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# FCC Test Report

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Report No.: AGC00174211202FE03

**FCC ID** : XPYANNAB4

**APPLICATION PURPOSE** : Original Equipment

**PRODUCT DESIGNATION** : ANNA-B4

**BRAND NAME** : u-blox

**MODEL NAME** : ANNA-B402, ANNA-B412

**APPLICANT** : u-blox AG

**DATE OF ISSUE** : Mar. 11, 2022

**STANDARD(S)** : FCC Part 15.247

**REPORT VERSION** : V1.0

Attestation of Global Compliance (Shenzhen) Co., Ltd



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**REPORT REVISE RECORD**

| Report Version | Revise Time | Issued Date   | Valid Version | Notes           |
|----------------|-------------|---------------|---------------|-----------------|
| V1.0           | /           | Mar. 11, 2022 | Valid         | Initial Release |

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## 1. VERIFICATION OF COMPLIANCE

|                                  |  |
|----------------------------------|--|
| <b>Applicant</b>                 | u-blox AG  |
| <b>Address</b>                   | Zuercherstrasse 68, Thalwil 8800, Switzerland  |
| <b>Manufacturer</b>              | u-blox AG  |
| <b>Address</b>                   | Zuercherstrasse 68, Thalwil 8800, Switzerland  |
| <b>Product Designation</b>       | ANNA-B4  |
| <b>Brand Name</b>                | u-blox   |
| <b>Test Model</b>                | ANNA-B402  |
| <b>Series Model</b>              | ANNA-B412  |
| <b>Declaration of Difference</b> | All the same except for the model names and use. (Compared to ANNA-B402, there is an additional SWD protection circuit on ANNA-B412. This SWD protection circuit will NOT affect radio characteristics.) |
| <b>Date of test</b>              | Jan. 05, 2022 to Mar. 11, 2022   |
| <b>Deviation</b>                 | No any deviation from the test method  |
| <b>Condition of Test Sample</b>  | Normal   |
| <b>Test Result</b>               | Pass   |
| <b>Report Template</b>           | AGCRT-US-BLE/RF  |

We hereby certify that:

The above equipment was tested by Attestation of Global Compliance (Shenzhen) Co., Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with radiated emission limits of FCC part 15.247.

Prepared By



Cool Cheng  
(Project Engineer)

Mar. 11, 2022

Reviewed By



Calvin Liu  
(Reviewer)

Mar. 11, 2022

Approved By



Max Zhang  
(Authorized Officer)

Mar. 11, 2022

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## 2. GENERAL INFORMATION

### 2.1. PRODUCT DESCRIPTION

The EUT is designed as a “ANNA-B4”. It is designed by way of utilizing the GFSK technology to achieve the system operation.

A major technical description of EUT is described as following

|                            |  |
|----------------------------|--|
| <b>Operation Frequency</b> | 2.402GHz to 2.480GHz   |
| <b>RF Output Power</b>     | 7.333dBm (Max)   |
| <b>Modulation</b>          | GFSK   |
| <b>Number of channels</b>  | 79 Channels  |
| <b>Antenna Designation</b> | See section 2.8 and 2.9 of the report (Comply with requirements of the FCC part 15.203)  |
| <b>Antenna Gain</b>        | Antenna 1: 5dBi(FXP72.07.0053A)<br>Antenna 2: 4dBi(FXP74.07.0100A)<br>Antenna 3: 2.5dBi(FXP75.07.0045B)<br>Antenna 4: 0.9dBi(PC17.07.0070A)<br>Antenna 5: 0.5dBi(AT1608-A2R4NAA) |
| <b>Hardware Version</b>    | A  |
| <b>Software Version</b>    | V1.0   |
| <b>Power Supply</b>        | DC 3.3V by control board   |

**Note:**

1. All antennas have been tested, and antenna 1 has the worst test data so it is recorded in this report.
2. All the models would be marketed with the CRYSTAL A(EPSON FA-118T) or the CRYSTAL B(Taisaw TZ 3124CIW-B4017). Both of them have the same size and radio parameters. The version of the CRYSTAL A had been tested with all the items and the version of the CRYSTAL B only had been tested with bandwidth test and RF output power test for the difference.

### 2.2. TABLE OF CARRIER FREQUENCIES

| Frequency Band | Channel Number | Frequency |
|----------------|----------------|-----------|
| 2402~2480MHz   | 0              | 2402 MHz  |
|                | 1              | 2403 MHz  |
|                | :              | :         |
|                | 38             | 2440 MHz  |
|                | 39             | 2441 MHz  |
|                | 40             | 2442 MHz  |
|                | :              | :         |
|                | 77             | 2479 MHz  |
|                | 78             | 2480 MHz  |

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### 2.3. RELATED SUBMITTAL(S)/GRANT(S)

This submittal(s) (test report) is intended for **FCC ID: XPYANNAB4** filing to comply with the FCC Part 15.247 requirements.

### 2.4. TEST METHODOLOGY

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10 (2013). Radiated testing was performed at an antenna to EUT distance 3 meters.

### 2.5. SPECIAL ACCESSORIES

Refer to section 5.2.

### 2.6. EQUIPMENT MODIFICATIONS

Not available for this EUT intended for grant.

### 2.7. ANTENNA REQUIREMENT

This intentional radiator is designed with a permanently attached antenna of an antenna to ensure that no antenna other than that furnished by the responsible party shall be used with the device. For more information of the antenna, please refer to the APPENDIX B: PHOTOGRAPHS OF EUT.

### 2.8. DESCRIPTION OF AVAILABLE ANTENNAS

| Dedicated Antenna       |                      |                     |                      |                     |
|-------------------------|----------------------|---------------------|----------------------|---------------------|
| Model No                | ANNA-B402            |                     | ANNA-B412            |                     |
| Antenna Type            | Frequency Band (GHz) | Max Peak Gain (dBi) | Frequency Band (GHz) | Max Peak Gain (dBi) |
| FPC antenna             | 2400~2483.5          | 5                   | 2400~2483.5          | 5                   |
| FPC antenna             | 2400~2483.5          | 4                   | 2400~2483.5          | 4                   |
| FPC antenna             | 2400~2483.5          | 2.5                 | 2400~2483.5          | 2.5                 |
| FPC antenna             | 2400~2483.5          | 0.9                 | 2400~2483.5          | 0.9                 |
| Multilayer Chip antenna | 2400~2483.5          | 0.5                 | 2400~2483.5          | 0.5                 |




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## 2.9. DESCRIPTION OF ANTENNA RF PORT

| Antenna RF Port                       |                           |  |
|---------------------------------------|---------------------------|--|
| Model No                              | ANNA-B402                 | ANNA-B412  |
| ANNA-B4 two model versions series use | Version tailored for OEMs | Pre-flashed u-blox Connectivity Software version |

|   |   |  |
|---|---|--|
|  <p> <input type="checkbox"/> EVK-ANNA-B402U/B412U<br/> <input type="checkbox"/> ANNA-B4 module<br/> <input type="checkbox"/> Reference design for module with U.FL connector         </p> |  <p> <input type="checkbox"/> EVK-ANNA-B402C/B412C<br/> <input type="checkbox"/> ANNA-B4 module<br/> <input type="checkbox"/> Antenna reference design for module being mounted at the corner of the board         </p> |  <p> <input type="checkbox"/> EVK-ANNA-B402E/B412E<br/> <input type="checkbox"/> ANNA-B4 module<br/> <input type="checkbox"/> Antenna reference design for module being mounted on edge of the board         </p> |
|---|---|--|

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### 3. MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement  $y \pm U$ , where expanded uncertainty  $U$  is based on a standard uncertainty multiplied by a coverage factor of  $k=2$ , providing a level of confidence of approximately 95%.

| Item  | Measurement Uncertainty    |
|---|----------------------------|
| Uncertainty of Conducted Emission for AC Port | $U_c = \pm 2.9 \text{ dB}$ |
| Uncertainty of Radiated Emission below 1GHz   | $U_c = \pm 3.8 \text{ dB}$ |
| Uncertainty of Radiated Emission above 1GHz   | $U_c = \pm 4.4 \text{ dB}$ |
| Uncertainty of total RF power, conducted      | $U_c = \pm 0.8 \text{ dB}$ |
| Uncertainty of RF power density, conducted    | $U_c = \pm 2.6 \text{ dB}$ |
| Uncertainty of spurious emissions, conducted  | $U_c = \pm 2 \%$           |
| Uncertainty of Occupied Channel Bandwidth     | $U_c = \pm 2 \%$           |

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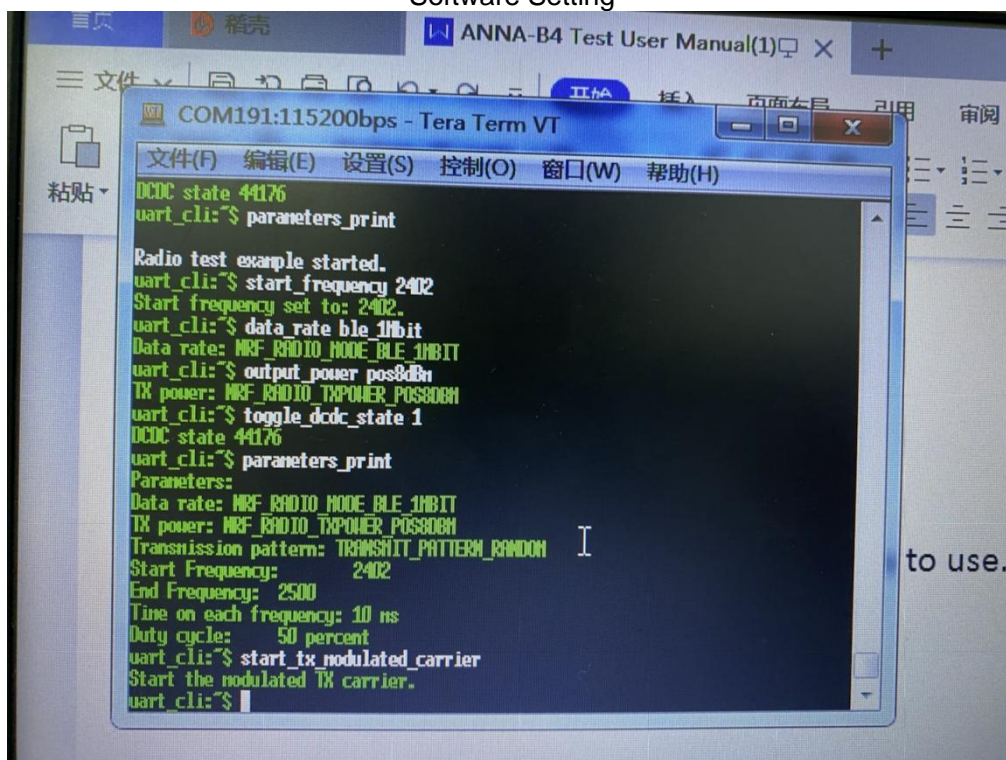
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#### 4. DESCRIPTION OF TEST MODES

| NO. | TEST MODE DESCRIPTION       |
|-----|-----------------------------|
| 1   | Low channel TX (2402MHz)    |
| 2   | Middle channel TX (2441MHz) |
| 3   | High channel TX (2480MHz)   |

- Note: 1. Only the result of the worst case was recorded in the report, if no other cases.  
2. For Radiated Emission, 3axis were chosen for testing for each applicable mode.  
3. For Conducted Test method, a temporary antenna connector is provided by the manufacture.

#### Software Setting

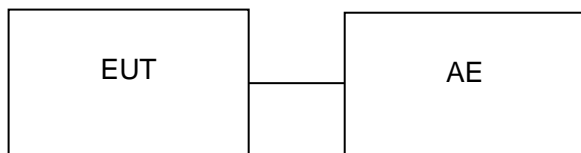


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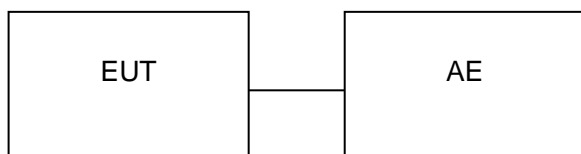
## 5. SYSTEM TEST CONFIGURATION

### 5.1. CONFIGURATION OF TESTED SYSTEM

Radiated Emission Configure:



Conducted Emission Configure:



### 5.2. EQUIPMENT USED IN TESTED SYSTEM

| Item | Equipment    | Model No.    | ID or Specification | Remark |
|------|--------------|--------------|---------------------|--------|
| 1    | ANNA-B4      | ANNA-B402    | XPYANNAB4           | EUT    |
| 2    | Mobile phone | Mate 30      | N/A                 | AE     |
| 3    | PC           | N/A          | N/A                 | AE     |
| 4    | PC adapter   | HW-059200CHQ | 1.5m unshielded     | AE     |

### 5.3. SUMMARY OF TEST RESULTS

| FCC RULES     | DESCRIPTION OF TEST                    | RESULT    |
|---------------|--|-----------|
| 15.247 (b)(3) | Peak Output Power                      | Compliant |
| 15.247 (a)(2) | 6 dB Bandwidth                         | Compliant |
| 15.247 (d)    | Conducted Spurious Emission            | Compliant |
| 15.247 (e)    | Maximum Conducted Output Power Density | Compliant |
| 15.209        | Radiated Emission                      | Compliant |
| 15.207        | Conducted Emission                     | Compliant |

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## 6. TEST FACILITY

|  |  |
|--|--|
| <b>Test Site</b>                         | Attestation of Global Compliance (Shenzhen) Co., Ltd   |
| <b>Location</b>                          | 1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China |
| <b>Designation Number</b>                | CN1259   |
| <b>FCC Test Firm Registration Number</b> | 975832   |
| <b>A2LA Cert. No.</b>                    | 5054.02  |
| <b>Description</b>                       | Attestation of Global Compliance (Shenzhen) Co., Ltd is accredited by A2LA   |

### TEST EQUIPMENT OF CONDUCTED EMISSION TEST

| Equipment                | Manufacturer | Model                    | S/N    | Cal. Date     | Cal. Due      |
|--------------------------|--------------|--------------------------|--------|---------------|---------------|
| Test Receiver            | R&S          | ESPI                     | 101206 | May.11, 2021  | May.10, 2022  |
| Artificial power network | R&S          | ESH2-Z5                  | 100086 | Jun. 09, 2021 | Jun. 08, 2022 |
| Test Software            | FARA         | EZ-EMC(Ver. AGC-CON03A1) | N/A    | N/A           | N/A           |

