ~ 30MHz with Peak and AVG detector in Max Hold mode. Run the receiver's pre-scan to record the maximum disturbance generated from Product in all power lines in the full band.
- For each frequency whose maximum record was higher or close to limit, measure its QP and AVG values and record.

### 6.4 EUT Operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

## 6.5 Test Result

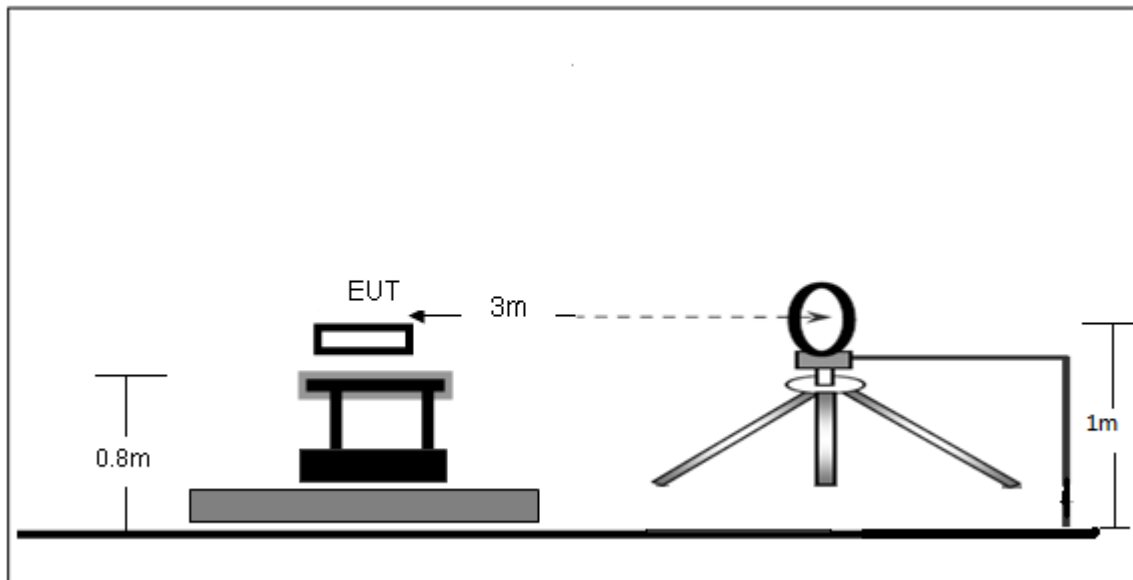
This equipment is a DC product and is not applicable to this test.



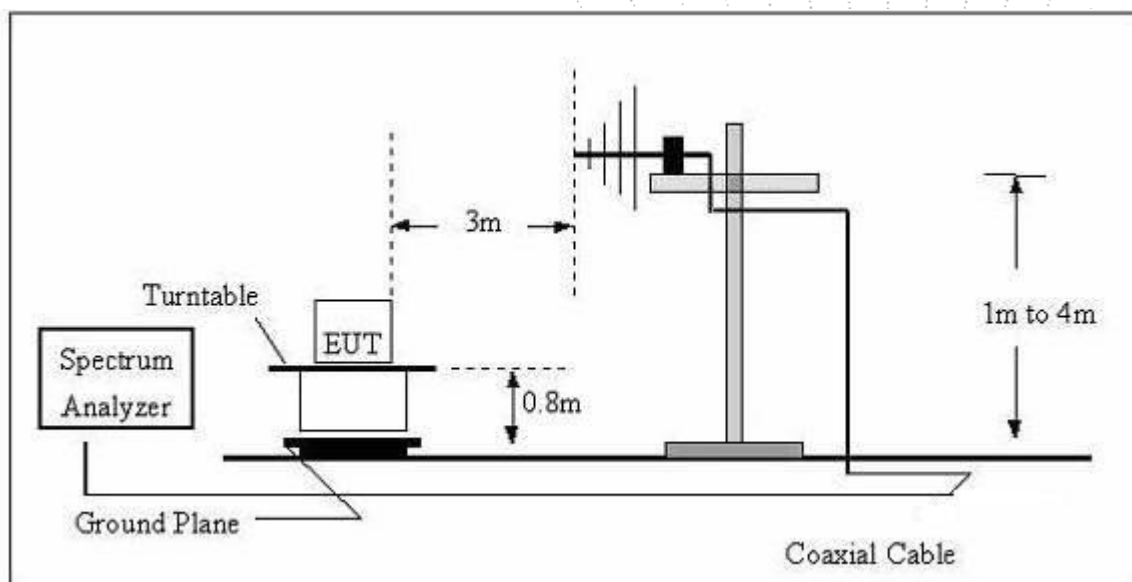
## 7. Radiated Emissions

### 7.1 Block Diagram Of Test Setup

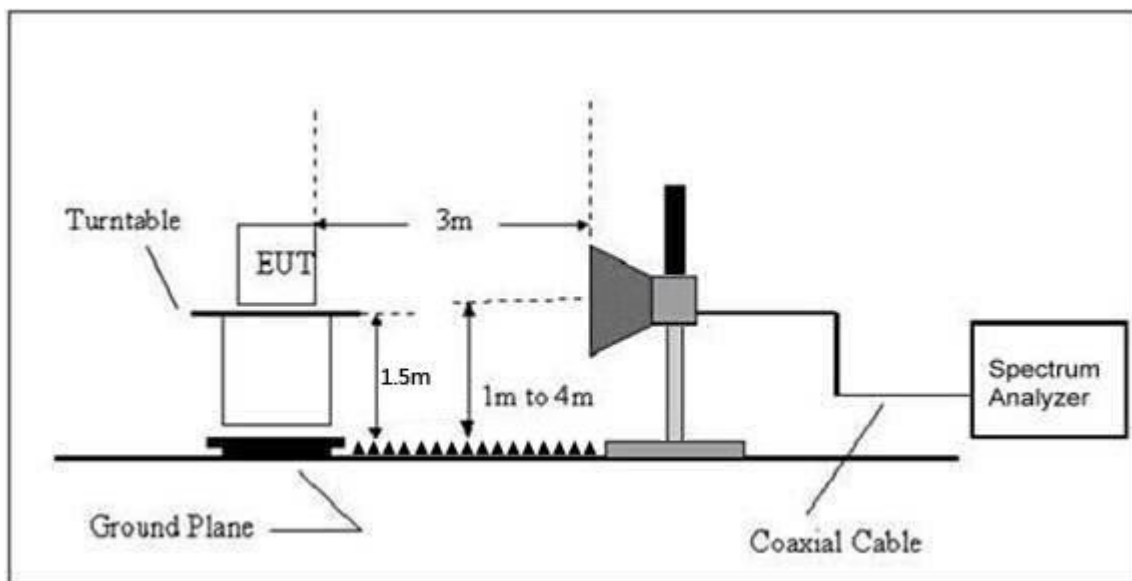
(A) Radiated Emission Test-Up Frequency Below 30MHz



(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



## (C) Radiated Emission Test-Up Frequency Above 1GHz



## 7.2 Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

| Frequency     | Field Strength        | Distance | Field Strength Limit at 3m Distance |                                       |
|---------------|-----------------------|----------|-------------------------------------|---------------------------------------|
| (MHz)         | uV/m                  | (m)      | uV/m                                | dBuV/m                                |
| 0.009 ~ 0.490 | $2400/F(\text{kHz})$  | 300      | $10000 * 2400/F(\text{kHz})$        | $20\log^{(2400/F(\text{kHz}))} + 80$  |
| 0.490 ~ 1.705 | $24000/F(\text{kHz})$ | 30       | $100 * 24000/F(\text{kHz})$         | $20\log^{(24000/F(\text{kHz}))} + 40$ |
| 1.705 ~ 30    | 30                    | 30       | $100 * 30$                          | $20\log^{(30)} + 40$                  |
| 30 ~ 88       | 100                   | 3        | 100                                 | $20\log^{(100)}$                      |
| 88 ~ 216      | 150                   | 3        | 150                                 | $20\log^{(150)}$                      |
| 216 ~ 960     | 200                   | 3        | 200                                 | $20\log^{(200)}$                      |
| Above 960     | 500                   | 3        | 500                                 | $20\log^{(500)}$                      |

## Limits Of Radiated Emission Measurement (Above 1000MHz)

| Frequency (MHz) | Limit (dBuV/m) (at 3M) |         |
|-----------------|------------------------|---------|
|                 | Peak                   | Average |
| Above 1000      | 74                     | 54      |

## Notes:

- (1)The limit for radiated test was performed according to FCC PART 15C.
- (2)The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

## Frequency Range Of Radiated Measurement

(a) For an intentional radiator the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:

(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(2) If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

(3) If the intentional radiator operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.

(4) If the intentional radiator operates at or above 95 GHz: To the third harmonic of the highest fundamental frequency or to 750 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.

(5) If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to the range specified in paragraphs (a) (1) through (4) of this section or the range applicable to the digital device, as shown in paragraph (b)(1) of this section, whichever is the higher frequency range of investigation.

## 7.3 Test procedure

| Receiver Parameter | Setting           |
|--------------------|-------------------|
| Attenuation        | Auto              |
| 9kHz~150kHz        | RBW 200Hz for QP  |
| 150kHz~30MHz       | RBW 9kHz for QP   |
| 30MHz~1000MHz      | RBW 120kHz for QP |

| Spectrum Parameter | Setting                                                            |
|--------------------|--------------------------------------------------------------------|
| 1-25GHz            | RBW 1 MHz /VBW 1 MHz for Peak,<br>RBW 1 MHz / VBW 10Hz for Average |

Below 1GHz test procedure as below:

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 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.

Above 1GHz test procedure as below:

- a. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. 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.
- d. 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 and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. 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.
- g. Test the EUT in the lowest channel, the middlest channel, the Highest channel.

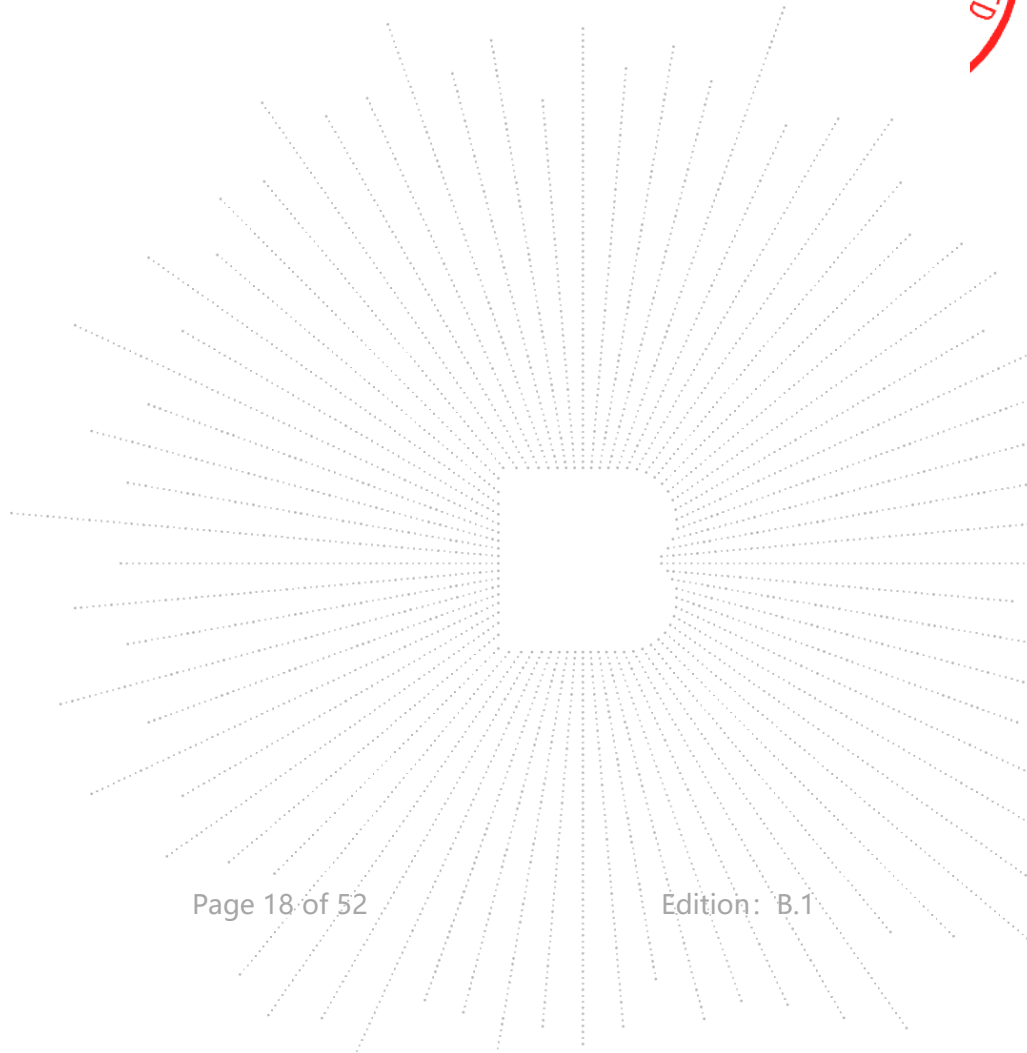
Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

## 7.4 EUT operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

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## 7.5 Test Result

Below 30MHz

|              |         |                    |         |
|--------------|---------|--------------------|---------|
| Temperature: | 25.7 °C | Relative Humidity: | 59%     |
| Pressure:    | 101KPa  | Test Voltage :     | DC 3.6V |
| Test Mode:   | Mode 4  |                    |         |

| Freq. | Reading  | Limit    | Margin | State |
|-------|----------|----------|--------|-------|
| (MHz) | (dBuV/m) | (dBuV/m) | (dB)   | P/F   |
| --    | --       | --       | --     | PASS  |
| --    | --       | --       | --     | PASS  |

Note:

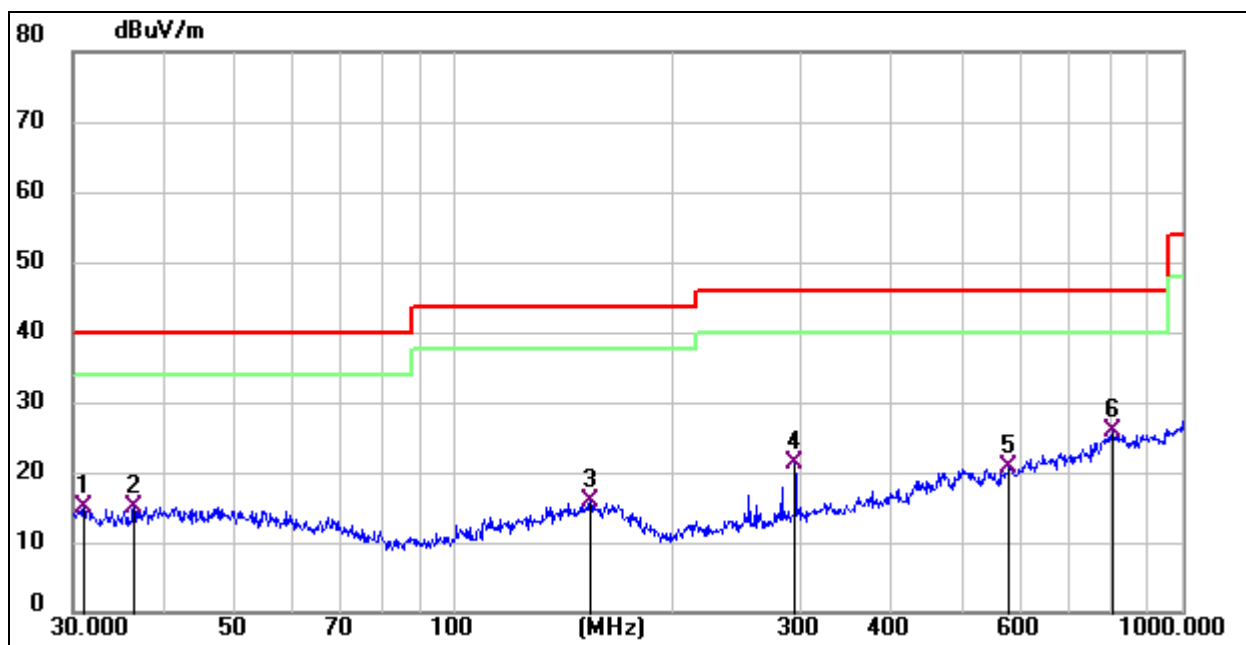
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =  $40 \log (\text{specific distance/test distance})(\text{dB})$ ;

Limit line = specific limits(dBuv) + distance extrapolation factor.