### TEST EQUIPMENT OF RADIATED EMISSION TEST

| Equipment                      | Manufacturer   | Model              | S/N        | Cal. Date     | Cal. Due      |
|--------------------------------|----------------|--------------------|------------|---------------|---------------|
| Test Receiver                  | R&S            | ESCI               | 100034     | Sep. 06, 2021 | Sep. 05, 2022 |
| EXA Signal Analyzer            | Aglient        | N9010A             | MY53470504 | Nov. 17, 2021 | Nov. 16, 2022 |
| 2.4GHz Filter                  | EM Electronics | 2400-2500MHz       | N/A        | Mar. 23, 2020 | Mar. 22, 2022 |
| Attenuator                     | ZHINAN         | E-002              | N/A        | Sep. 03, 2020 | Sep. 02, 2022 |
| Horn Antenna                   | SCHWARZBECK    | BBHA9170           | 768        | Oct. 31, 2021 | Oct. 30, 2023 |
| Active loop antenna (9K-30MHz) | ZHINAN         | ZN30900C           | 18051      | May 22, 2020  | May 21, 2022  |
| preamplifier                   | ChengYi        | EMC184045SE        | 980508     | Oct. 29, 2021 | Oct. 28, 2023 |
| Double-Ridged Waveguide Horn   | ETS LINDGREN   | 3117               | 00154520   | Sep. 06, 2021 | Sep. 05, 2023 |
| Preamplifier Assembly          | ETS LINDGREN   | 3117PA             | 00225134   | Sep. 03, 2020 | Sep. 02, 2022 |
| Wideband Antenna               | SCHWARZBECK    | VULB9168           | 494        | Jan. 08, 2021 | Jan. 07, 2023 |
| Test Software                  | FARA           | EZ-EMC(Ver.RA-03A) | N/A        | N/A           | N/A           |

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## 7. PEAK OUTPUT POWER

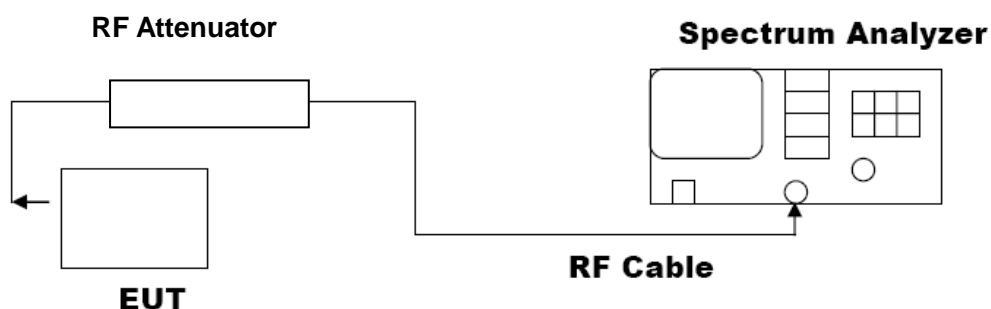
### 7.1. MEASUREMENT PROCEDURE

For peak power test:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2.  $RBW \geq DTS$  bandwidth.
3.  $VBW \geq 3 * RBW$ .
4.  $SPAN \geq VBW$ .
5. Sweep: Auto.
6. Detector function: Peak.
7. Trace: Max hold.

Allow trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power, after any corrections for external attenuators and cables.

### 7.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) PEAK POWER TEST SETUP



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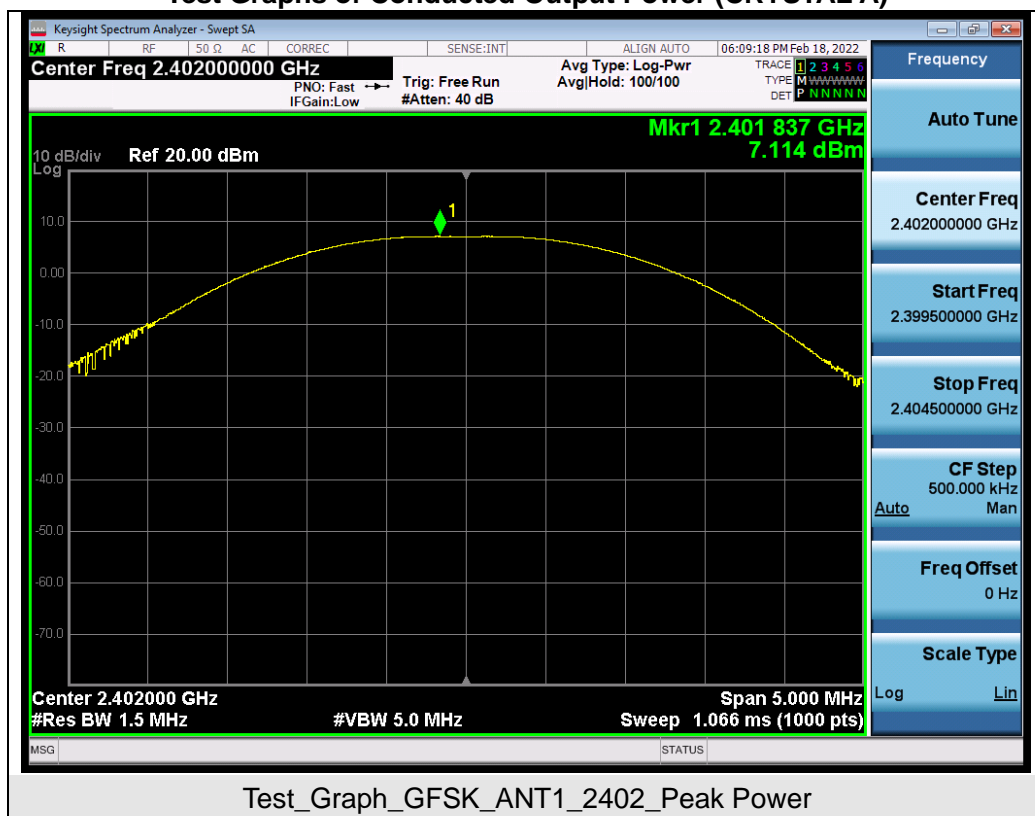
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### 7.3. LIMITS AND MEASUREMENT RESULT

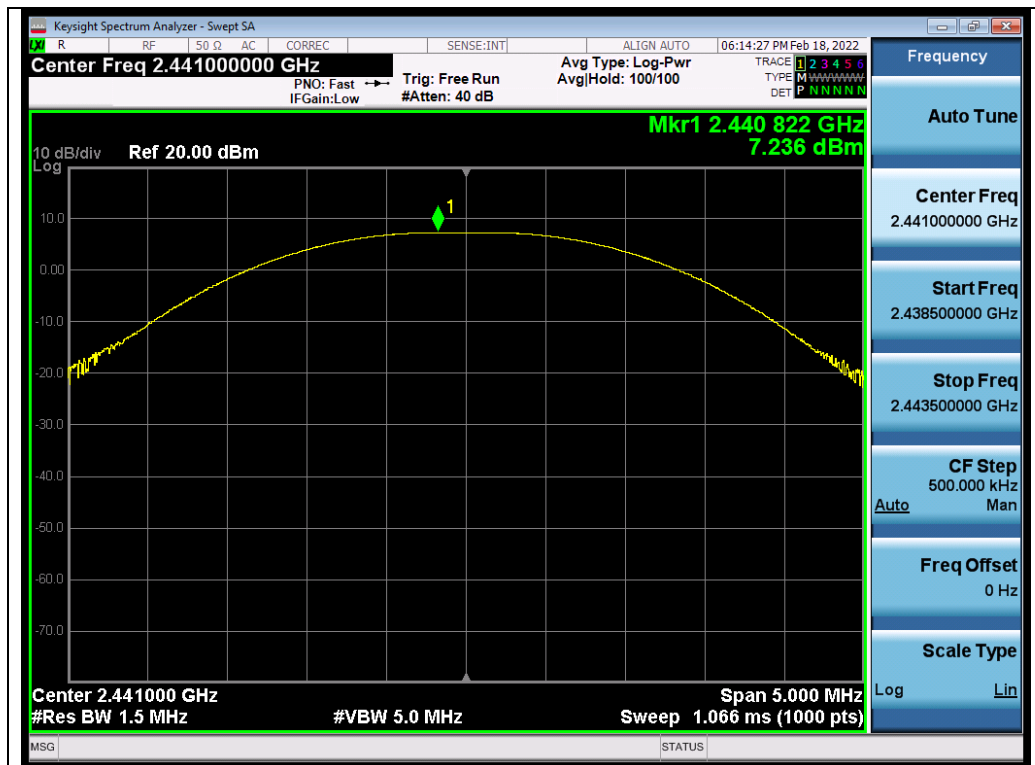
| Test Data of Conducted Output Power (CRYSTAL A) |                    |                  |              |              |
|---|--------------------|------------------|--------------|--------------|
| Test Mode                                       | Test Channel (MHz) | Peak Power (dBm) | Limits (dBm) | Pass or Fail |
| GFSK  | 2402               | 7.114            | $\leq 30$    | Pass         |
|   | 2441               | 7.236            | $\leq 30$    | Pass         |
|   | 2480               | 7.333            | $\leq 30$    | Pass         |
| Test Data of Conducted Output Power (CRYSTAL B) |                    |                  |              |              |
| Test Mode                                       | Test Channel (MHz) | Peak Power (dBm) | Limits (dBm) | Pass or Fail |
| GFSK  | 2402               | 7.171            | $\leq 30$    | Pass         |
|   | 2441               | 7.278            | $\leq 30$    | Pass         |
|   | 2480               | 7.358            | $\leq 30$    | Pass         |

### Test Graphs of Conducted Output Power (CRYSTAL A)



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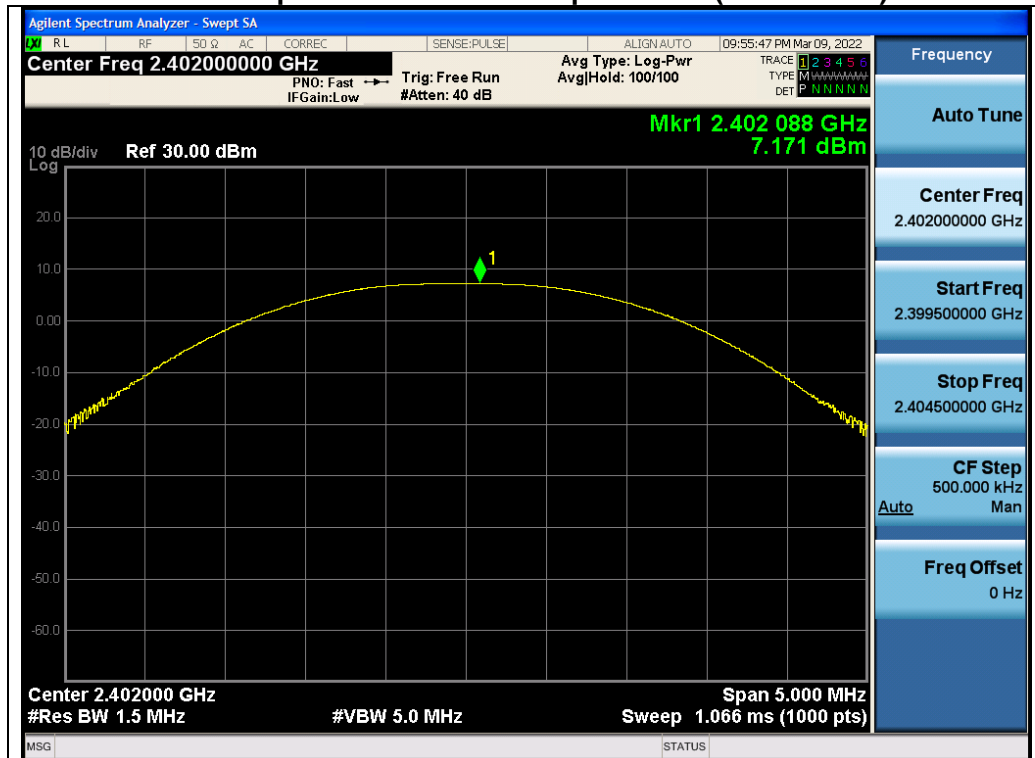
Test\_Graph\_GFSK\_ANT1\_2441\_Peak Power



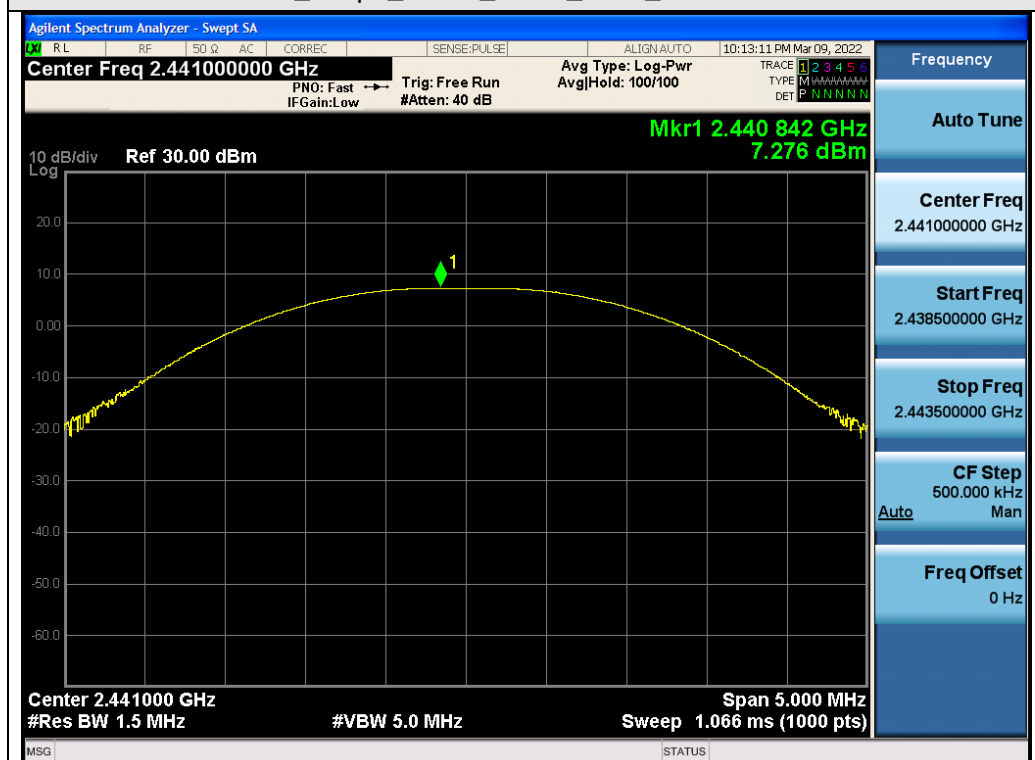
Test\_Graph\_GFSK\_ANT1\_2480\_Peak Power

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### Test Graphs of Conducted Output Power (CRYSTAL B)

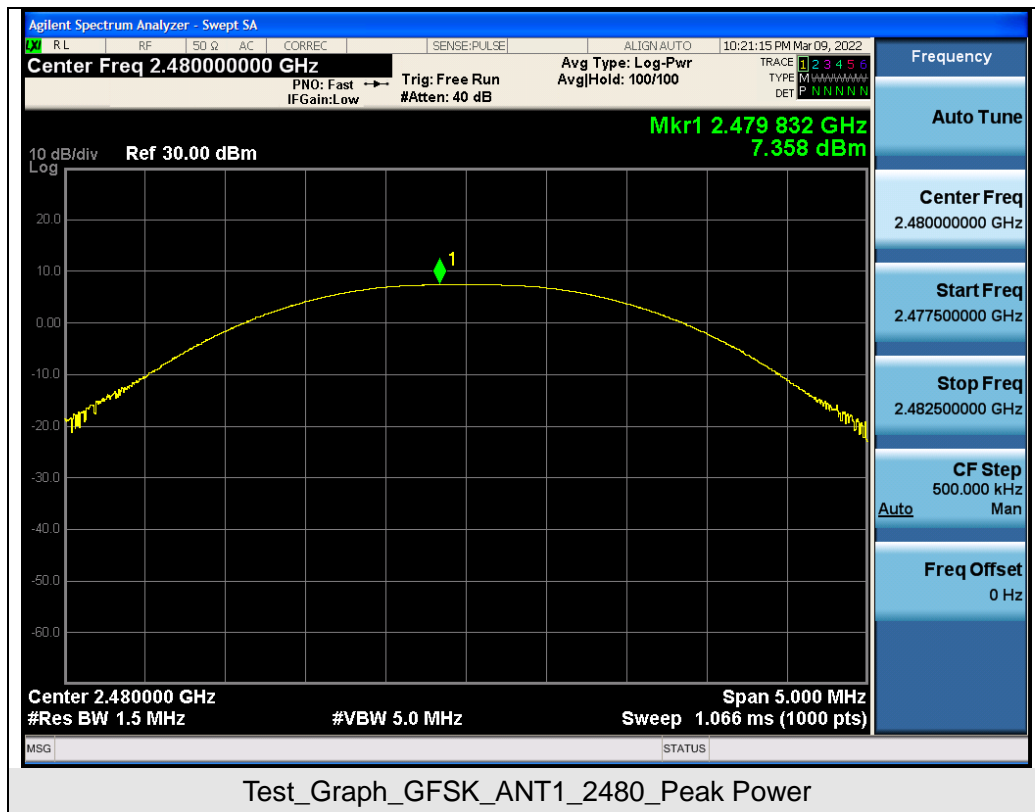


Test\_Graph\_GFSK\_ANT1\_2402\_Peak Power



Test\_Graph\_GFSK\_ANT1\_2441\_Peak Power

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## 8. BANDWIDTH

### 8.1. MEASUREMENT PROCEDURE

6dB bandwidth:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set SPA Centre Frequency = Operation Frequency, RBW= 100 kHz, VBW $\geq 3 \times$  RBW.
4. Set SPA Trace 1 Max hold, then View.

Occupied bandwidth:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel  
The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW; Sweep = auto; Detector function = peak
4. Set SPA Trace 1 Max hold, then View.

**Note:** The EUT was tested according to ANSI C63.10 for compliance to FCC PART 15.247 requirements.

### 8.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

The same as described in section 7.2.

### 8.3. LIMITS AND MEASUREMENT RESULTS

| Test Data of Occupied Bandwidth and DTS Bandwidth (CRYSTAL A) |                    |                              |                      |              |              |
|---|--------------------|------------------------------|----------------------|--------------|--------------|
| Test Mode   | Test Channel (MHz) | 99% Occupied Bandwidth (MHz) | -6dB Bandwidth (MHz) | Limits (MHz) | Pass or Fail |
| GFSK  | 2402               | 0.926                        | 0.504                | $\geq 0.5$   | Pass         |
|   | 2441               | 0.951                        | 0.503                | $\geq 0.5$   | Pass         |
|   | 2480               | 0.923                        | 0.501                | $\geq 0.5$   | Pass         |
| Test Data of Occupied Bandwidth and DTS Bandwidth (CRYSTAL B) |                    |                              |                      |              |              |
| Test Mode   | Test Channel (MHz) | 99% Occupied Bandwidth (MHz) | -6dB Bandwidth (MHz) | Limits (MHz) | Pass or Fail |
| GFSK  | 2402               | 0.956                        | 0.503                | $\geq 0.5$   | Pass         |
|   | 2441               | 0.927                        | 0.503                | $\geq 0.5$   | Pass         |
|   | 2480               | 0.921                        | 0.504                | $\geq 0.5$   | Pass         |

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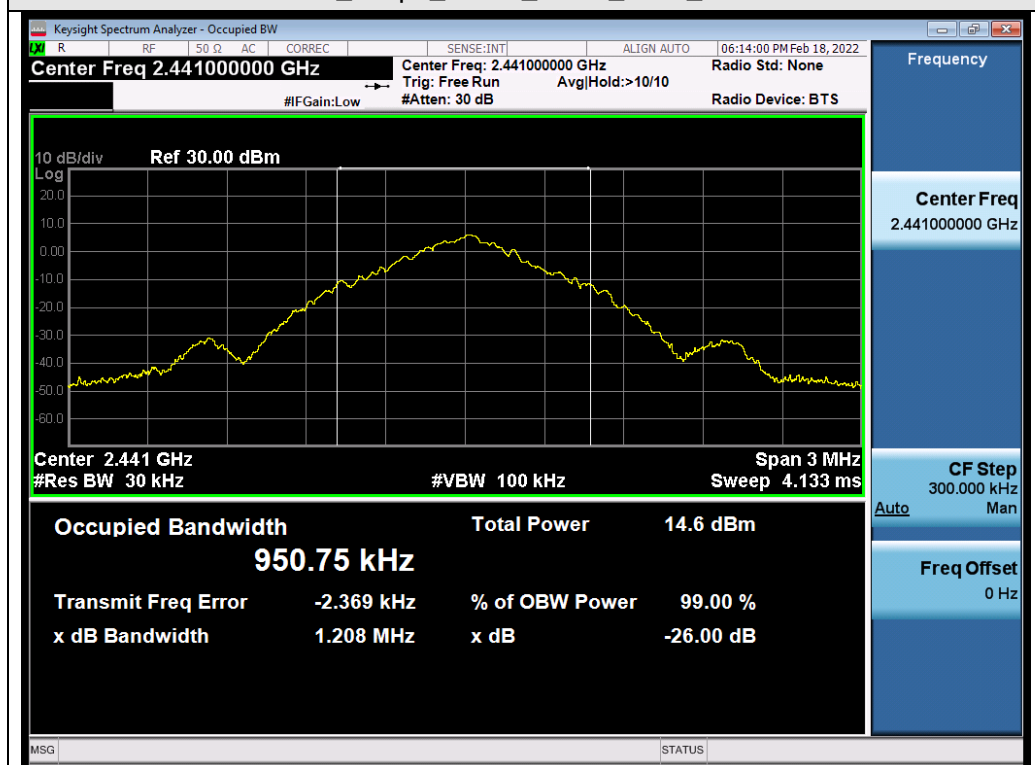
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### Test Graphs of Occupied Bandwidth (CRYSTAL A)

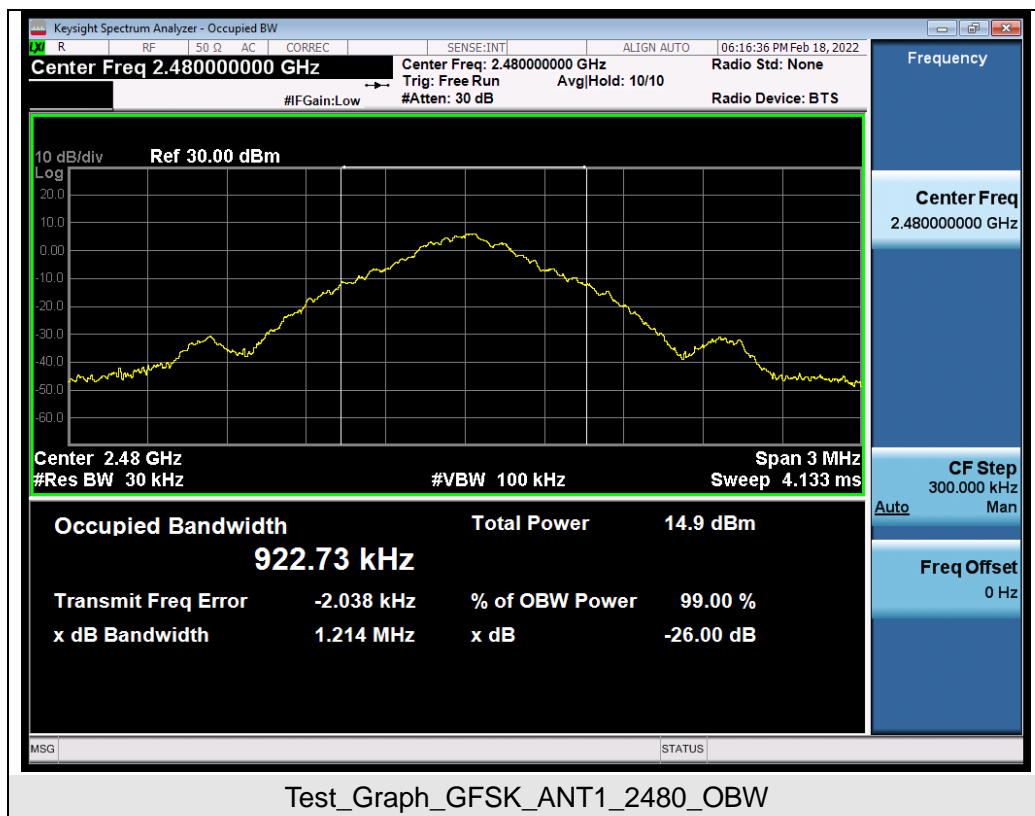


Test\_Graph\_GFSK\_ANT1\_2402\_OBW

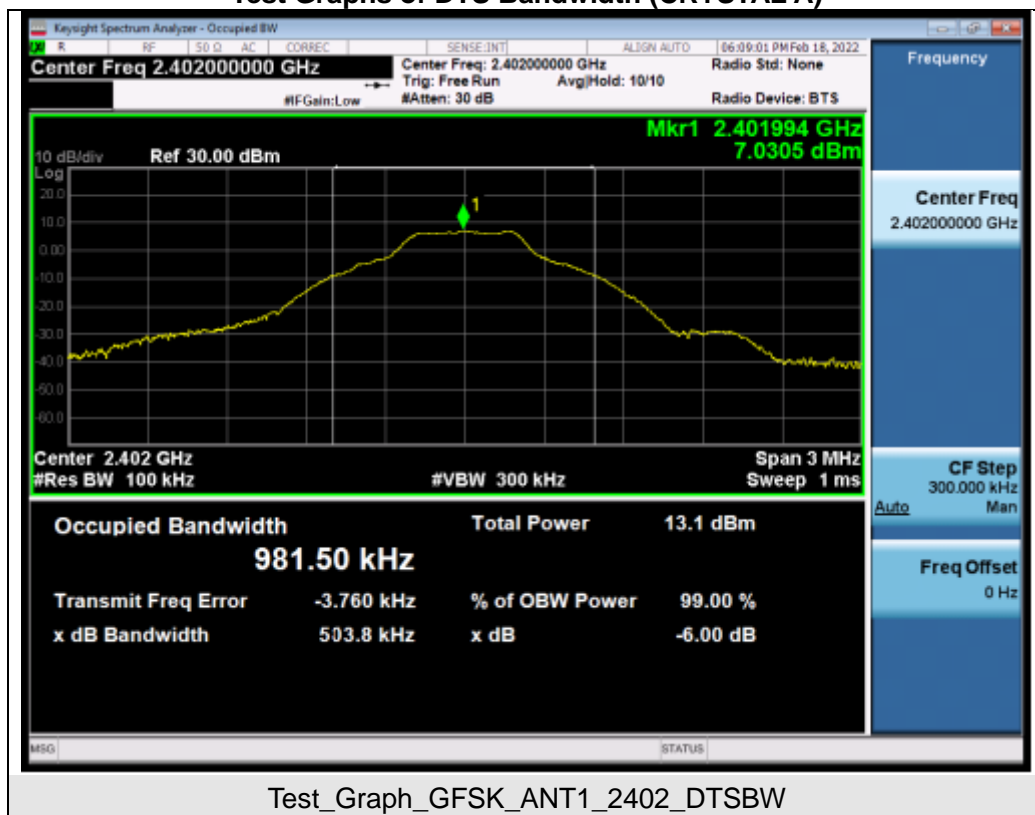


Test\_Graph\_GFSK\_ANT1\_2441\_OBW

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Test Graphs of DTS Bandwidth (CRYSTAL A)



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Test\_Graph\_GFSK\_ANT1\_2441\_DTSBW