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|              |         |                    |            |
|--------------|---------|--------------------|------------|
| Temperature: | 25.7 °C | Relative Humidity: | 59%        |
| Pressure:    | 101KPa  | Phase :            | Horizontal |
| Test Mode:   | Mode 4  | Test Voltage :     | DC 3.6V    |



Remark:

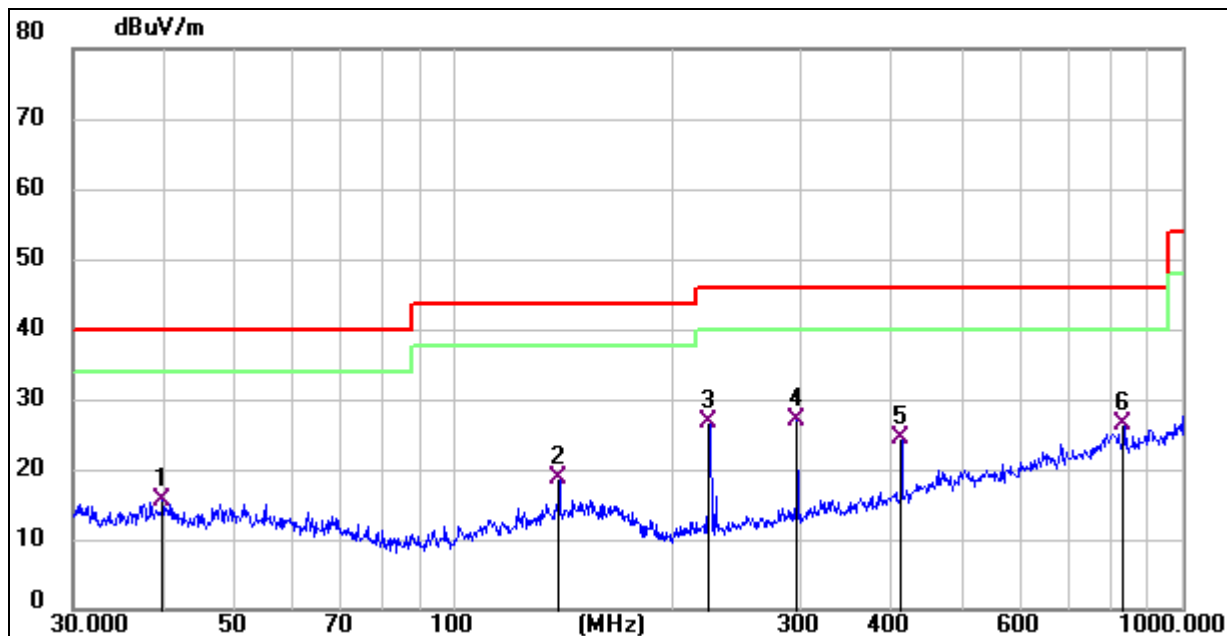
Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Margin = (Reading + Factor) – Limit

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|-----|-----------------|----------------|---------------|----------------|----------------|-------------|----------|
| 1   | 30.9800         | 26.53          | -11.47        | 15.06          | 40.00          | -24.94      | QP       |
| 2   | 36.3006         | 26.45          | -11.34        | 15.11          | 40.00          | -24.89      | QP       |
| 3   | 154.0083        | 25.93          | -10.12        | 15.81          | 43.50          | -27.69      | QP       |
| 4   | 294.0794        | 32.24          | -11.00        | 21.24          | 46.00          | -24.76      | QP       |
| 5   | 580.7026        | 25.77          | -4.93         | 20.84          | 46.00          | -25.16      | QP       |
| 6 * | 803.0994        | 25.42          | 0.38          | 25.80          | 46.00          | -20.20      | QP       |

\* Indicates the worst data.

|              |         |                    |          |
|--------------|---------|--------------------|----------|
| Temperature: | 25.7 °C | Relative Humidity: | 59%      |
| Pressure:    | 101KPa  | Phase :            | Vertical |
| Test Mode:   | Mode 4  | Test Voltage :     | DC 3.6V  |



Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Margin = (Reading + Factor) – Limit

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|-----|-----------------|----------------|---------------|----------------|----------------|-------------|----------|
| 1   | 39.8449         | 26.63          | -10.94        | 15.69          | 40.00          | -24.31      | QP       |
| 2   | 139.8508        | 29.48          | -10.85        | 18.63          | 43.50          | -24.87      | QP       |
| 3   | 224.9133        | 39.93          | -13.22        | 26.71          | 46.00          | -19.29      | QP       |
| 4 * | 296.1836        | 38.09          | -11.08        | 27.01          | 46.00          | -18.99      | QP       |
| 5   | 412.8844        | 32.78          | -8.38         | 24.40          | 46.00          | -21.60      | QP       |
| 6   | 831.7601        | 26.07          | 0.45          | 26.52          | 46.00          | -19.48      | QP       |

\* Indicates the worst data.

Between 1GHz – 25GHz

| GFSK 1Mbps     |           |                  |                   |                  |              |        |                  |
|----------------|-----------|------------------|-------------------|------------------|--------------|--------|------------------|
| Polar<br>(H/V) | Frequency | Reading<br>Level | Correct<br>Factor | Measure-<br>ment | Limits       | Over   | Detector<br>Type |
|                | (MHz)     | (dBuV/m)         | (dB)              | (dBuV/m)         | (dBuV/<br>m) | (dB)   |                  |
| Low channel    |           |                  |                   |                  |              |        |                  |
| V              | 4804.00   | 66.71            | -9.61             | 57.10            | 74.00        | -16.90 | PK               |
| V              | 4804.00   | 56.87            | -9.61             | 47.26            | 54.00        | -6.74  | AV               |
| V              | 7206.00   | 58.58            | -4.13             | 54.45            | 74.00        | -19.55 | PK               |
| V              | 7206.00   | 47.79            | -4.13             | 43.66            | 54.00        | -10.34 | AV               |
| H              | 4804.00   | 65.16            | -9.61             | 55.55            | 74.00        | -18.45 | PK               |
| H              | 4804.00   | 55.37            | -9.61             | 45.76            | 54.00        | -8.24  | AV               |
| H              | 7206.00   | 56.50            | -4.13             | 52.37            | 74.00        | -21.63 | PK               |
| H              | 7206.00   | 47.74            | -4.13             | 43.61            | 54.00        | -10.39 | AV               |
| Middle channel |           |                  |                   |                  |              |        |                  |
| V              | 4880.00   | 64.05            | -8.84             | 55.21            | 74.00        | -18.79 | PK               |
| V              | 4880.00   | 57.19            | -8.84             | 48.35            | 54.00        | -5.65  | AV               |
| V              | 7320.00   | 53.09            | -3.37             | 49.72            | 74.00        | -24.28 | PK               |
| V              | 7320.00   | 44.26            | -3.37             | 40.89            | 54.00        | -13.11 | AV               |
| H              | 4880.00   | 62.82            | -8.84             | 53.98            | 74.00        | -20.02 | PK               |
| H              | 4880.00   | 53.66            | -8.84             | 44.82            | 54.00        | -9.18  | AV               |
| H              | 7320.00   | 50.62            | -3.37             | 47.25            | 74.00        | -26.75 | PK               |
| H              | 7320.00   | 41.85            | -3.37             | 38.48            | 54.00        | -15.52 | AV               |
| High channel   |           |                  |                   |                  |              |        |                  |
| V              | 4960.00   | 65.60            | -8.65             | 56.95            | 74.00        | -17.05 | PK               |
| V              | 4960.00   | 56.08            | -8.65             | 47.43            | 54.00        | -6.57  | AV               |
| V              | 7440.00   | 59.08            | -3.4              | 55.68            | 74.00        | -18.32 | PK               |
| V              | 7440.00   | 48.41            | -3.4              | 45.01            | 54.00        | -8.99  | AV               |
| H              | 4960.00   | 63.91            | -8.65             | 55.26            | 74.00        | -18.74 | PK               |
| H              | 4960.00   | 53.16            | -8.65             | 44.51            | 54.00        | -9.49  | AV               |
| H              | 7440.00   | 57.31            | -3.4              | 53.91            | 74.00        | -20.09 | PK               |
| H              | 7440.00   | 48.98            | -3.4              | 45.58            | 54.00        | -8.42  | AV               |

Remark:

1. Emission Level = Meter Reading + Factor, Factor = Antenna Factor + Cable Loss – Pre-amplifier. Over = Emission Level - Limit

2. In restricted bands of operation, The spurious emissions below the permissible value more than 20dB

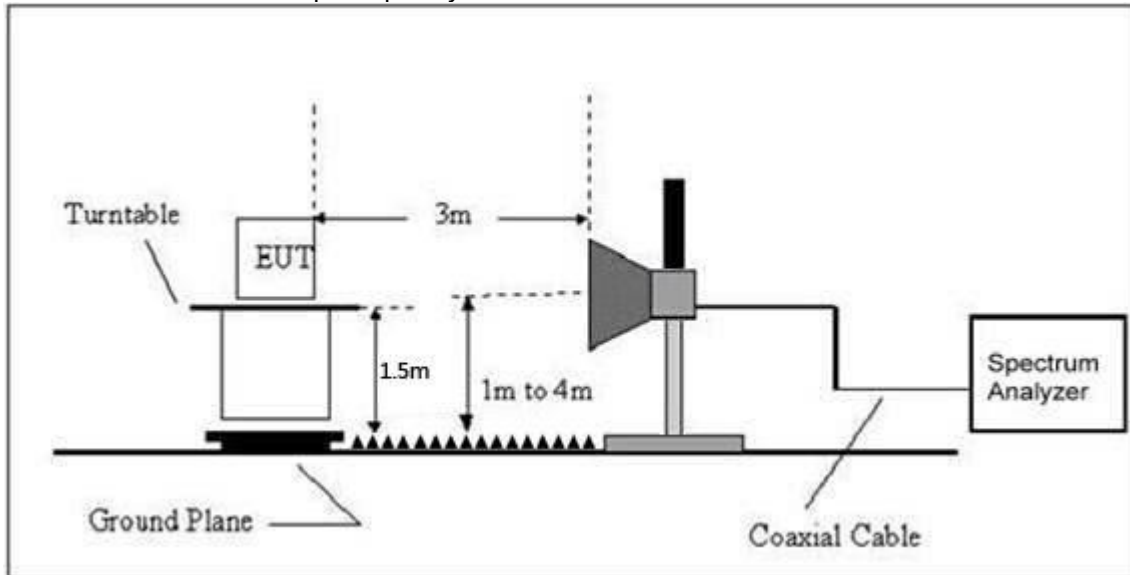
3. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

4. The worst mode is GFSK 1Mbps, so only the worst mode is displayed

## 8. Radiated Band Emission Measurement and Restricted Bands Of Operation

### 8.1 Block Diagram Of Test Setup

Radiated Emission Test-Up Frequency Above 1GHz



### 8.2 Limit

FCC Part15 C Section 15.209 and 15.205

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz               | MHz                 | MHz           | GHz              |
|-------------------|---------------------|---------------|------------------|
| 0.090-0.110       | 16.42-16.423        | 399.9-410     | 4.5-5.15         |
| 0.495-0.505       | 16.69475-16.69525   | 608-614       | 5.35-5.46        |
| 2.1735-2.1905     | 16.80425-16.80475   | 960-1240      | 7.25-7.75        |
| 4.125-4.128       | 25.5-25.67          | 1300-1427     | 8.025-8.5        |
| 4.17725-4.17775   | 37.5-38.25          | 1435-1626.5   | 9.0-9.2          |
| 4.20725-4.20775   | 73-74.6             | 1645.5-1646.5 | 9.3-9.5          |
| 6.215-6.218       | 74.8-75.2           | 1660-1710     | 10.6-12.7        |
| 6.26775-6.26825   | 108-121.94          | 1718.8-1722.2 | 13.25-13.4       |
| 6.31175-6.31225   | 123-138             | 2200-2300     | 14.47-14.5       |
| 8.291-8.294       | 149.9-150.05        | 2310-2390     | 15.35-16.2       |
| 8.362-8.366       | 156.52475-156.52525 | 2483.5-2500   | 17.7-21.4        |
| 8.37625-8.38675   | 156.7-156.9         | 2690-2900     | 22.01-23.12      |
| 8.41425-8.41475   | 162.0125-167.17     | 3260-3267     | 23.6-24.0        |
| 12.29-12.293      | 167.72-173.2        | 3332-3339     | 31.2-31.8        |
| 12.51975-12.52025 | 240-285             | 3345.8-3358   | 36.43-36.5       |
| 12.57675-12.57725 | 322-335.4           | 3600-4400     | ( <sup>3</sup> ) |
| 13.36-13.41       |                     |               |                  |

### Limits Of Radiated Emission Measurement (Above 1000MHz)

| Frequency (MHz) | Limit (dBuV/m) (at 3M) |         |
|-----------------|------------------------|---------|
|                 | Peak                   | Average |
| Above 1000      | 74                     | 54      |

Notes:

- (1)The limit for radiated test was performed according to FCC PART 15C.
- (2)The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

### 8.3 Test Procedure

| Receiver Parameter                    | Setting                                          |
|---------------------------------------|--------------------------------------------------|
| Attenuation                           | Auto                                             |
| Start Frequency                       | 2300MHz                                          |
| Stop Frequency                        | 2520                                             |
| RB / VB (emission in restricted band) | 1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average |

Above 1GHz test procedure as below:

- a.The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b.The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c.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.
- d.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 and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e.The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. 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.
- g. Test the EUT in the lowest channel, the middle channel, the Highest channel.

Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

### 8.4 EUT Operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

## 8.5 Test Result

| GFSK<br>1Mbps | Polar<br>(H/V)       | Frequency<br>(MHz) | Reading<br>Level<br>(dBuV/m) | Correct<br>Factor<br>(dB) | Measure-<br>ment<br>(dBuV/m) | Limits<br>(dBuV/m) |       | Result |  |
|---------------|----------------------|--------------------|------------------------------|---------------------------|------------------------------|--------------------|-------|--------|--|
|               |                      |                    |                              |                           | PK                           | PK                 | AV    |        |  |
|               | Low Channel 2402MHz  |                    |                              |                           |                              |                    |       |        |  |
|               | H                    | 2390.00            | 63.01                        | -17.27                    | 45.74                        | 74.00              | 54.00 | PASS   |  |
|               | H                    | 2400.00            | 66.84                        | -17.23                    | 49.61                        | 74.00              | 54.00 | PASS   |  |
|               | V                    | 2390.00            | 62.40                        | -17.27                    | 45.13                        | 74.00              | 54.00 | PASS   |  |
|               | V                    | 2400.00            | 66.42                        | -17.23                    | 49.19                        | 74.00              | 54.00 | PASS   |  |
|               | High Channel 2480MHz |                    |                              |                           |                              |                    |       |        |  |
|               | H                    | 2483.50            | 65.84                        | -16.91                    | 48.93                        | 74.00              | 54.00 | PASS   |  |
|               | H                    | 2500.00            | 62.00                        | -16.71                    | 45.29                        | 74.00              | 54.00 | PASS   |  |
| V             | 2483.50              | 66.55              | -16.91                       | 49.64                     | 74.00                        | 54.00              | PASS  |        |  |
| V             | 2500.00              | 62.67              | -16.71                       | 45.96                     | 74.00                        | 54.00              | PASS  |        |  |

### Remark:

1. Emission Level = Meter Reading + Factor,

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Over= Emission Level - Limit

2. If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.

3 In restricted bands of operation, The spurious emissions below the permissible value more than 20dB

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

5.The worst mode is GFSK 1Mbps, so only the worst mode is displayed

## 9. Power Spectral Density Test

### 9.1 Block Diagram Of Test Setup



### 9.2 Limit

| FCC Part15 (15.247) , Subpart C |                        |                     |                       |        |
|---------------------------------|------------------------|---------------------|-----------------------|--------|
| Section                         | Test Item              | Limit               | Frequency Range (MHz) | Result |
| 15.247                          | Power Spectral Density | 8 dBm (in any 3KHz) | 2400-2483.5           | PASS   |

Limits Of Radiated Emission Measurement (Above 1000MHz)

### 9.3 Test procedure

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: 3 kHz
4. Set the VBW  $\geq 3 \times$  RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

### 9.4 EUT Operating Conditions

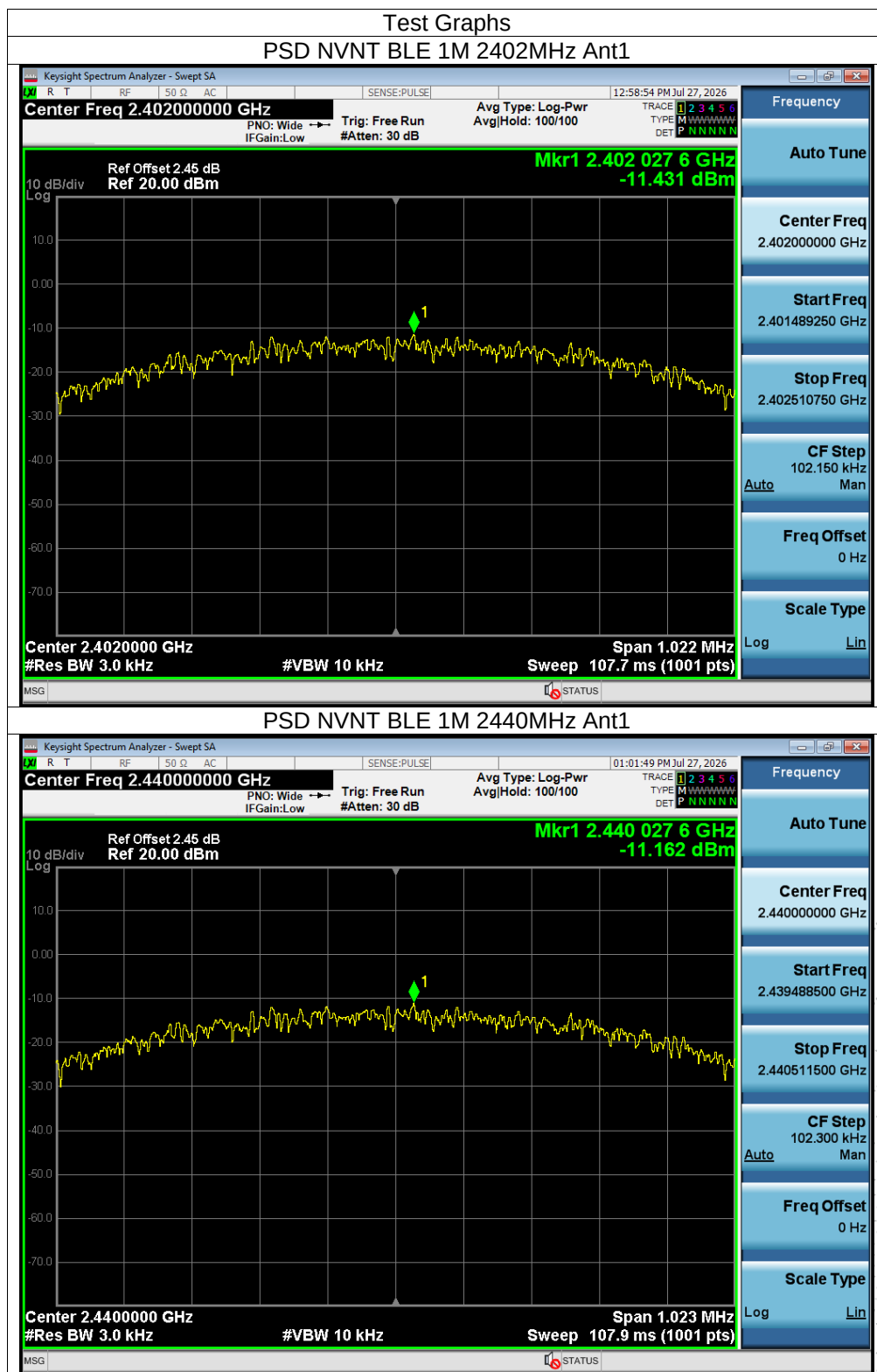
The EUT tested system was configured as the statements of 4.6 Unless otherwise a special operating condition is specified in the follows during the testing.

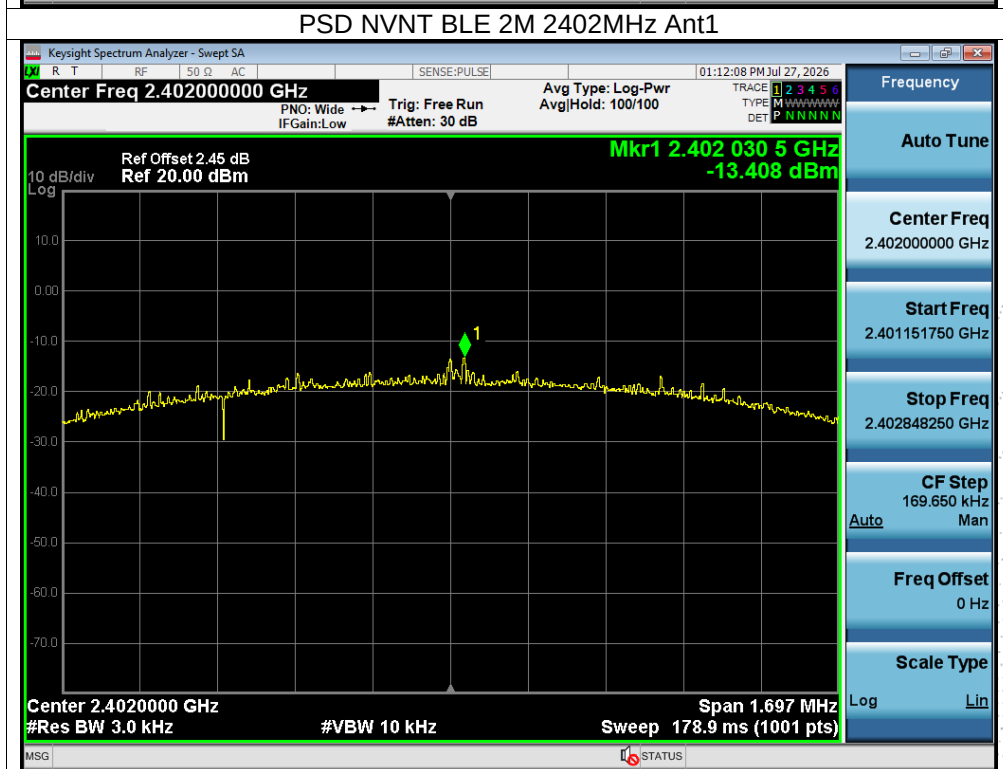
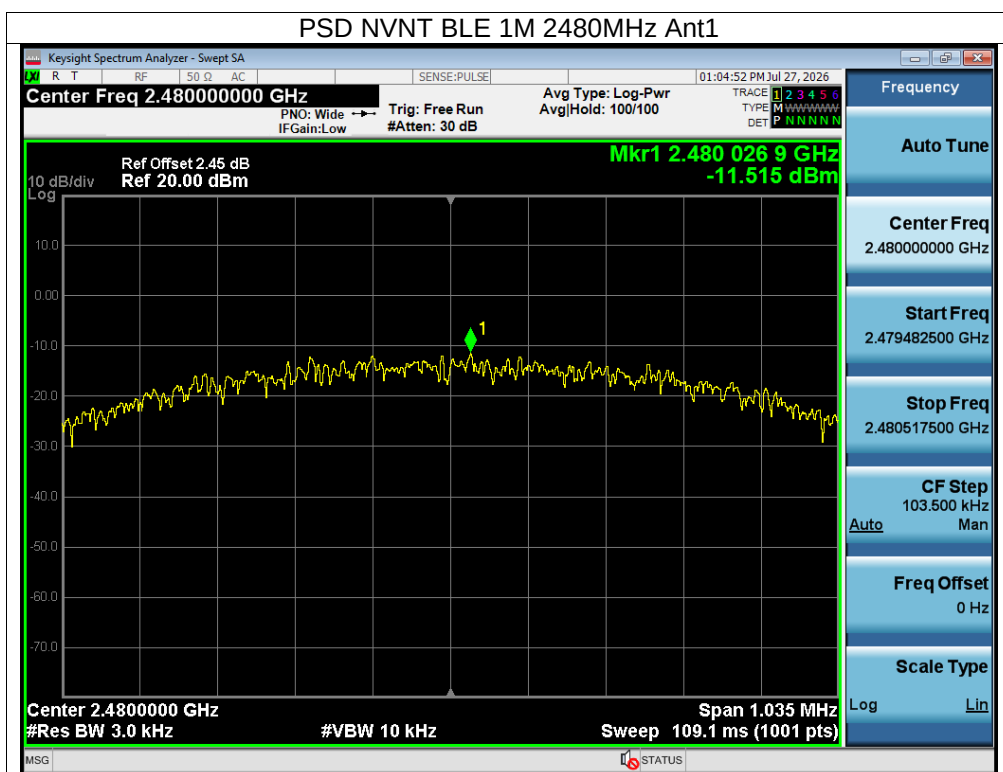
Note: Power Spectral Density(dBm)=Reading+Cable Loss