Test\_Graph\_GFSK\_ANT1\_2480\_DTSBW

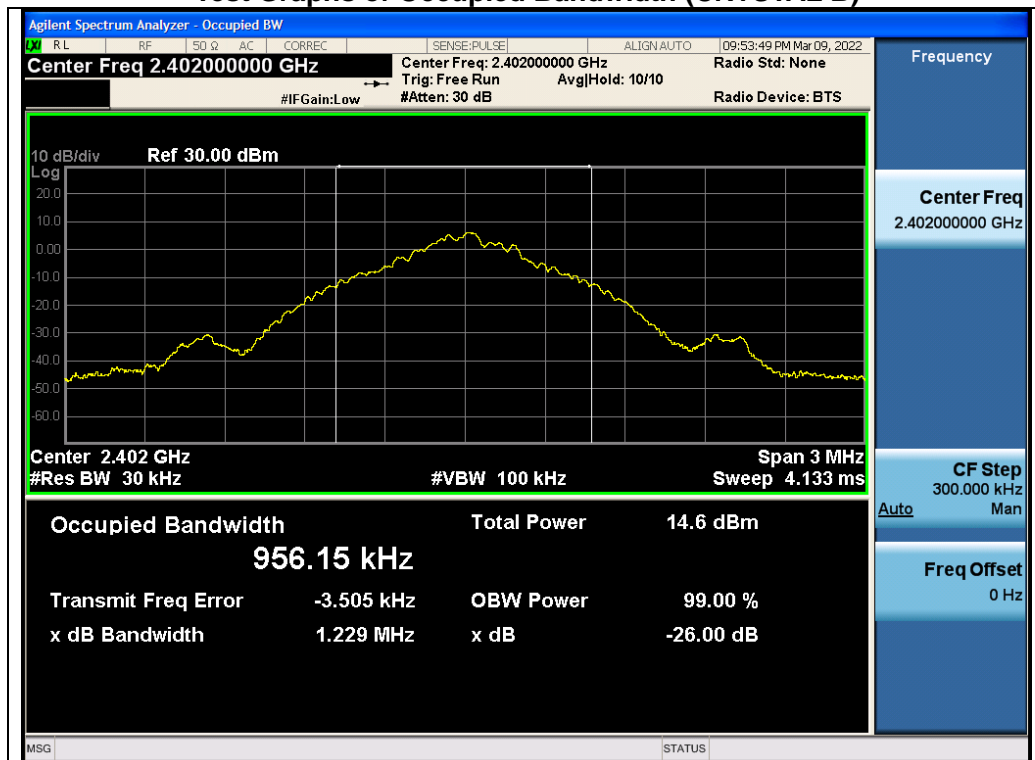
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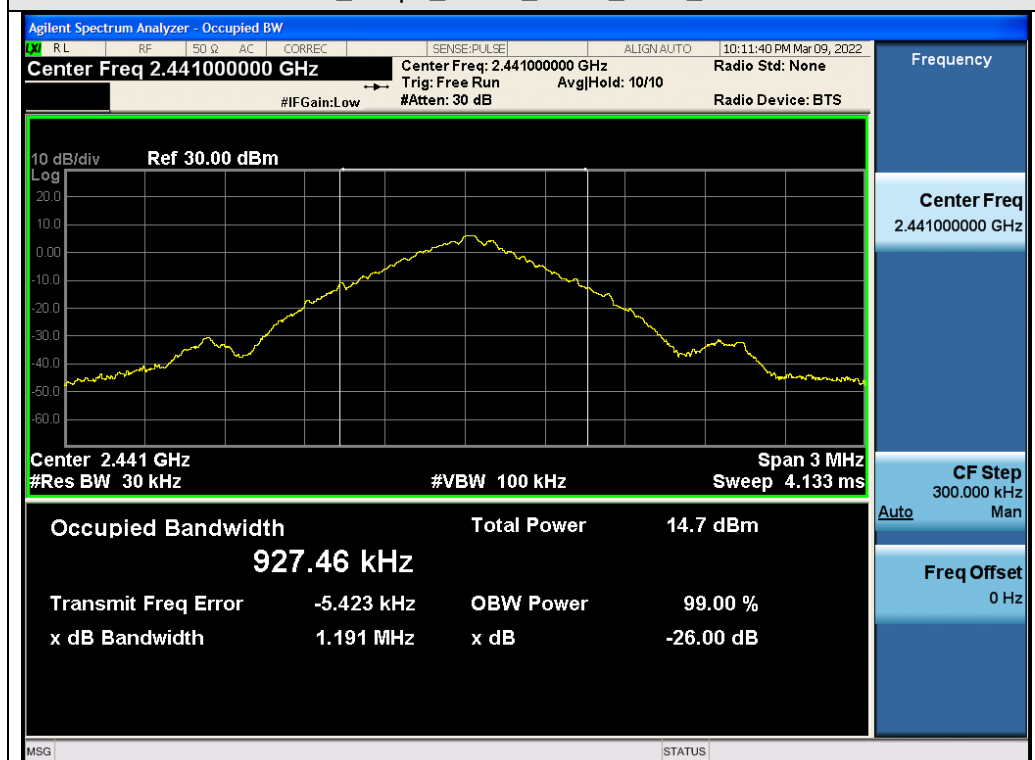
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### Test Graphs of Occupied Bandwidth (CRYSTAL B)

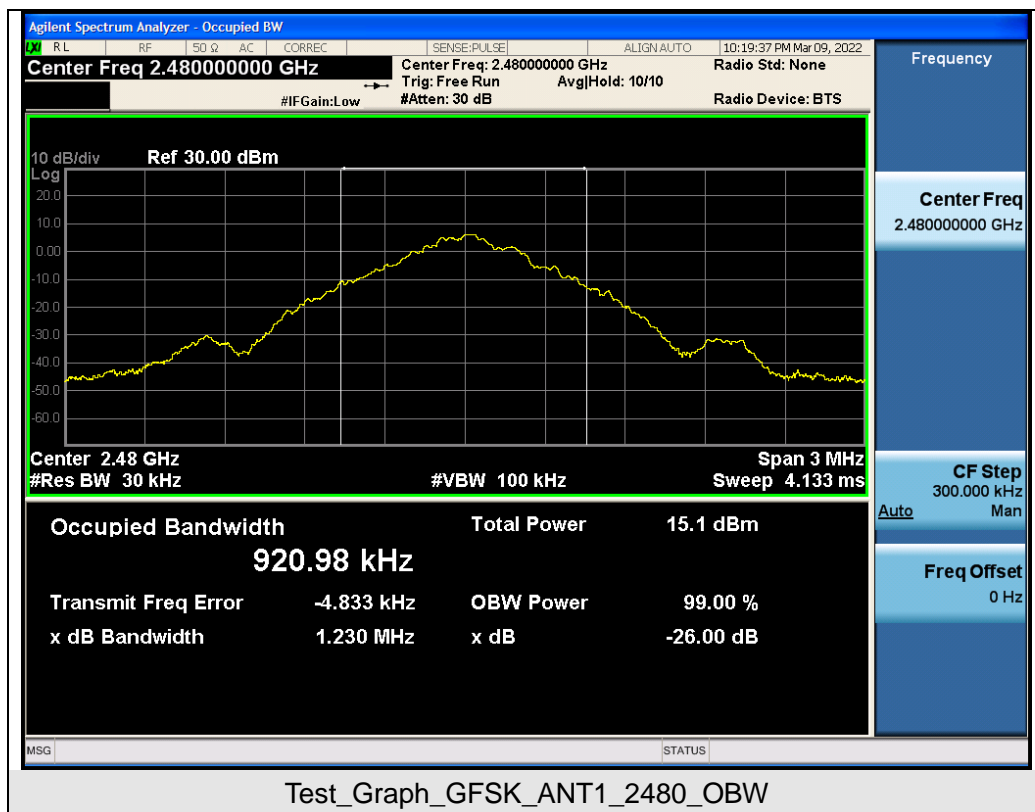


Test\_Graph\_GFSK\_ANT1\_2402\_OBW

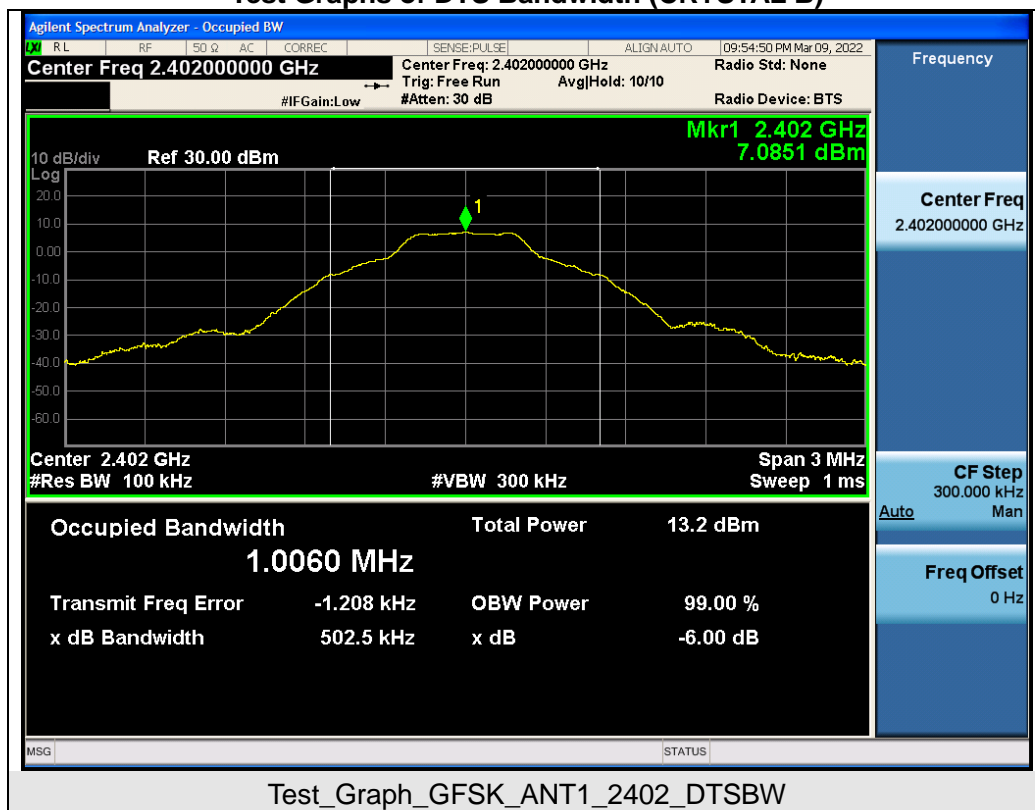


Test\_Graph\_GFSK\_ANT1\_2441\_OBW

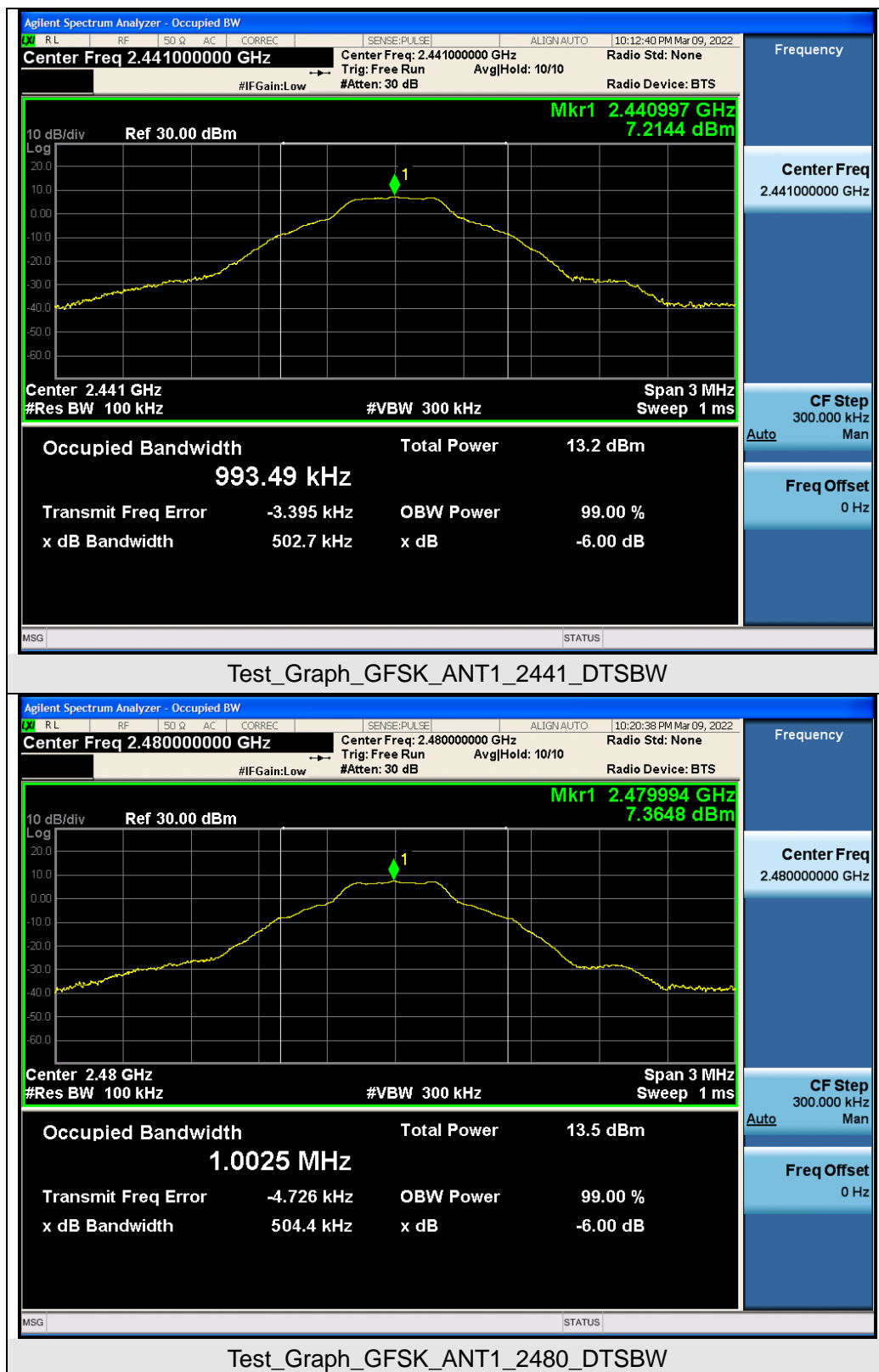
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Test Graphs of DTS Bandwidth (CRYSTAL B)



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## 9. CONDUCTED SPURIOUS EMISSION

### 9.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set SPA Trace 1 Max hold, then View.

**Note:** The EUT was tested according to ANSI C63.10 for compliance to FCC PART 15.247 requirements.

### 9.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

The same as described in section 7.2.

### 9.3. MEASUREMENT EQUIPMENT USED

The same as described in section 6.