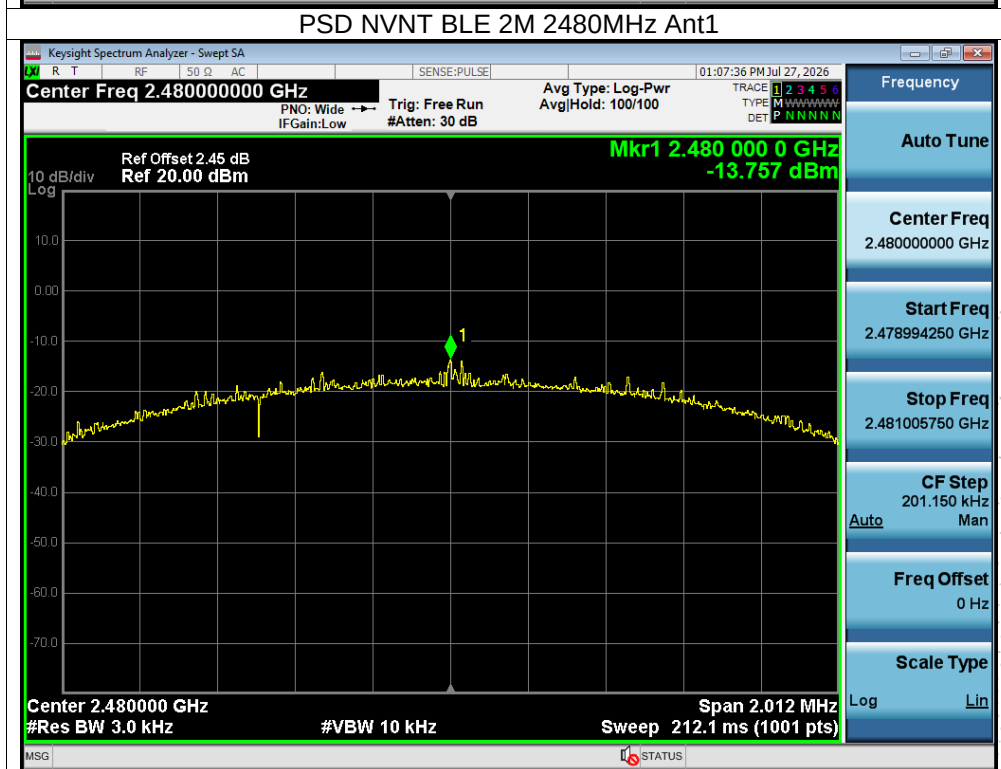
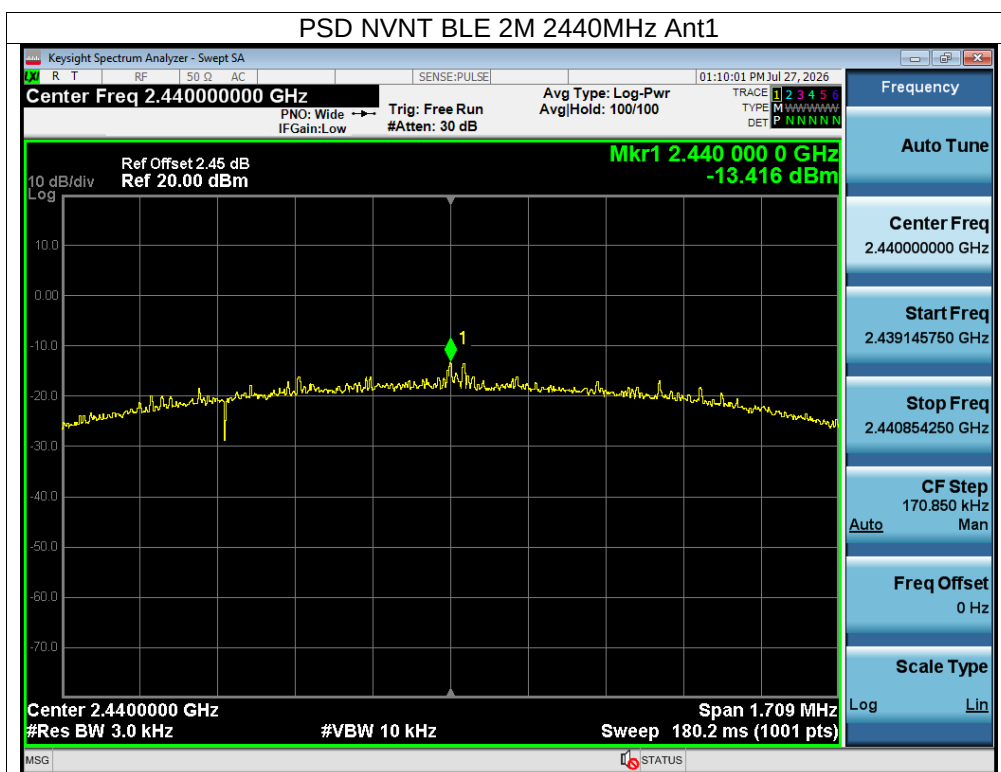
## 9.5 Test Result

|              |         |                    |         |
|--------------|---------|--------------------|---------|
| Temperature: | 24.5 °C | Relative Humidity: | 54%     |
| Pressure:    | 101KPa  | Test Voltage :     | DC 3.6V |

| Frequency          | Power Spectral Density(dBm/3kHz) | Limit (dBm/3kHz) | Result |
|--------------------|----------------------------------|------------------|--------|
| 2402 MHz<br>BLE 1M | -11.43                           | 8                | PASS   |
| 2440 MHz<br>BLE 1M | -11.16                           | 8                | PASS   |
| 2480 MHz<br>BLE 1M | -11.52                           | 8                | PASS   |
| 2402 MHz<br>BLE 2M | -13.41                           | 8                | PASS   |
| 2440 MHz<br>BLE 2M | -13.42                           | 8                | PASS   |
| 2480 MHz<br>BLE 2M | -13.76                           | 8                | PASS   |







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## 10. Bandwidth Test

### 10.1 Block Diagram Of Test Setup



### 10.2 Limit

| FCC Part15 (15.247) , Subpart C |           |                                          |                       |        |
|---------------------------------|-----------|------------------------------------------|-----------------------|--------|
| Section                         | Test Item | Limit                                    | Frequency Range (MHz) | Result |
| 15.247(a)(2)                    | Bandwidth | $\geq 500\text{KHz}$<br>(-6dB bandwidth) | 2400-2483.5           | PASS   |

### 10.3 Test procedure

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. 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.

### 10.4 EUT operating Conditions

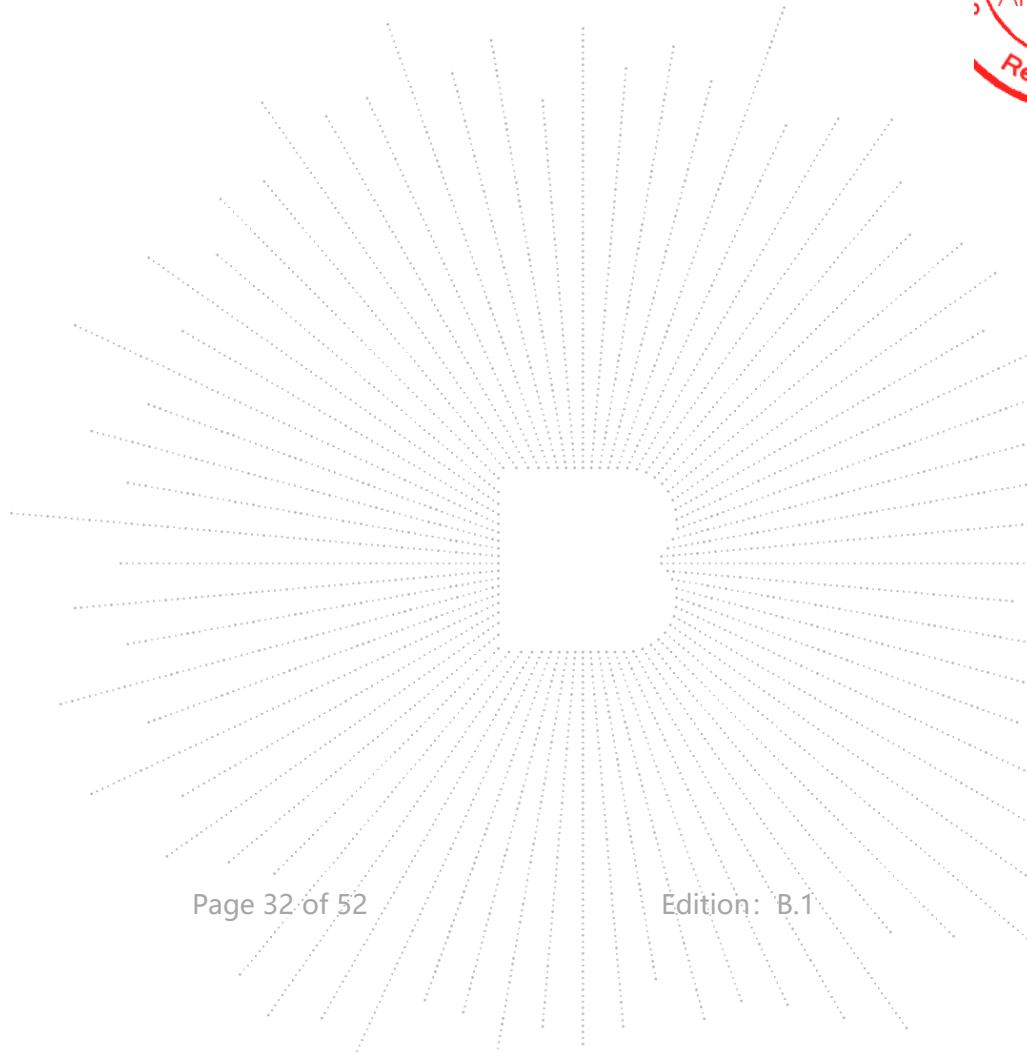
The EUT tested system was configured as the statements of 4.6 Unless otherwise a special operating condition is specified in the follows during the testing.

Note: Power Spectral Density(dBm)=Reading+Cable Loss

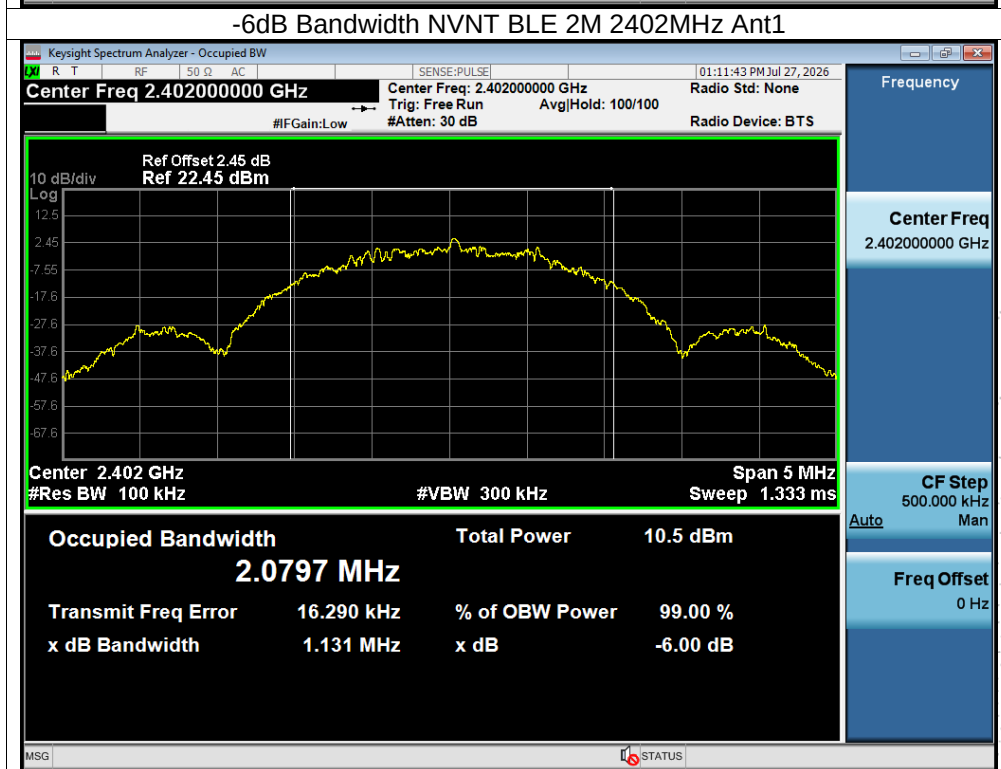
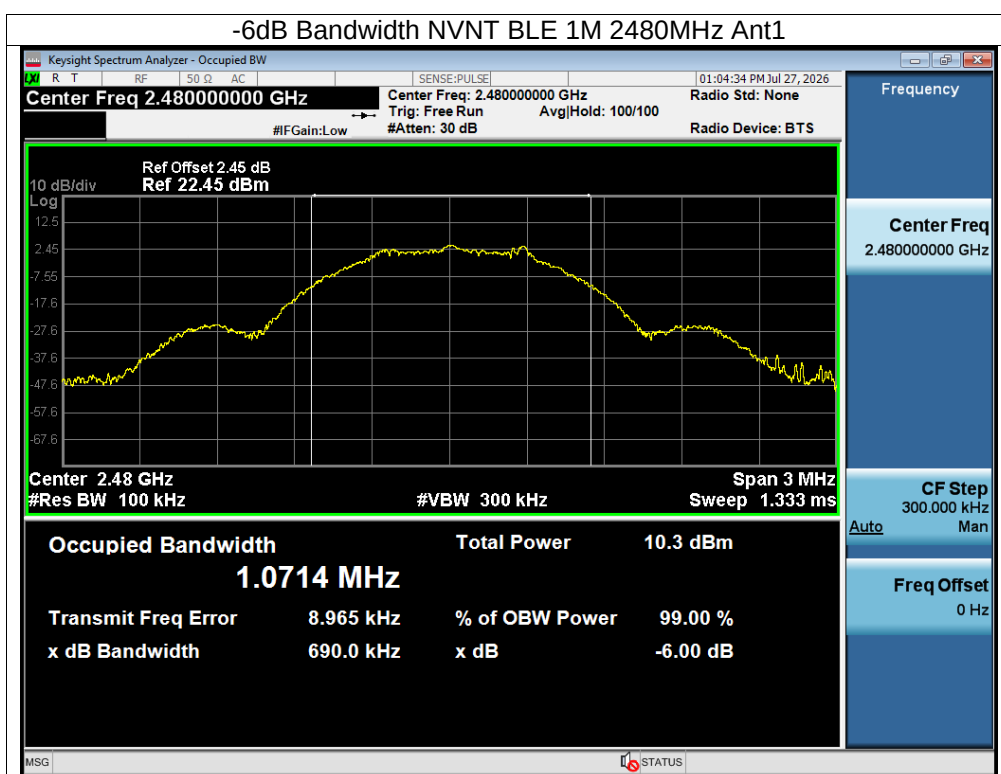
## 10.5 Test Result