### 9.4. LIMITS AND MEASUREMENT RESULT

| LIMITS AND MEASUREMENT RESULT  |  |          |
|--|--|----------|
| Applicable Limits  | Measurement Result                       |          |
|  | Test Data                                | Criteria |
| In any 100 kHz Bandwidth Outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produce by the intentional radiator shall be at least 20 dB below that in 100KHz bandwidth within the band that contains the highest level of the desired power. | At least -20dBc than the reference level | PASS     |

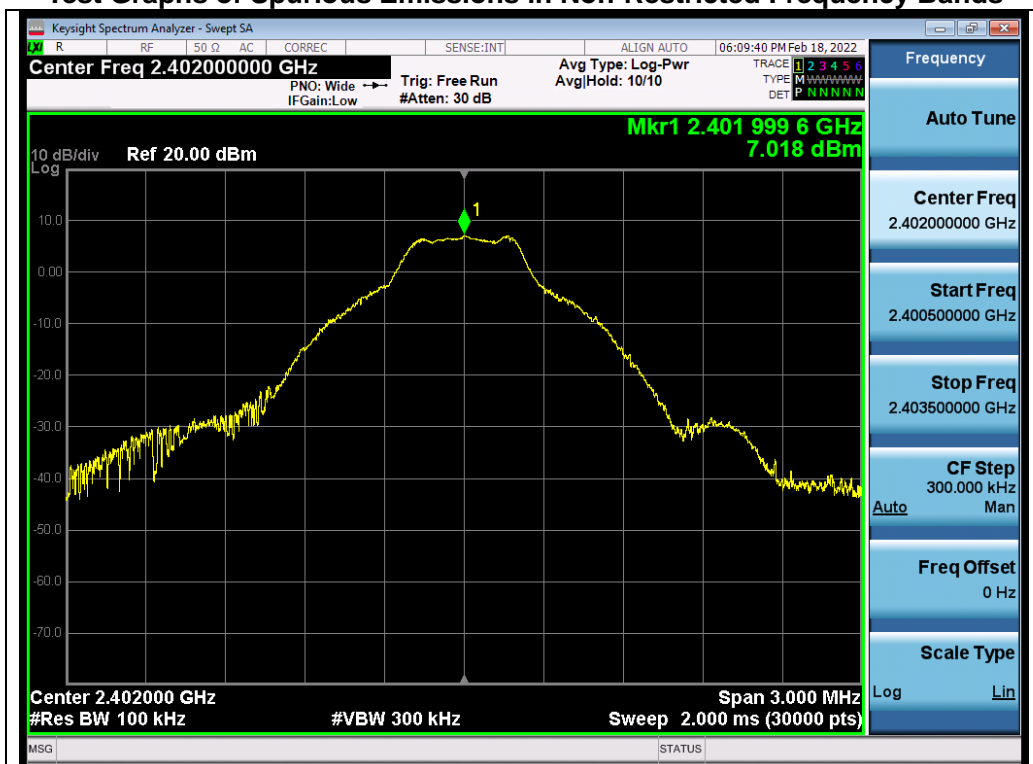
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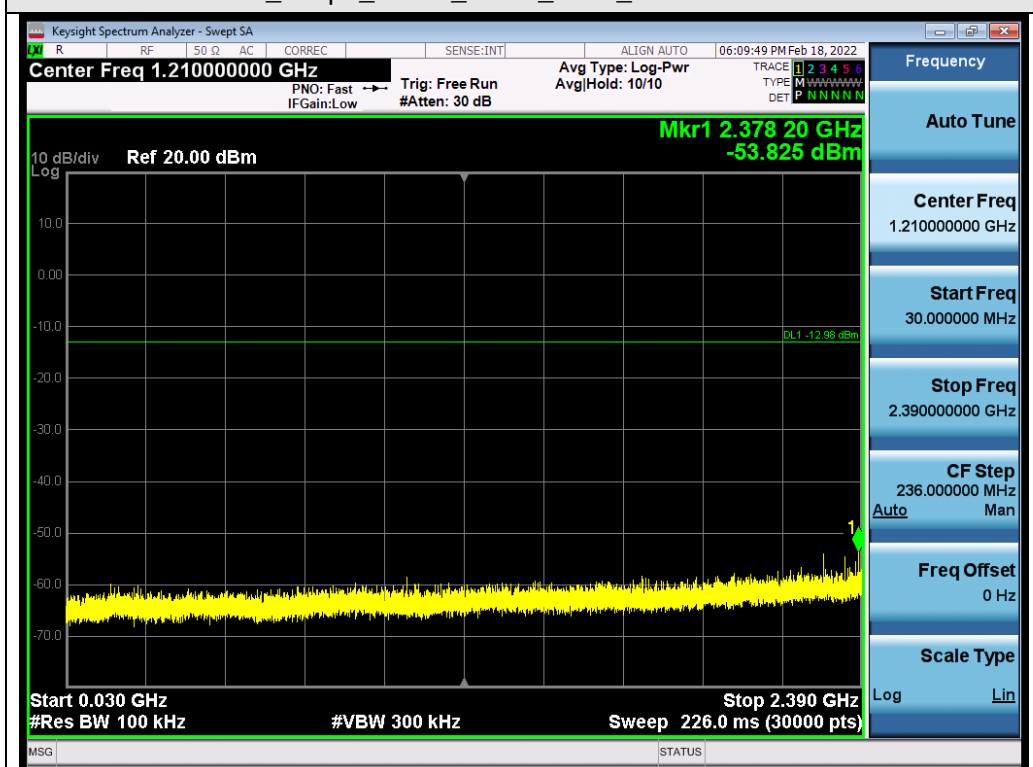
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### Test Graphs of Spurious Emissions in Non-Restricted Frequency Bands



Test\_Graph\_GFSK\_ANT1\_2402\_Reference Level



Test\_Graph\_GFSK\_ANT1\_2402\_Lower Band Emissions

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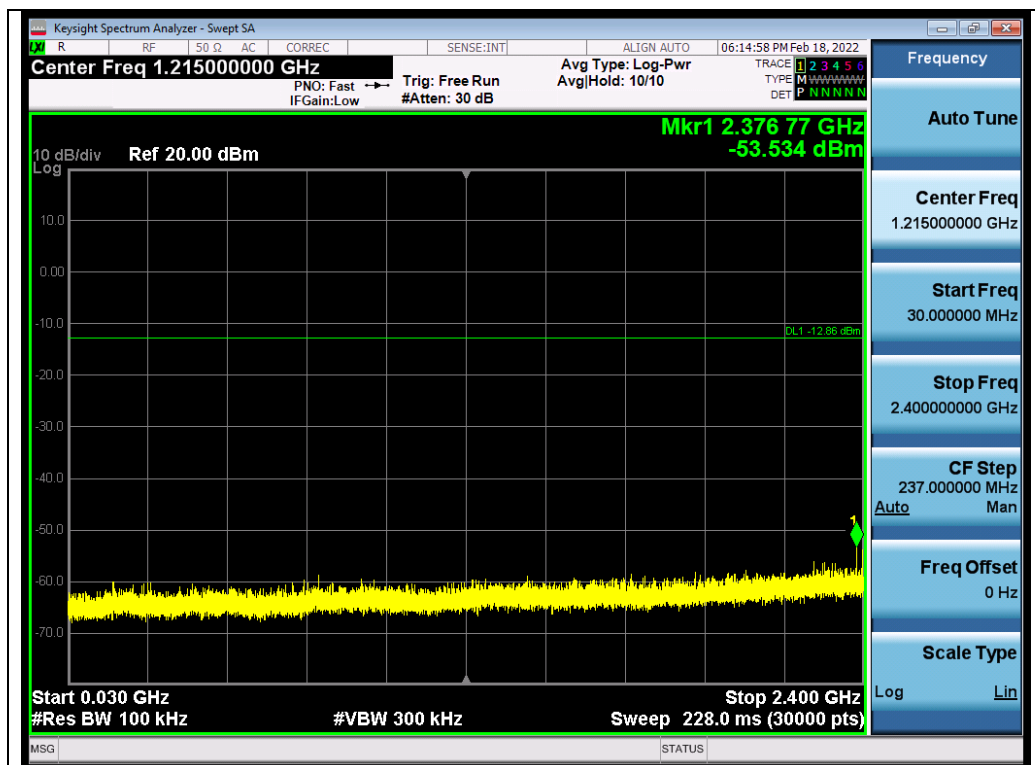


Test\_Graph\_GFSK\_ANT1\_2402\_Higher Band Emissions



Test\_Graph\_GFSK\_ANT1\_2441\_Reference Level

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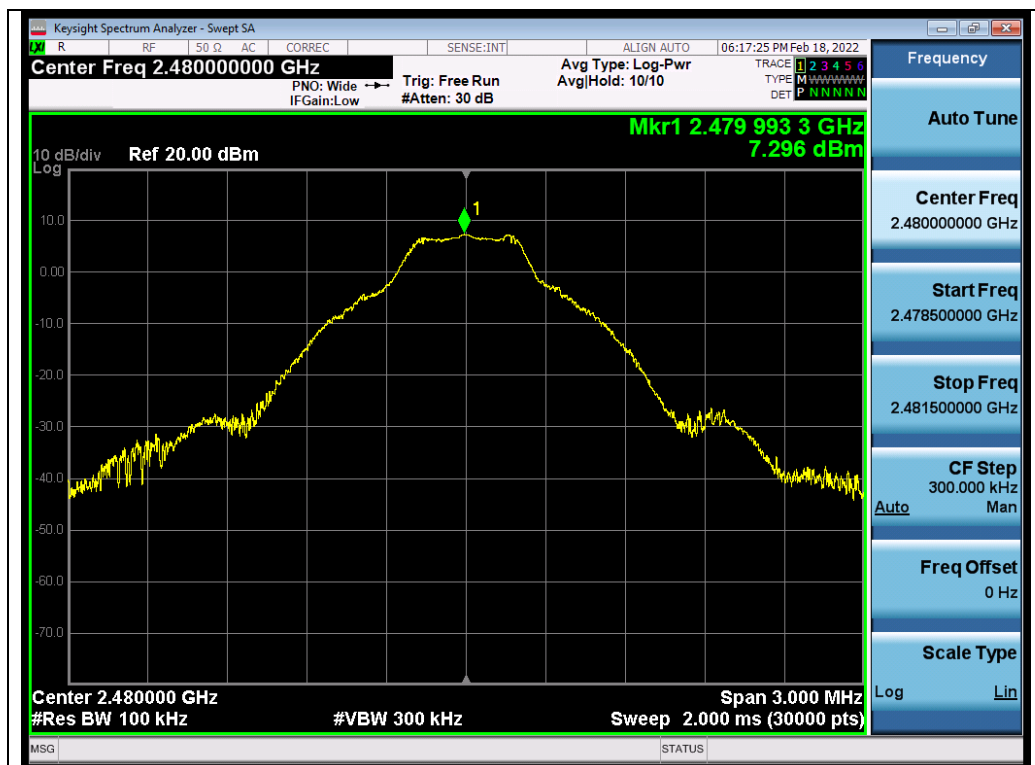


Test\_Graph\_GFSK\_ANT1\_2441\_Lower Band Emissions

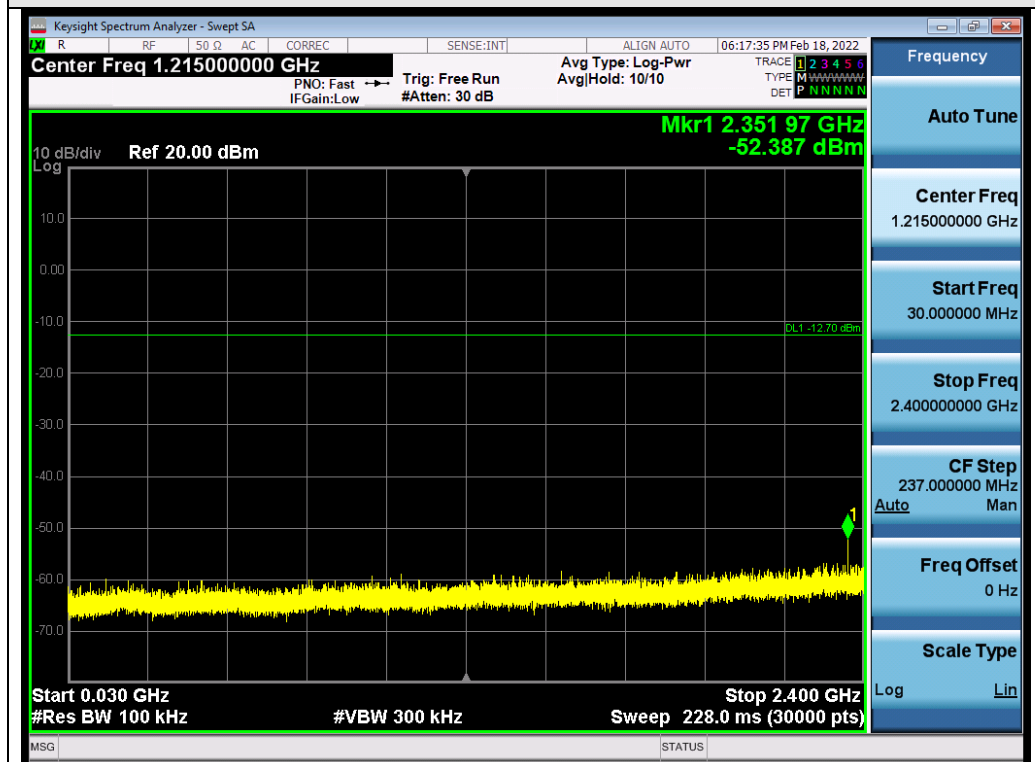


Test\_Graph\_GFSK\_ANT1\_2441\_Higher Band Emissions

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Test\_Graph\_GFSK\_ANT1\_2480\_Reference Level



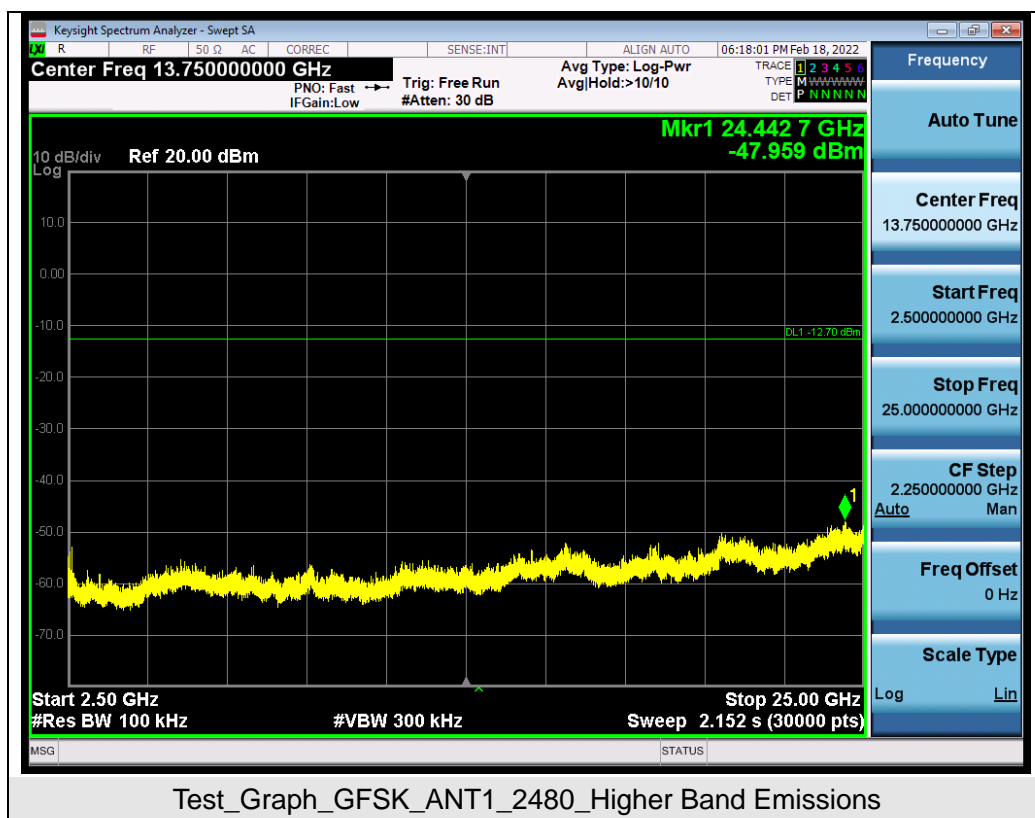
Test\_Graph\_GFSK\_ANT1\_2480\_Lower Band Emissions

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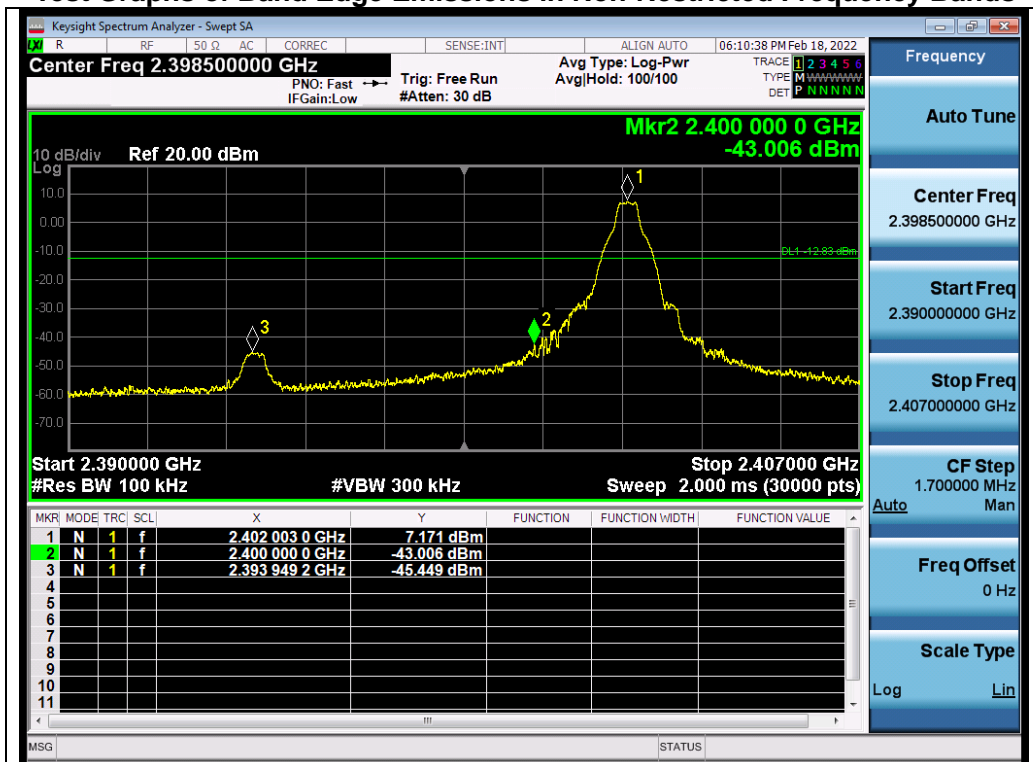
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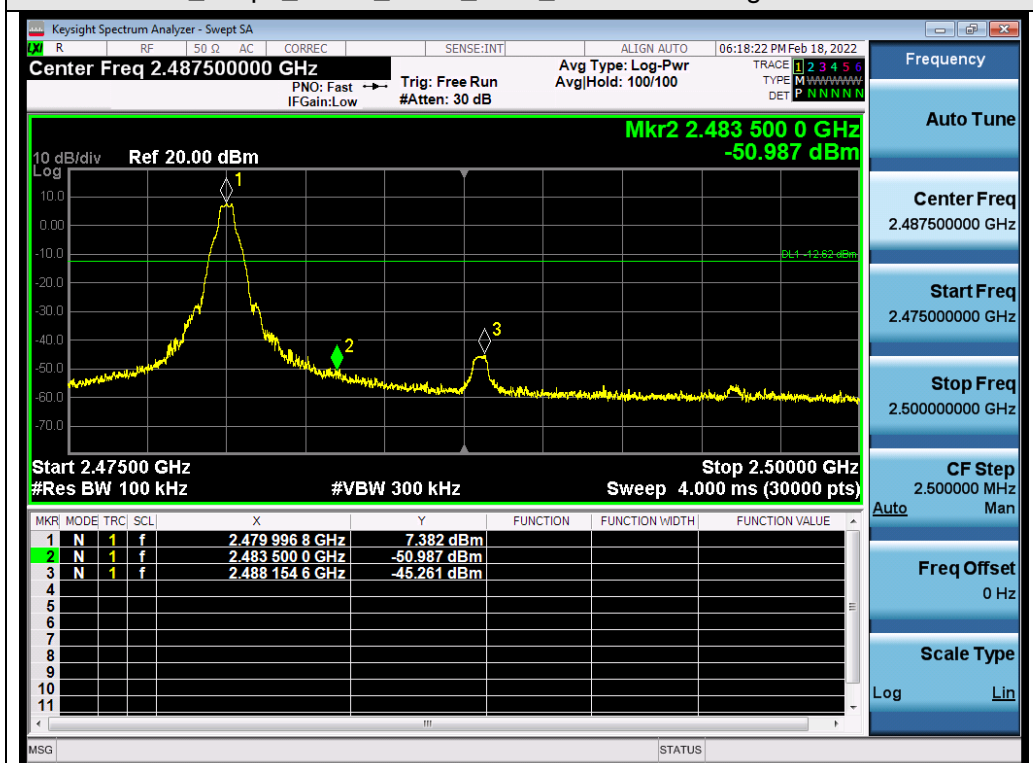
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### Test Graphs of Band Edge Emissions in Non-Restricted Frequency Bands



Test\_Graph\_GFSK\_ANT1\_2402\_Lower Band Edge Emissions



Test\_Graph\_GFSK\_ANT1\_2480\_Higher Band Edge Emissions

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## 10. MAXIMUM CONDUCTED OUTPUT POWER SPECTRAL DENSITY

### 10.1. MEASUREMENT PROCEDURE

- (1). Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
- (2). Set the EUT Work on the top, the middle and the bottom operation frequency individually.
- (3). Set the SPA Trace 1 Max hold, then View.

Note: The method of PKPSD in the KDB 558074 item 8.4 was used in this testing.

### 10.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

Refer to Section 7.2.

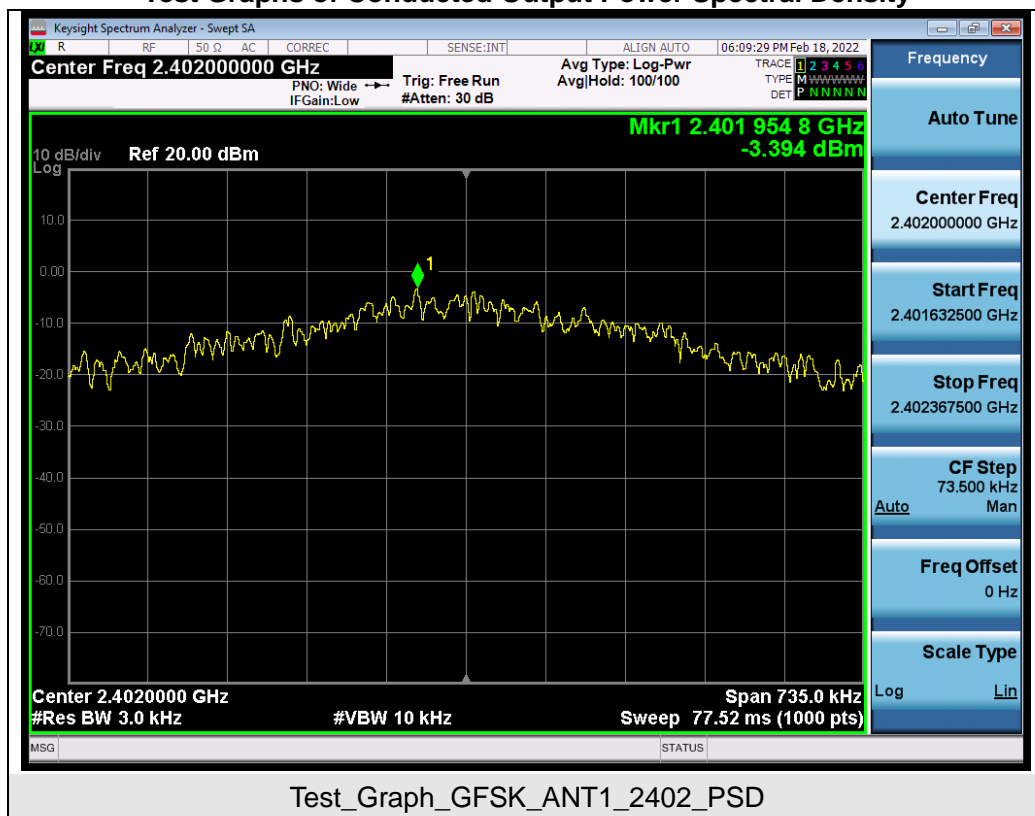
### 10.3. MEASUREMENT EQUIPMENT USED

Refer to Section 6.

### 10.4. LIMITS AND MEASUREMENT RESULT

| Test Data of Conducted Output Power Spectral Density |                    |                          |                  |              |
|--|--------------------|--------------------------|------------------|--------------|
| Test Mode  | Test Channel (MHz) | Power density (dBm/3kHz) | Limit (dBm/3kHz) | Pass or Fail |
| GFSK   | 2402               | -3.394                   | $\leq 8$         | Pass         |
|  | 2441               | -3.534                   | $\leq 8$         | Pass         |
|  | 2480               | -2.919                   | $\leq 8$         | Pass         |

Test Graphs of Conducted Output Power Spectral Density



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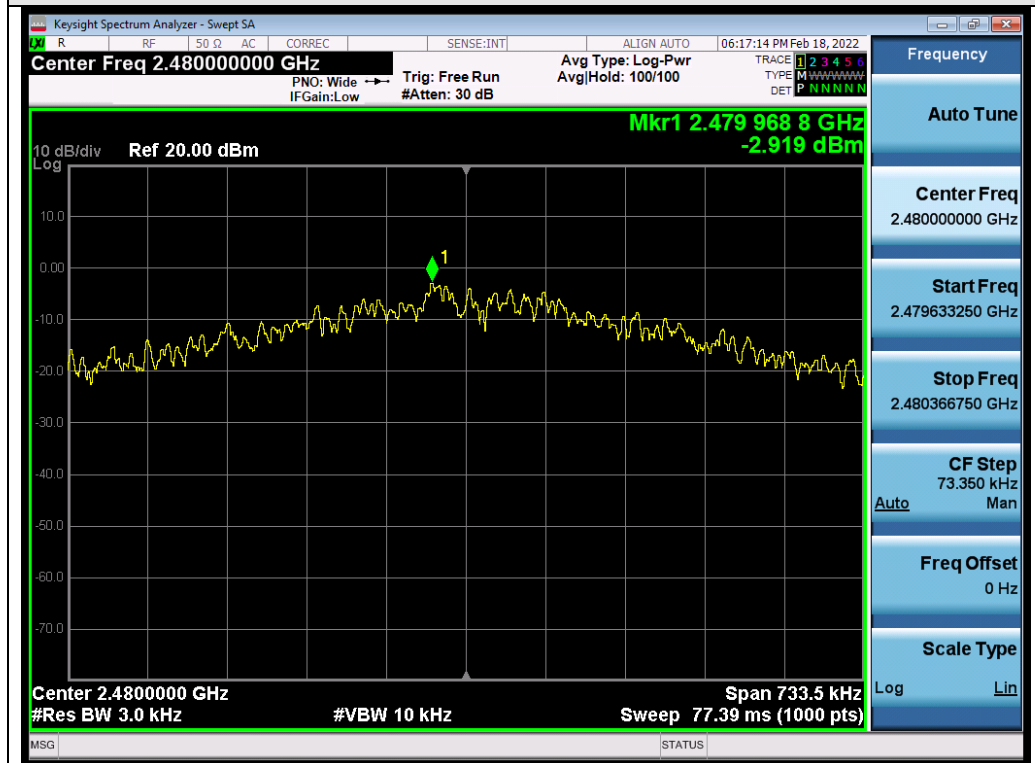
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Test\_Graph\_GFSK\_ANT1\_2441\_PSD