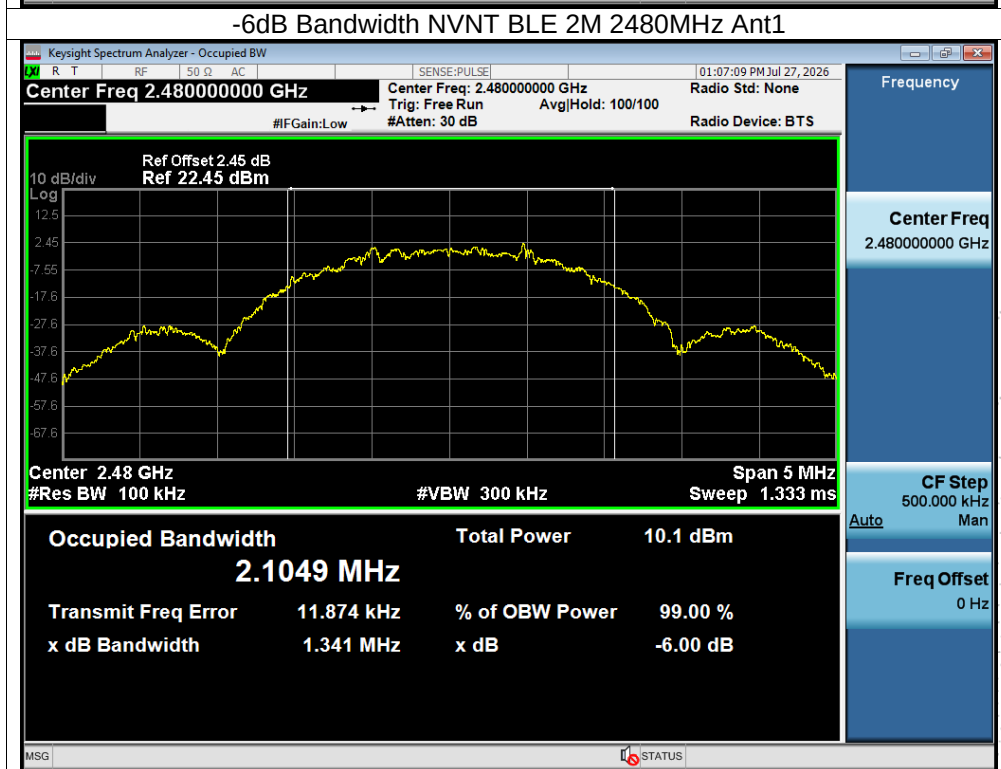
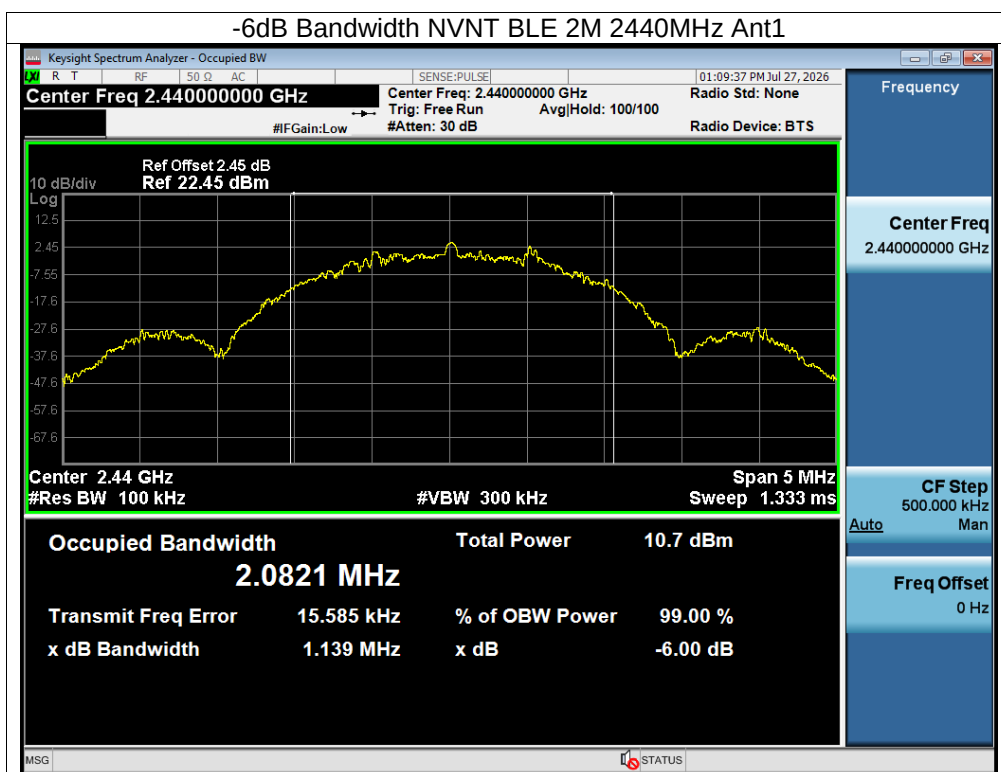
|              |         |                    |         |
|--------------|---------|--------------------|---------|
| Temperature: | 24.5 °C | Relative Humidity: | 54%     |
| Pressure:    | 101KPa  | Test Voltage :     | DC 3.6V |

| Frequency (MHz)    | -6dB bandwidth (MHz) | Limit (MHz) | Result |
|--------------------|----------------------|-------------|--------|
| 2402 MHz<br>BLE 1M | 0.681                | 0.5         | Pass   |
| 2440 MHz<br>BLE 1M | 0.682                | 0.5         | Pass   |
| 2480 MHz<br>BLE 1M | 0.690                | 0.5         | Pass   |
| 2402 MHz<br>BLE 2M | 1.131                | 0.5         | Pass   |
| 2440 MHz<br>BLE 2M | 1.139                | 0.5         | Pass   |
| 2480 MHz<br>BLE 2M | 1.341                | 0.5         | Pass   |









## 11. Peak Output Power Test

### 11.1 Block Diagram Of Test Setup



### 11.2 Limit

| FCC Part15 (15.247) , Subpart C |                   |                 |                       |        |
|---------------------------------|-------------------|-----------------|-----------------------|--------|
| Section                         | Test Item         | Limit           | Frequency Range (MHz) | Result |
| 15.247(b)(3)                    | Peak Output Power | 1 watt or 30dBm | 2400-2483.5           | PASS   |

### 11.3 Test Procedure

- The EUT was directly connected to the Power meter

### 11.4 EUT Operating Conditions

The EUT tested system was configured as the statements of 4.6 Unless otherwise a special operating condition is specified in the follows during the testing.

Note: Power Spectral Density(dBm)=Reading+Cable Loss

## 11.5 Test Result

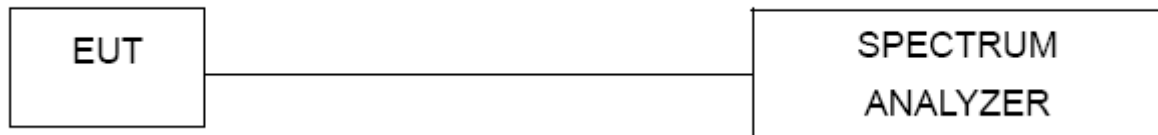
|              |        |                    |         |
|--------------|--------|--------------------|---------|
| Temperature: | 24.5℃  | Relative Humidity: | 54%     |
| Pressure:    | 101KPa | Test Voltage :     | DC 3.6V |

|             | Frequency(MHz) | Maximum Conducted Output Power(PK) (dBm) | Conducted Output Power Limit(dBm) |
|-------------|----------------|------------------------------------------|-----------------------------------|
| GFSK BLE 1M | 2402           | 4.18                                     | 30                                |
|             | 2440           | 4.28                                     | 30                                |
|             | 2480           | 4.06                                     | 30                                |
| GFSK BLE 2M | 2402           | 4.18                                     | 30                                |
|             | 2440           | 4.30                                     | 30                                |
|             | 2480           | 4.05                                     | 30                                |

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## 12. 100 kHz Bandwidth Of Frequency Band Edge

### 12.1 Block Diagram Of Test Setup



### 12.2 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

### 12.3 Test procedure

Using the following spectrum analyzer setting:

- Set the RBW = 100KHz.
- Set the VBW = 300KHz.
- Sweep time = auto couple.
- Detector function = peak.
- Trace mode = max hold.
- Allow trace to fully stabilize.

### 12.4 EUT operating Conditions

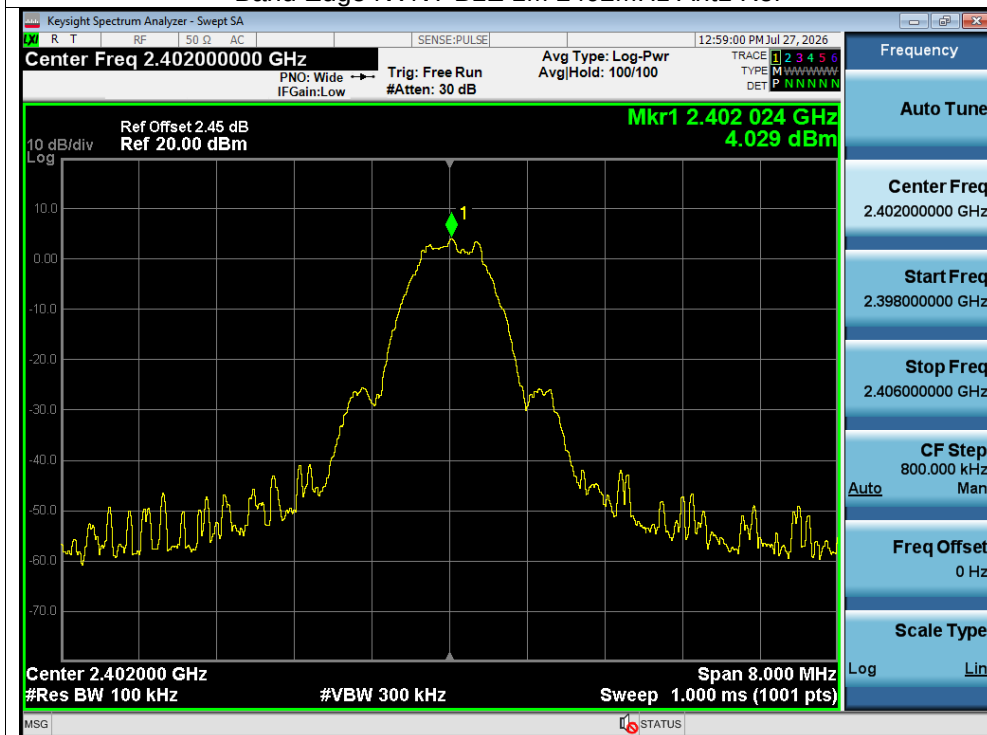
The EUT tested system was configured as the statements of 4.6 Unless otherwise a special operating condition is specified in the follows during the testing.

Note: Power Spectral Density(dBm)=Reading+Cable Loss

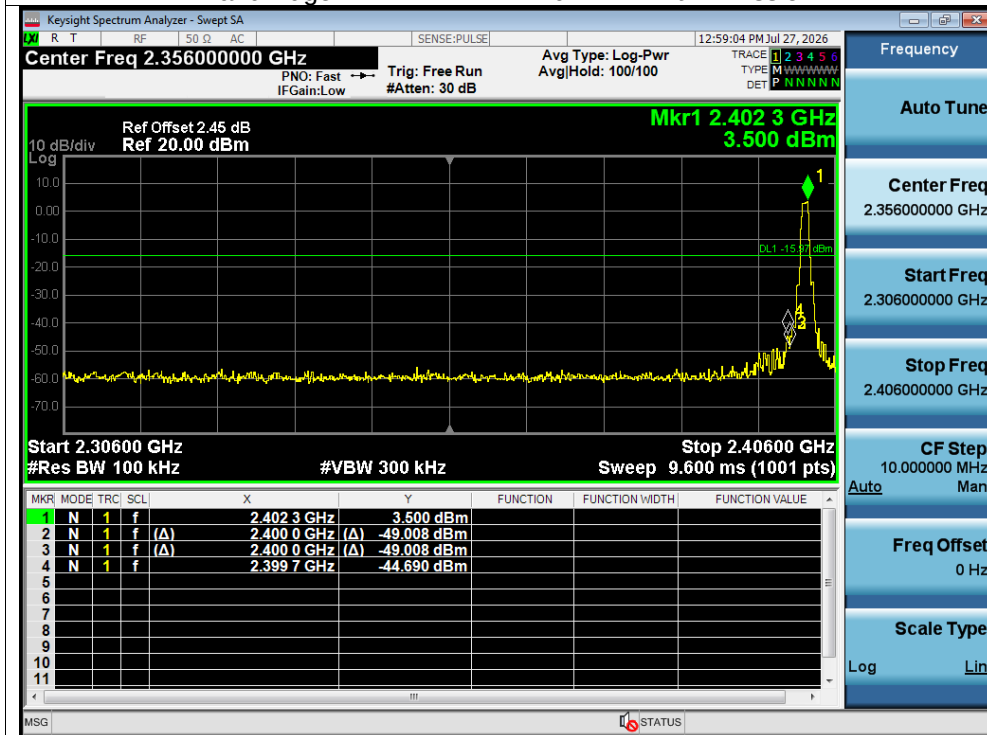
### 12.5 Test Result

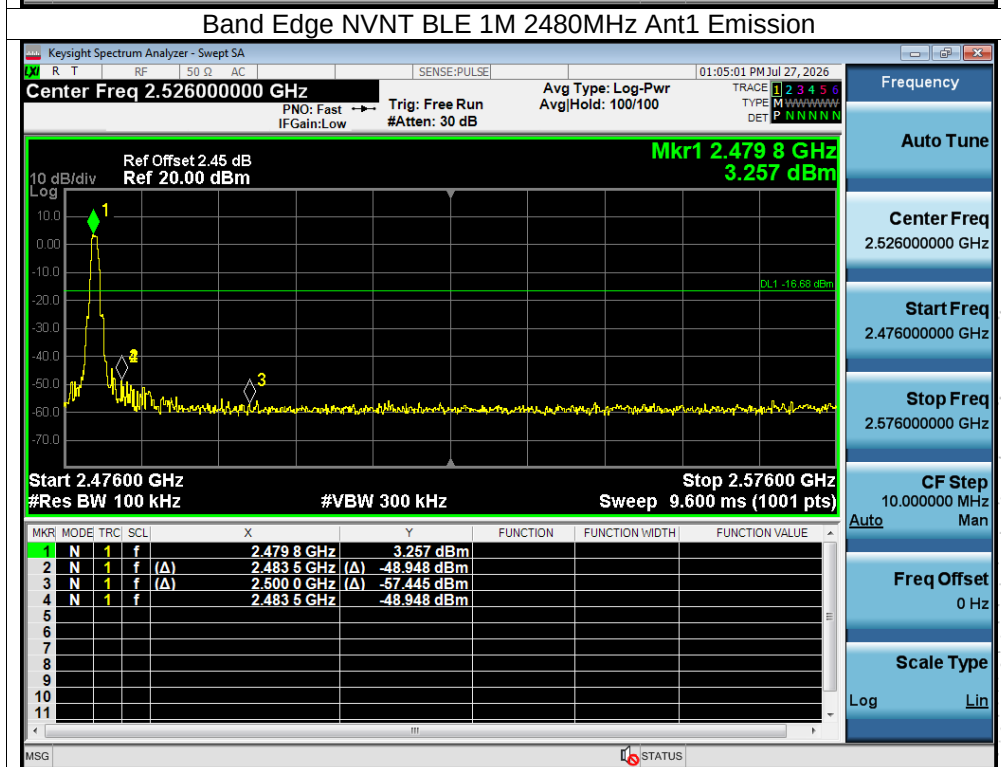
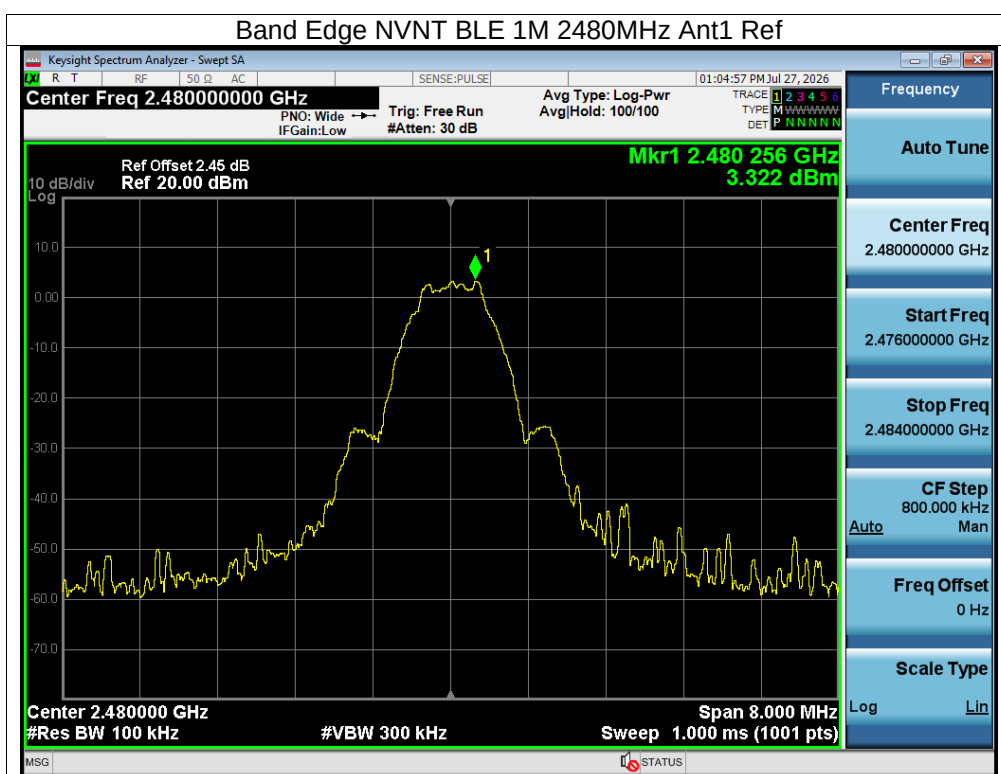
### Test Graphs

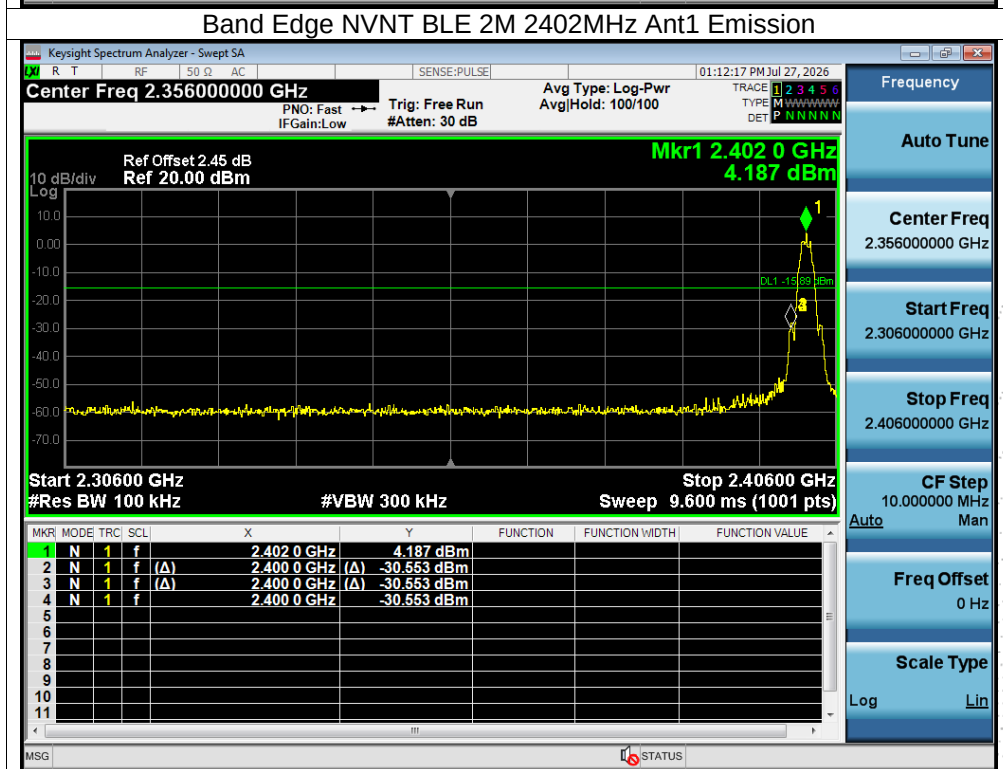
#### Band Edge NVNT BLE 1M 2402MHz Ant1 Ref

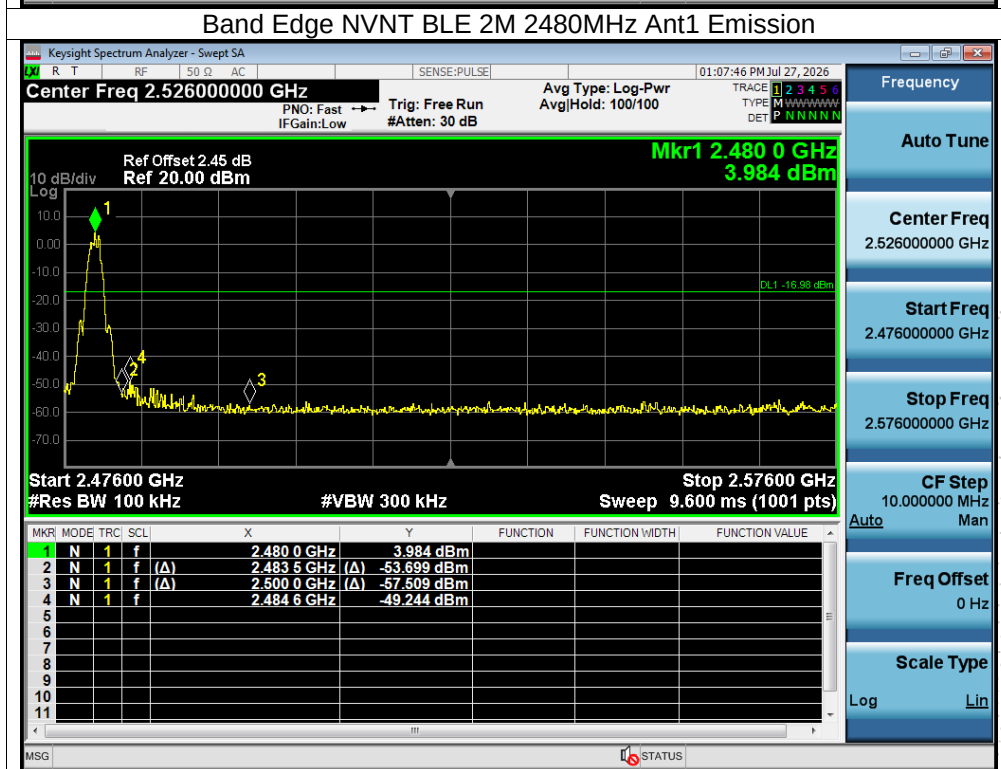
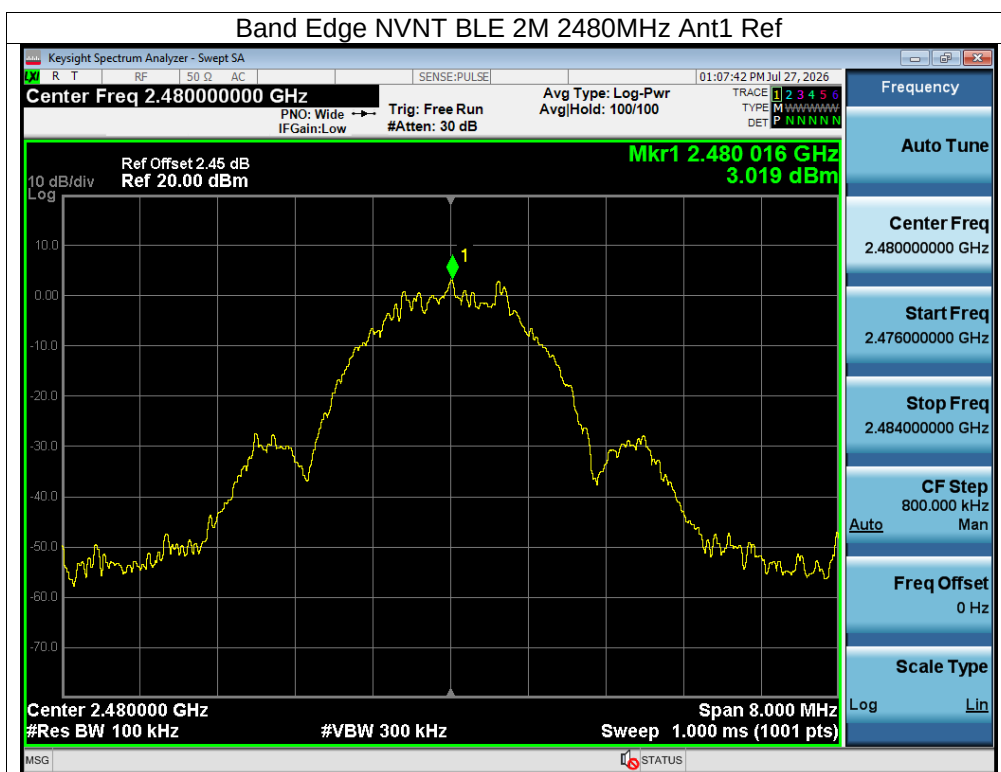