Test\_Graph\_GFSK\_ANT1\_2480\_PSD

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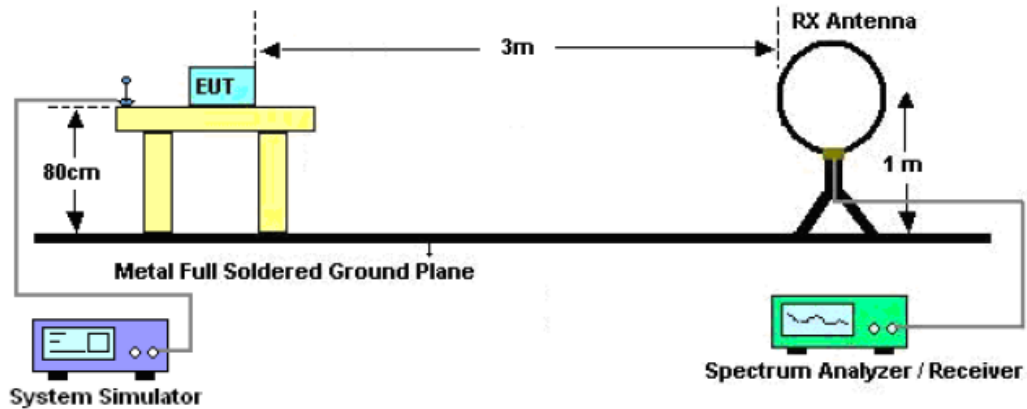
## 11. RADIATED EMISSION

### 11.1. MEASUREMENT PROCEDURE

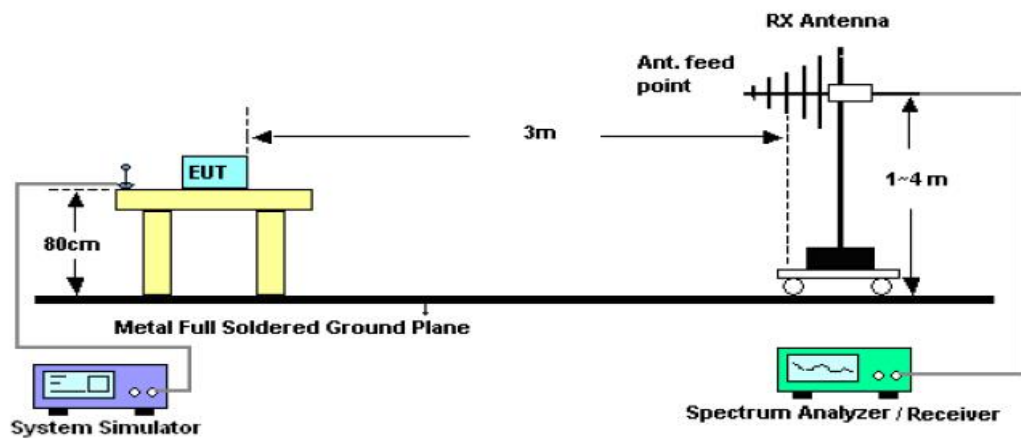
1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emission, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz RBW and 3MHz VBW for peak reading. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

## 11.2. TEST SETUP

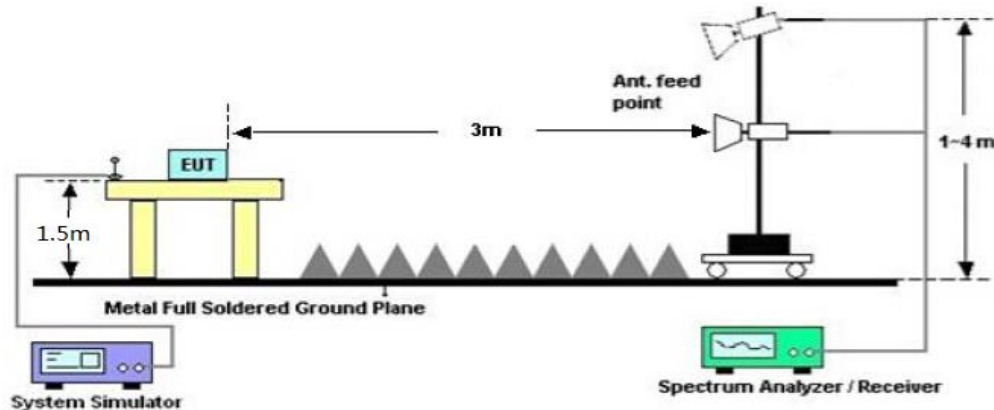
Radiated Emission Test-Setup Frequency Below 30MHz



RADIATED EMISSION TEST SETUP 30MHz-1000MHz



RADIATED EMISSION TEST SETUP ABOVE 1000MHz



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### 11.3. LIMITS AND MEASUREMENT RESULT

15.209 Limit in the below table has to be followed

| Frequencies<br>(MHz) | Field Strength<br>(microvolts/meter) | Measurement Distance<br>(meters) |
|----------------------|--------------------------------------|----------------------------------|
| 0.009~0.490          | 2400/F(kHz)                          | 300                              |
| 0.490~1.705          | 24000/F(kHz)                         | 30                               |
| 1.705~30.0           | 30                                   | 30                               |
| 30~88                | 100                                  | 3                                |
| 88~216               | 150                                  | 3                                |
| 216~960              | 200                                  | 3                                |
| Above 960            | 500                                  | 3                                |

Note: All modes were tested for restricted band radiated emission, the test records reported below are the worst result compared to other modes.

### 11.4. TEST RESULT

#### Radiated emission below 30MHz

The amplitude of spurious emissions from 9kHz to 30MHz which are attenuated more than 20 dB below the permissible value need not be reported.

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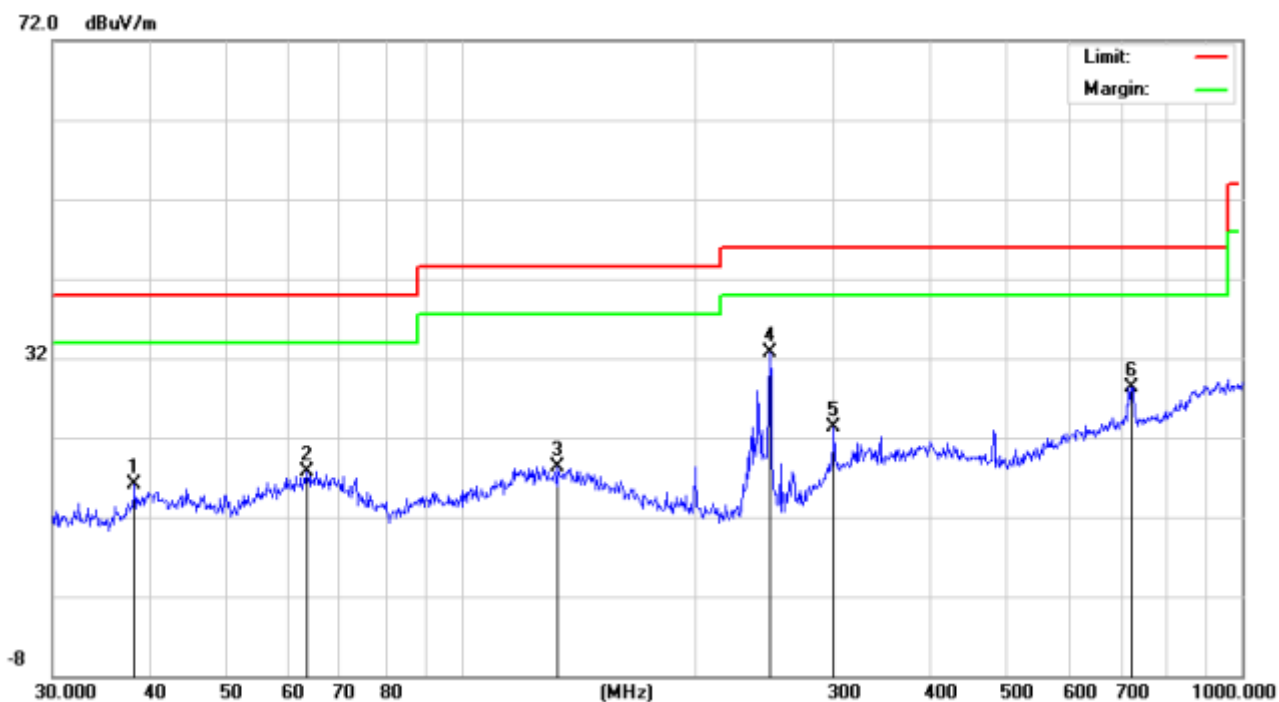
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### Radiated emission from 30MHz to 1000MHz

|             |         |                   |                |
|-------------|---------|-------------------|----------------|
| EUT         | ANNA-B4 | Model Name        | ANNA-B402      |
| Temperature | 21.8°C  | Relative Humidity | 58%            |
| Pressure    | 985hPa  | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 3  | Antenna           | Horizontal     |



| 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 |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|
| 1   |     | 38.2120      | 6.93                     | 9.10                    | 16.03                      | 40.00           | -23.97     | peak     |
| 2   |     | 63.5356      | 5.98                     | 11.70                   | 17.68                      | 40.00           | -22.32     | peak     |
| 3   |     | 133.1511     | 5.57                     | 12.75                   | 18.32                      | 43.50           | -25.18     | peak     |
| 4   | *   | 248.5519     | 24.28                    | 8.51                    | 32.79                      | 46.00           | -13.21     | peak     |
| 5   |     | 300.3672     | 9.93                     | 13.45                   | 23.38                      | 46.00           | -22.62     | peak     |
| 6   |     | 721.7259     | 9.87                     | 18.42                   | 28.29                      | 46.00           | -17.71     | peak     |

**RESULT: PASS**

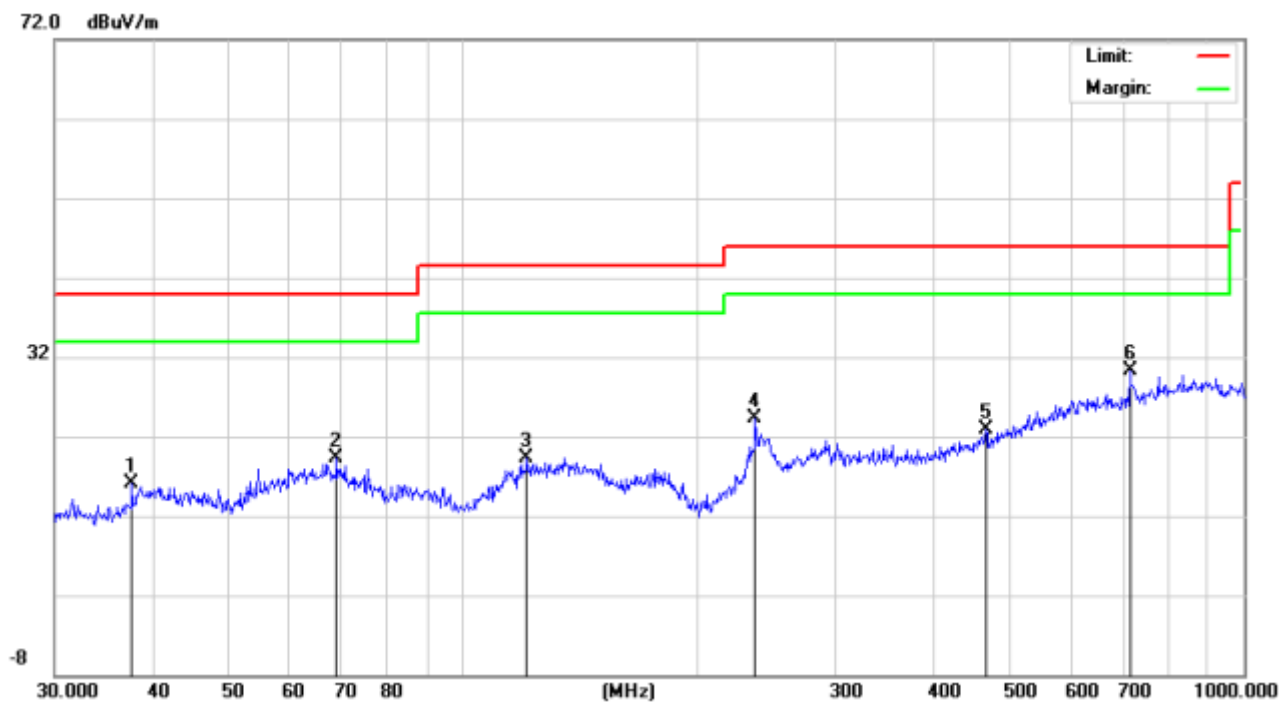
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|             |         |                   |                |
|-------------|---------|-------------------|----------------|
| EUT         | ANNA-B4 | Model Name        | ANNA-B402      |
| Temperature | 21.8°C  | Relative Humidity | 58%            |
| Pressure    | 985hPa  | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 3  | Antenna           | Vertical       |



| 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 |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|
| 1   |     | 37.6798      | 7.24                     | 8.80                    | 16.04                      | 40.00           | -23.96     | peak     |
| 2   |     | 68.8721      | 7.14                     | 12.08                   | 19.22                      | 40.00           | -20.78     | peak     |
| 3   |     | 120.6991     | 6.29                     | 12.98                   | 19.27                      | 43.50           | -24.23     | peak     |
| 4   |     | 236.6447     | 11.28                    | 13.09                   | 24.37                      | 46.00           | -21.63     | peak     |
| 5   |     | 467.2349     | 6.93                     | 16.00                   | 22.93                      | 46.00           | -23.07     | peak     |
| 6   | *   | 714.1734     | 9.75                     | 20.47                   | 30.22                      | 46.00           | -15.78     | peak     |