#### Band Edge NVNT BLE 1M 2402MHz Ant1 Emission



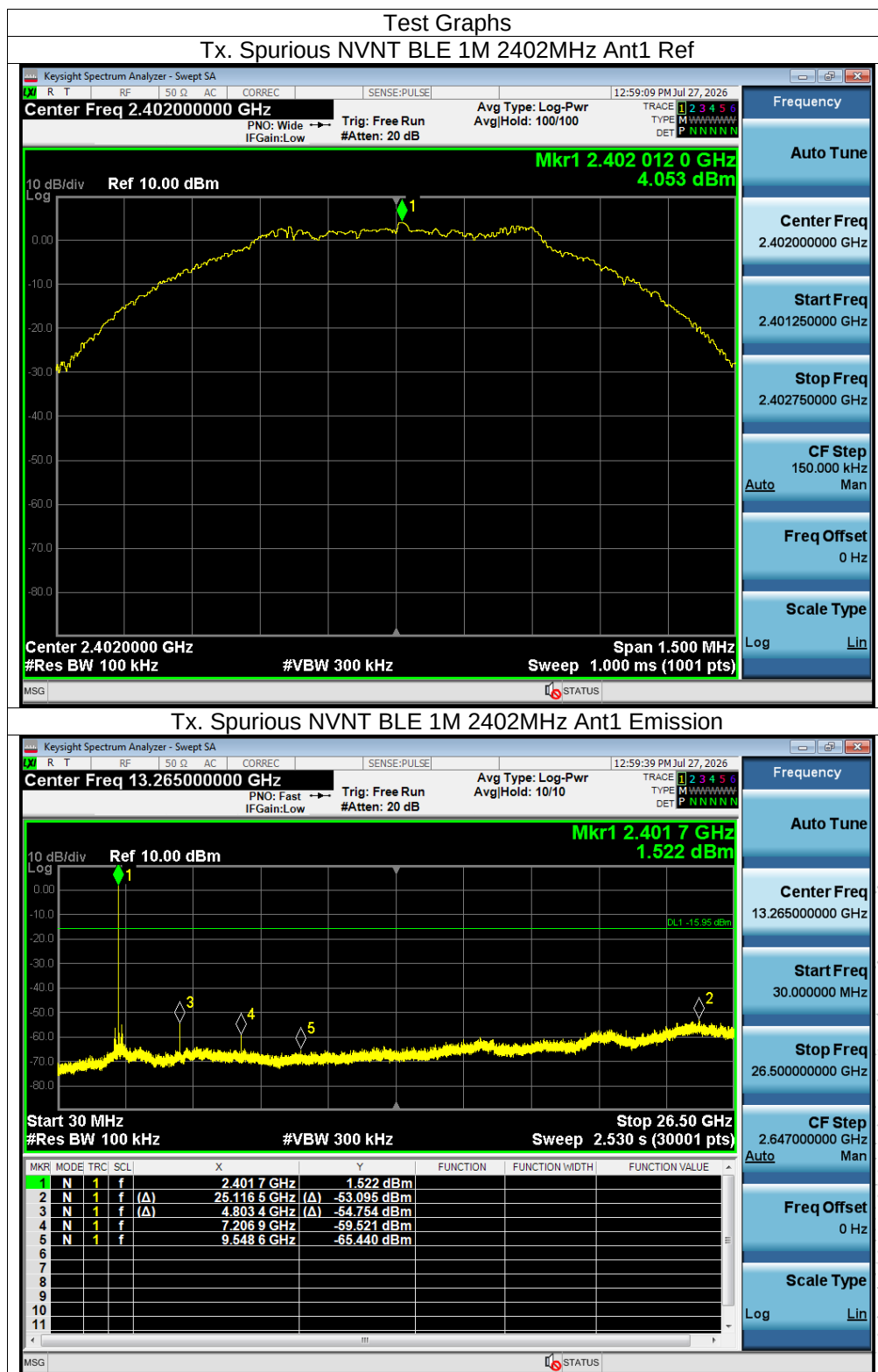


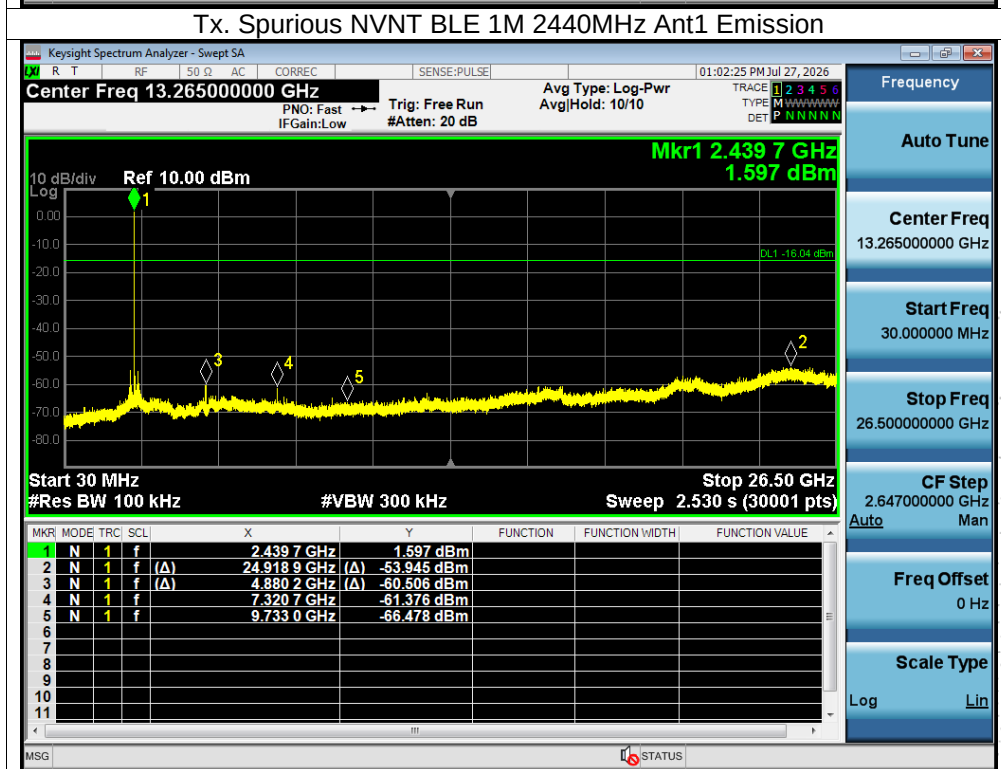
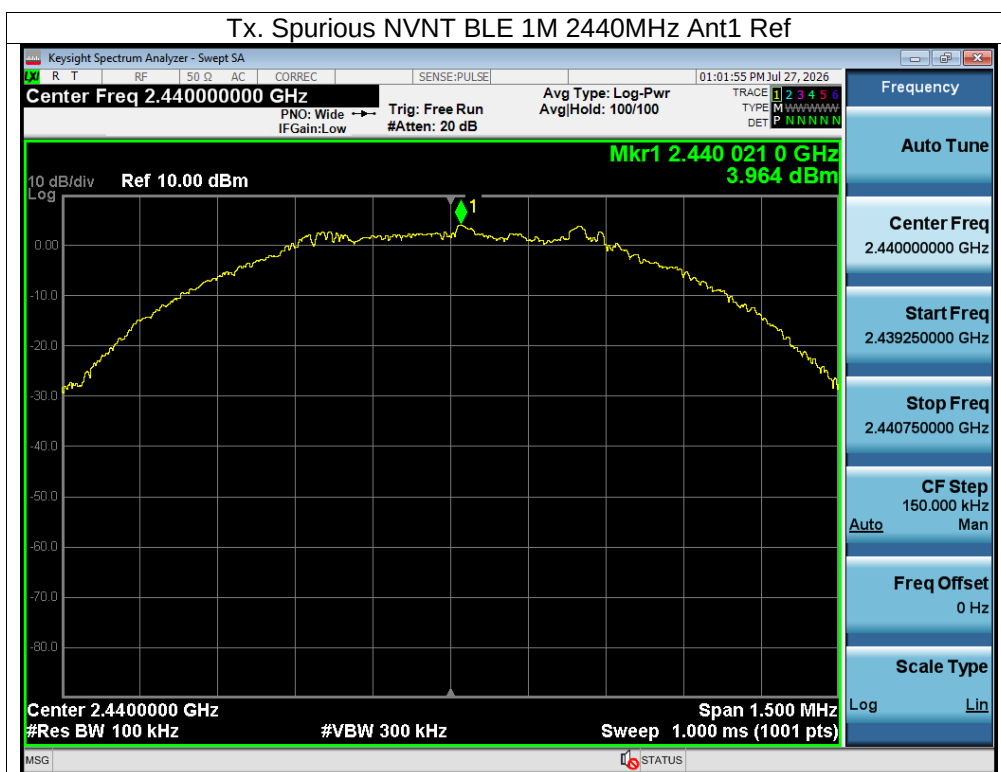


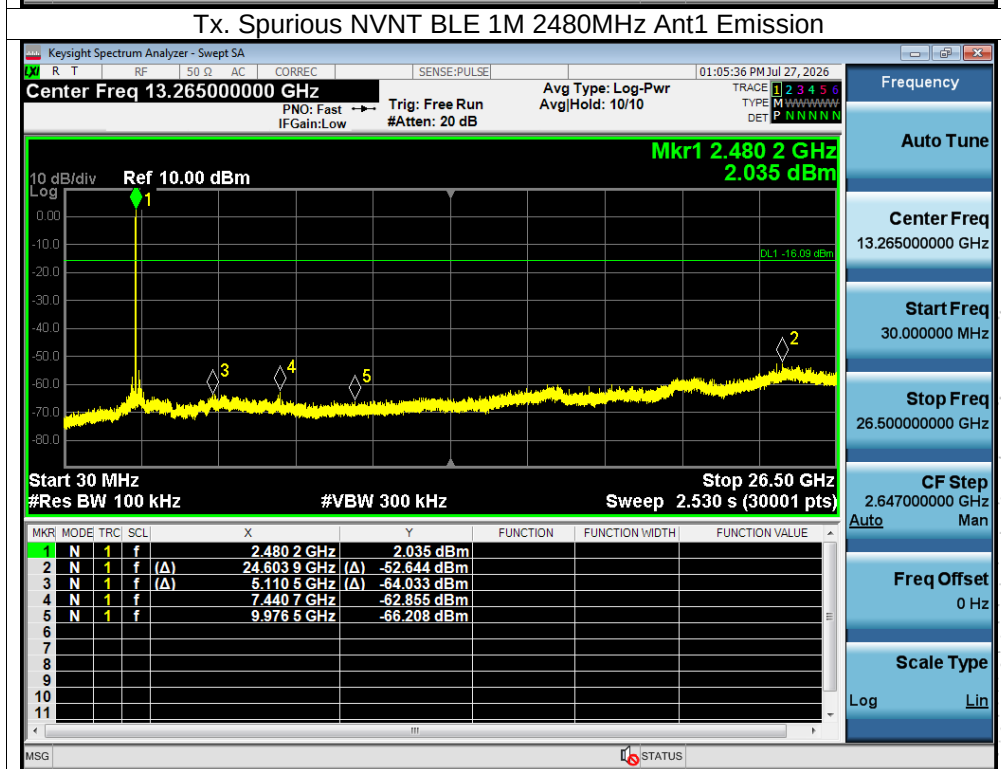
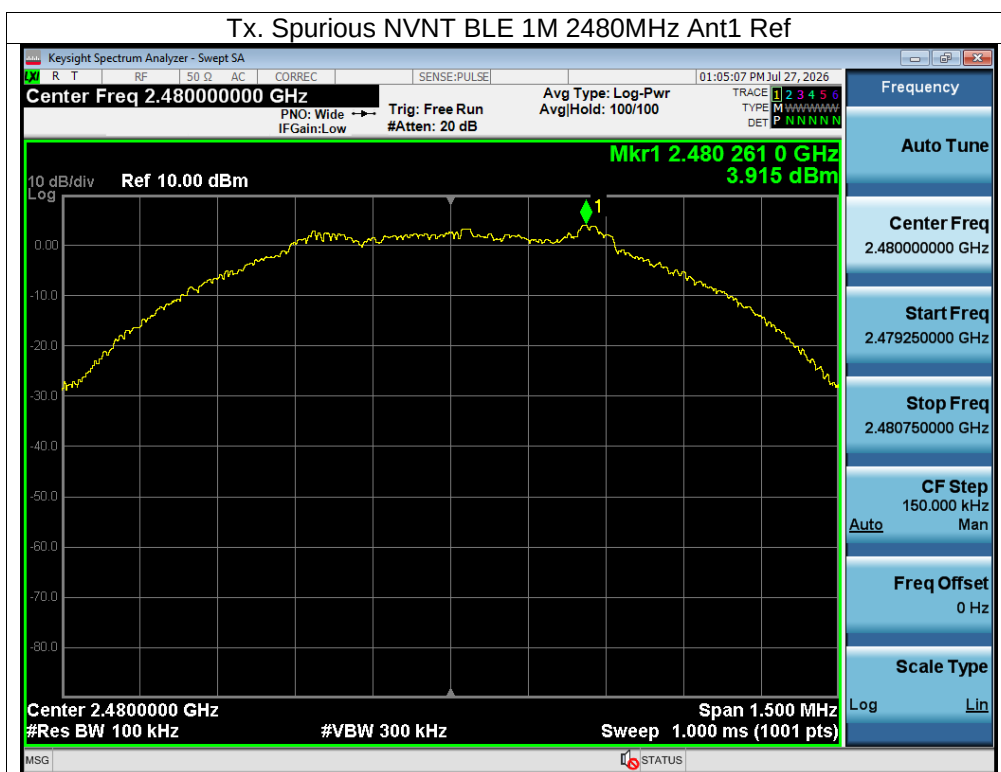


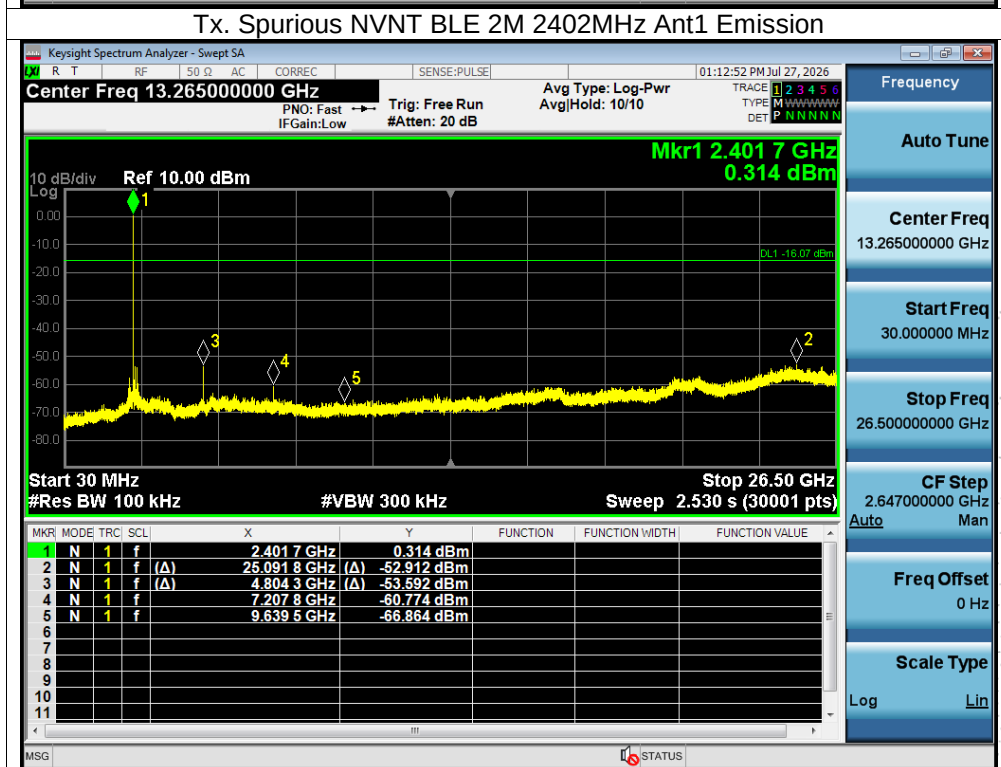
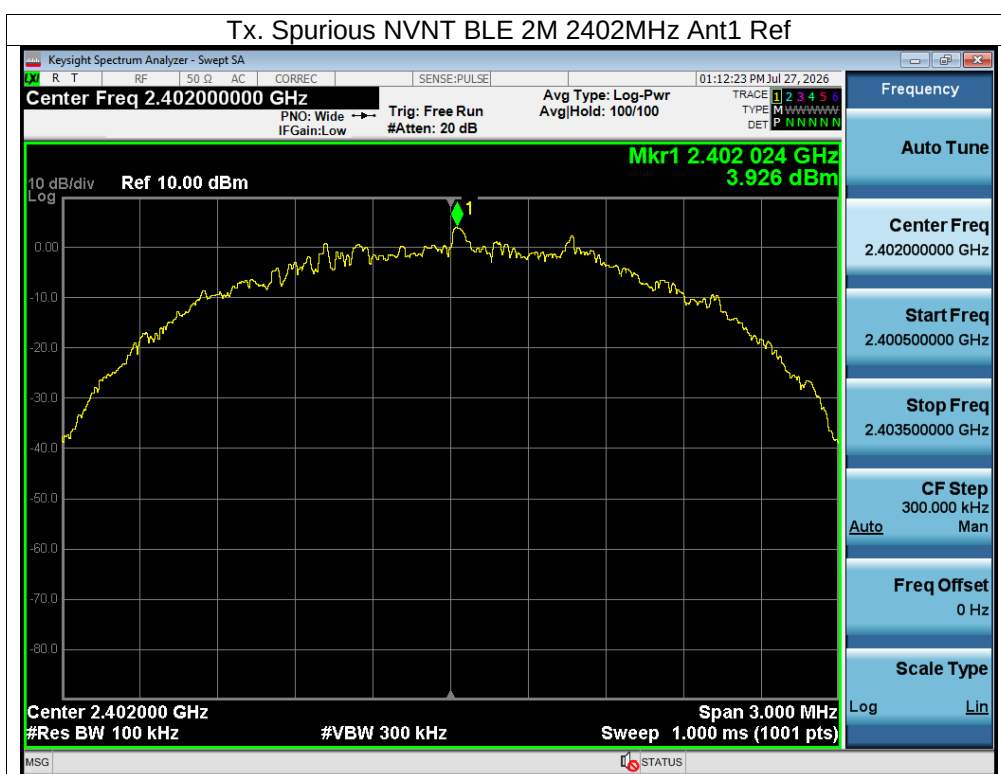
CO., LTD

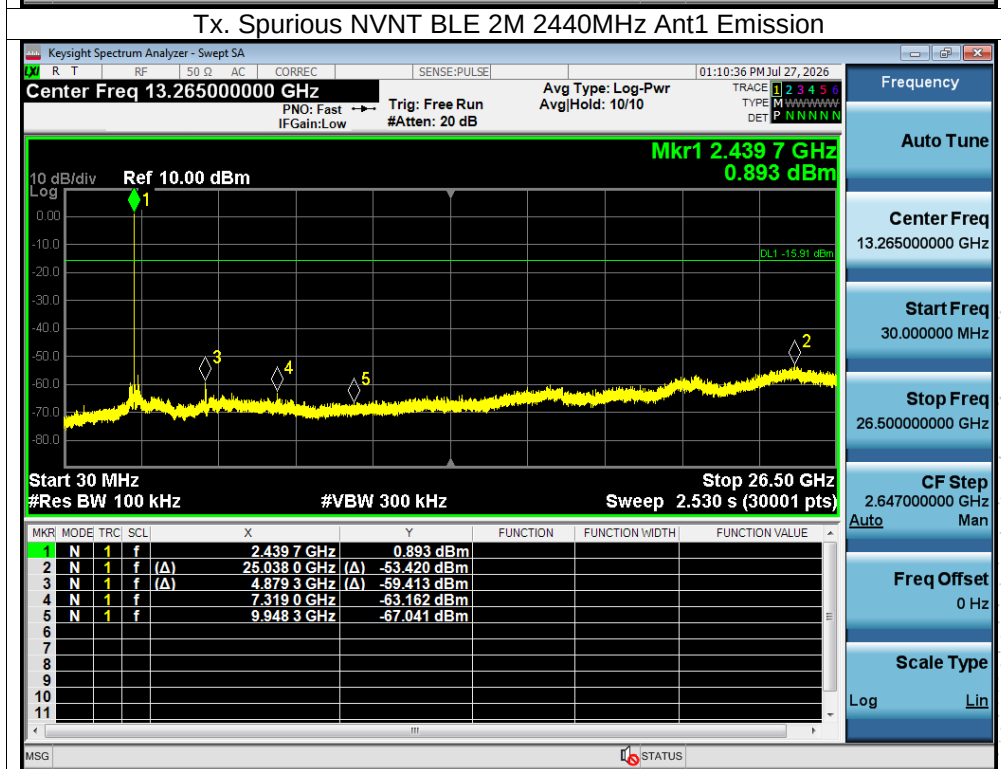
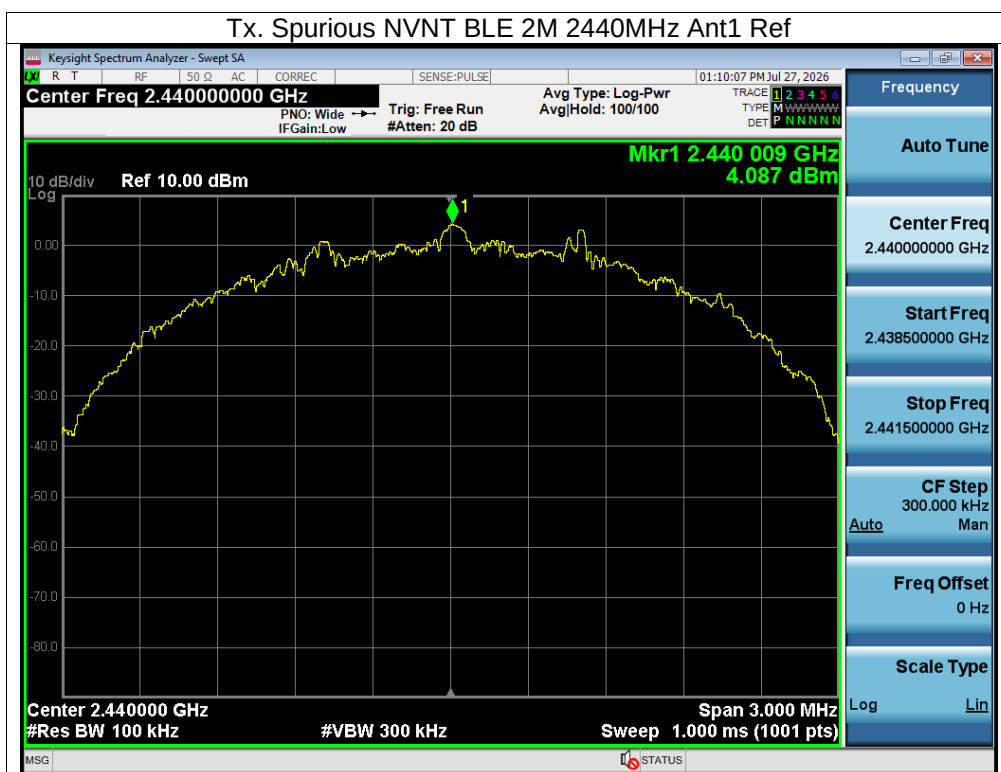
## Conducted Emission Measurement

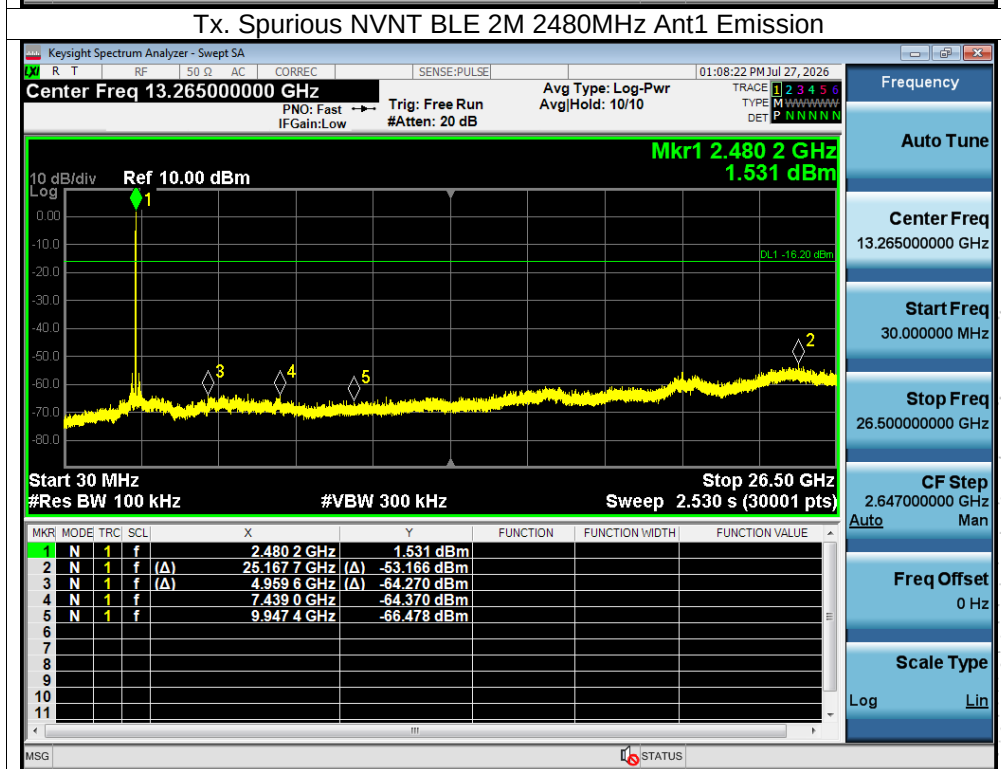
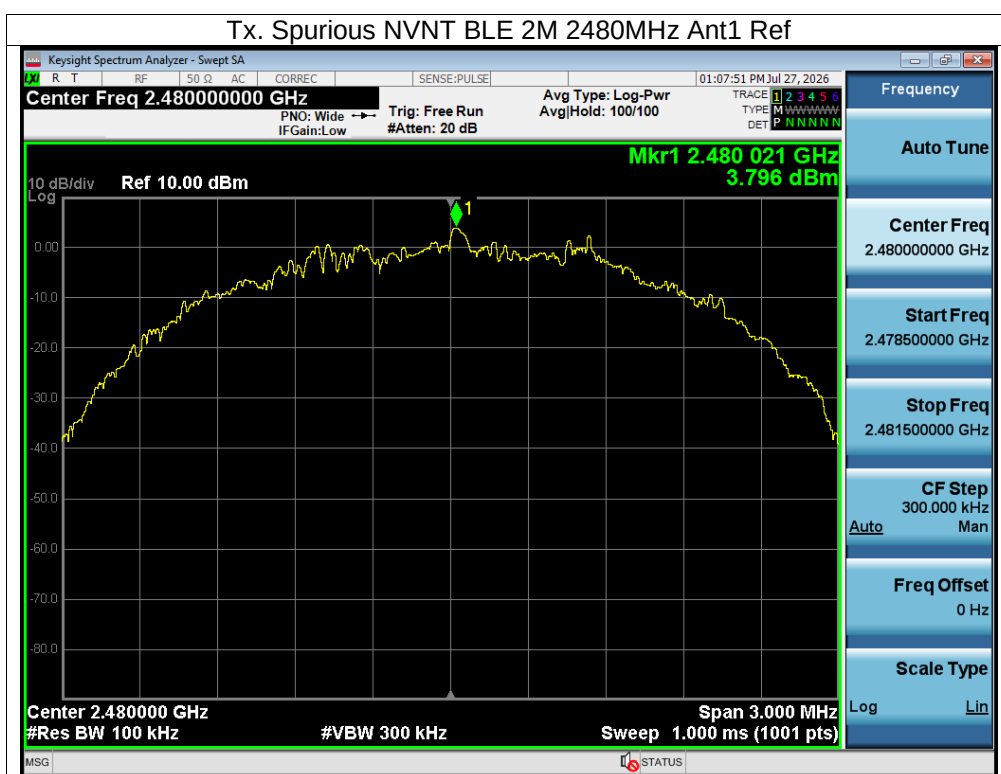












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## 13. Antenna Requirement

### 13.1 Limit

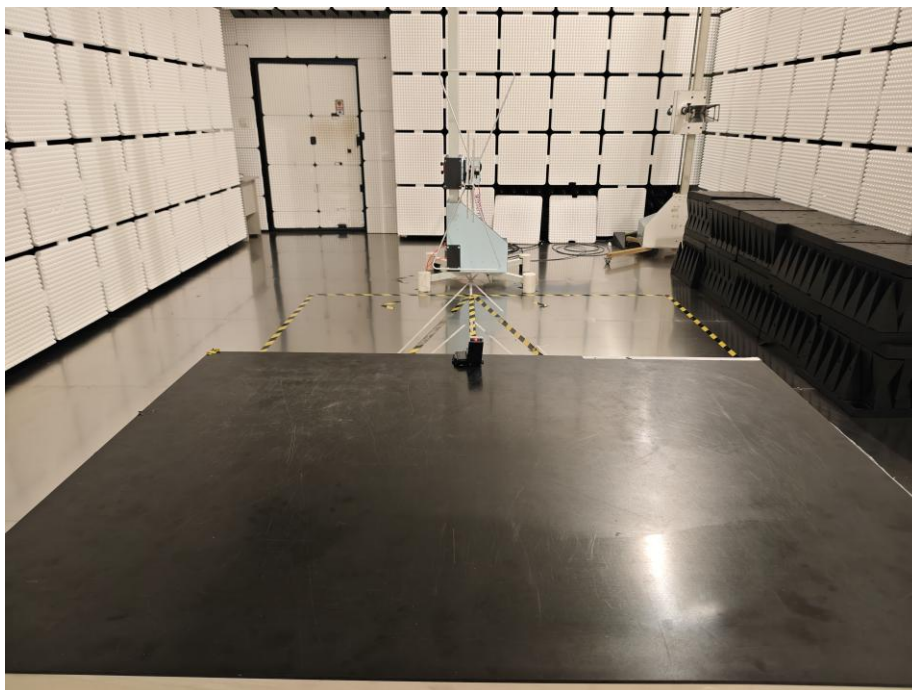
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

### 13.2 Test Result

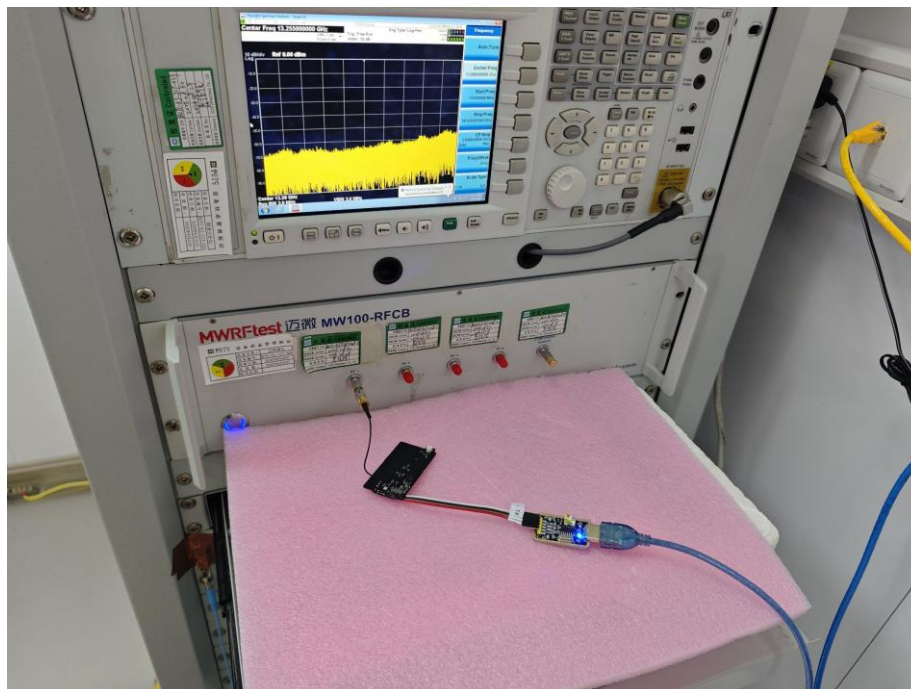
The EUT antenna is PCB antenna, fulfill the requirement of this section.

## 14. EUT Test Setup Photographs

### Radiated Measurement Photos



RF Conducted



TECHNOLOGY  
BCTC  
APPROVED  
Signature Seal

## STATEMENT

1. The equipment lists are traceable to the International System of Units (SI)
2. The test report can not be partially copied unless prior written approval is issued from our lab.
3. The test report is invalid without the "special seal for inspection and testing".
4. The test report is invalid without the signature of the approver.
5. The test process and test result is only related to the Unit Under Test.
6. Sample information is provided by the client and the laboratory is not responsible for its authenticity.
7. The quality system of our laboratory is in accordance with ISO/IEC 17025:2017.
8. If there is any objection to this test report, the client should inform issuing laboratory within 15 days from the date of receiving test report.

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\*\*\*\*\* END \*\*\*\*\*