# **RESULT: PASS**

**Note:** 1. Factor=Antenna Factor + Cable loss, Over=Measurement-Limit.

2. All test modes had been tested. The mode 3 is the worst case and recorded in the report.

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### Radiated emission above 1GHz

|                    |         |                          |                |
|--------------------|---------|--------------------------|----------------|
| <b>EUT</b>         | ANNA-B4 | <b>Model Name</b>        | ANNA-B402      |
| <b>Temperature</b> | 25°C    | <b>Relative Humidity</b> | 60%            |
| <b>Pressure</b>    | 985hPa  | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 1  | <b>Antenna</b>           | Horizontal     |

| Frequency<br>(MHz)                                    | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|---|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4804.000  | 49.55                   | 0.08           | 49.63                      | 74                 | -24.37         | peak       |
| 4804.000  | 37.65                   | 0.08           | 37.73                      | 54                 | -16.27         | AVG        |
| 7206.000  | 42.07                   | 2.21           | 44.28                      | 74                 | -29.72         | peak       |
| 7206.000  | 32.72                   | 2.21           | 34.93                      | 54                 | -19.07         | AVG        |
|   |                         |                |                            |                    |                |            |
|   |                         |                |                            |                    |                |            |
| Remark:   |                         |                |                            |                    |                |            |
| Factor = Antenna Factor + Cable Loss – Pre-amplifier. |                         |                |                            |                    |                |            |

|                    |         |                          |                |
|--------------------|---------|--------------------------|----------------|
| <b>EUT</b>         | ANNA-B4 | <b>Model Name</b>        | ANNA-B402      |
| <b>Temperature</b> | 25°C    | <b>Relative Humidity</b> | 60%            |
| <b>Pressure</b>    | 985hPa  | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 1  | <b>Antenna</b>           | Vertical       |

| Frequency<br>(MHz)                                    | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|---|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4804.000  | 48.34                   | 0.08           | 48.42                      | 74                 | -25.58         | peak       |
| 4804.000  | 37.85                   | 0.08           | 37.93                      | 54                 | -16.07         | AVG        |
| 7206.000  | 42.63                   | 2.21           | 44.84                      | 74                 | -29.16         | peak       |
| 7206.000  | 31.52                   | 2.21           | 33.73                      | 54                 | -20.27         | AVG        |
|   |                         |                |                            |                    |                |            |
|   |                         |                |                            |                    |                |            |
| Remark:   |                         |                |                            |                    |                |            |
| Factor = Antenna Factor + Cable Loss – Pre-amplifier. |                         |                |                            |                    |                |            |

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|                    |         |                          |                |
|--------------------|---------|--------------------------|----------------|
| <b>EUT</b>         | ANNA-B4 | <b>Model Name</b>        | ANNA-B402      |
| <b>Temperature</b> | 25°C    | <b>Relative Humidity</b> | 60%            |
| <b>Pressure</b>    | 985hPa  | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 2  | <b>Antenna</b>           | Horizontal     |

| Frequency   | Meter Reading | Factor | Emission Level | Limits   | Margin | Value Type |
|---|---------------|--------|----------------|----------|--------|------------|
| (MHz)   | (dBμV)        | (dB)   | (dBμV/m)       | (dBμV/m) | (dB)   |            |
| 4882.000  | 51.02         | 0.14   | 51.16          | 74       | -22.84 | peak       |
| 4882.000  | 37.47         | 0.14   | 37.61          | 54       | -16.39 | AVG        |
| 7323.000  | 43.61         | 2.36   | 45.97          | 74       | -28.03 | peak       |
| 7323.000  | 31.57         | 2.36   | 33.93          | 54       | -20.07 | AVG        |
|   |               |        |                |          |        |            |
|   |               |        |                |          |        |            |
| Remark:   |               |        |                |          |        |            |
| Factor = Antenna Factor + Cable Loss – Pre-amplifier. |               |        |                |          |        |            |

|                    |         |                          |                |
|--------------------|---------|--------------------------|----------------|
| <b>EUT</b>         | ANNA-B4 | <b>Model Name</b>        | ANNA-B402      |
| <b>Temperature</b> | 25°C    | <b>Relative Humidity</b> | 60%            |
| <b>Pressure</b>    | 985hPa  | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 2  | <b>Antenna</b>           | Vertical       |

| Frequency   | Meter Reading | Factor | Emission Level | Limits   | Margin | Value Type |
|---|---------------|--------|----------------|----------|--------|------------|
| (MHz)   | (dBμV)        | (dB)   | (dBμV/m)       | (dBμV/m) | (dB)   |            |
| 4882.000  | 50.57         | 0.14   | 50.71          | 74       | -23.29 | peak       |
| 4880.000  | 36.89         | 0.14   | 37.03          | 54       | -16.97 | AVG        |
| 7323.000  | 44.57         | 2.36   | 46.93          | 74       | -27.07 | peak       |
| 7323.000  | 31.27         | 2.36   | 33.63          | 54       | -20.37 | AVG        |
|   |               |        |                |          |        |            |
|   |               |        |                |          |        |            |
| Remark:   |               |        |                |          |        |            |
| Factor = Antenna Factor + Cable Loss – Pre-amplifier. |               |        |                |          |        |            |

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|                    |         |                          |                |
|--------------------|---------|--------------------------|----------------|
| <b>EUT</b>         | ANNA-B4 | <b>Model Name</b>        | ANNA-B402      |
| <b>Temperature</b> | 25°C    | <b>Relative Humidity</b> | 60%            |
| <b>Pressure</b>    | 985hPa  | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 3  | <b>Antenna</b>           | Horizontal     |

| Frequency   | Meter Reading | Factor | Emission Level | Limits   | Margin | Value Type |
|---|---------------|--------|----------------|----------|--------|------------|
| (MHz)   | (dBμV)        | (dB)   | (dBμV/m)       | (dBμV/m) | (dB)   |            |
| 4960.000  | 52.47         | 0.22   | 52.69          | 74       | -21.31 | peak       |
| 4960.000  | 38.87         | 0.22   | 39.09          | 54       | -14.91 | AVG        |
| 7440.000  | 46.37         | 2.64   | 49.01          | 74       | -24.99 | peak       |
| 7440.000  | 34.57         | 2.64   | 37.21          | 54       | -16.79 | AVG        |
|   |               |        |                |          |        |            |
|   |               |        |                |          |        |            |
| Remark:   |               |        |                |          |        |            |
| Factor = Antenna Factor + Cable Loss – Pre-amplifier. |               |        |                |          |        |            |

|                    |         |                          |                |
|--------------------|---------|--------------------------|----------------|
| <b>EUT</b>         | ANNA-B4 | <b>Model Name</b>        | ANNA-B402      |
| <b>Temperature</b> | 25°C    | <b>Relative Humidity</b> | 60%            |
| <b>Pressure</b>    | 985hPa  | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 3  | <b>Antenna</b>           | Vertical       |

| Frequency   | Meter Reading | Factor | Emission Level | Limits   | Margin | Value Type |
|---|---------------|--------|----------------|----------|--------|------------|
| (MHz)   | (dBμV)        | (dB)   | (dBμV/m)       | (dBμV/m) | (dB)   |            |
| 4960.000  | 50.23         | 0.22   | 50.45          | 74       | -23.55 | peak       |
| 4960.000  | 37.49         | 0.22   | 37.71          | 54       | -16.29 | AVG        |
| 7440.000  | 45.23         | 2.64   | 47.87          | 74       | -26.13 | peak       |
| 7440.000  | 32.77         | 2.64   | 35.41          | 54       | -18.59 | AVG        |
|   |               |        |                |          |        |            |
|   |               |        |                |          |        |            |
| Remark:   |               |        |                |          |        |            |
| Factor = Antenna Factor + Cable Loss – Pre-amplifier. |               |        |                |          |        |            |

## RESULT: PASS

### Note:

The amplitude of other spurious emissions from 1G to 25 GHz which are attenuated more than 20 dB below the permissible value need not be reported.

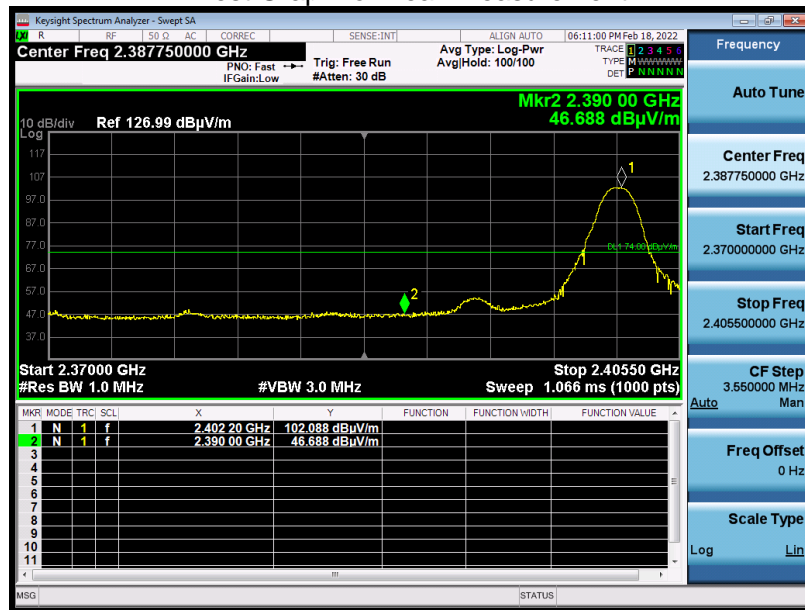
Factor = Antenna Factor + Cable loss - Amplifier gain, Margin=Emission Level-Limit.

The "Factor" value can be calculated automatically by software of measurement system.

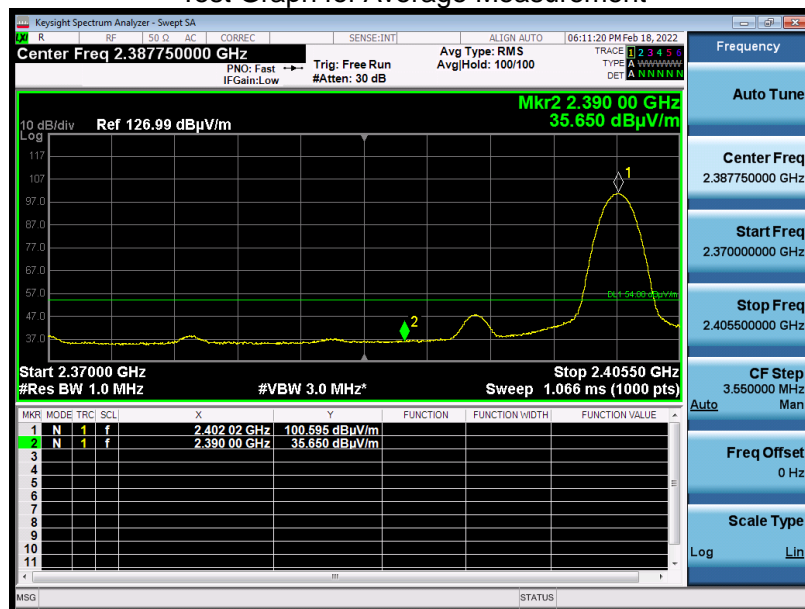
### Test result for band edge emission at restricted bands

|             |         |                   |                |
|-------------|---------|-------------------|----------------|
| EUT         | ANNA-B4 | Model Name        | ANNA-B402      |
| Temperature | 25°C    | Relative Humidity | 55%            |
| Pressure    | 985hPa  | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 1  | Antenna           | Horizontal     |

### Test Graph for Peak Measurement



### Test Graph for Average Measurement



**RESULT: PASS**

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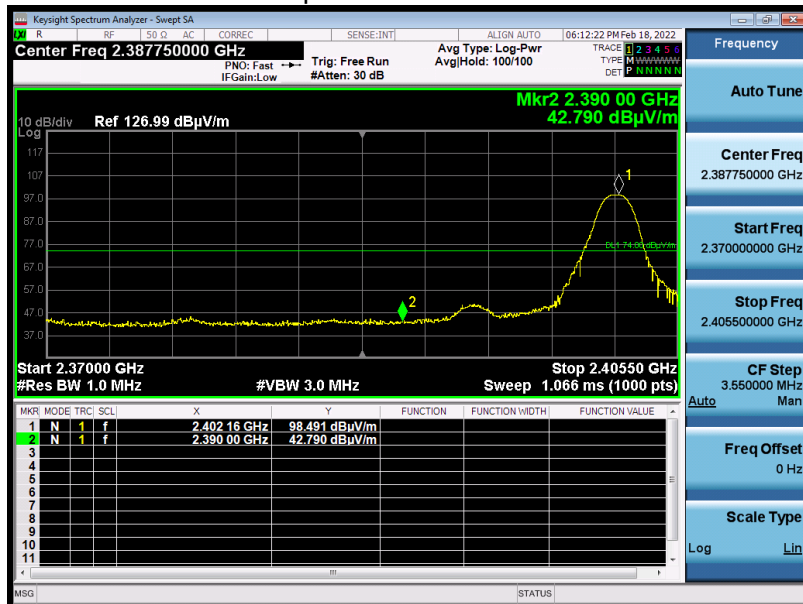
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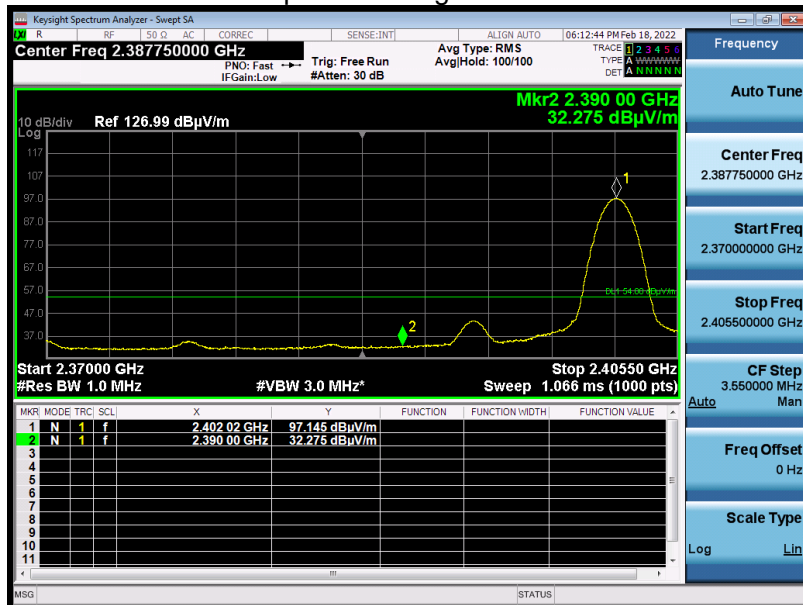
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|             |         |                   |                |
|-------------|---------|-------------------|----------------|
| EUT         | ANNA-B4 | Model Name        | ANNA-B402      |
| Temperature | 25°C    | Relative Humidity | 55%            |
| Pressure    | 985hPa  | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 1  | Antenna           | Vertical       |

Test Graph for Peak Measurement



Test Graph for Average Measurement



RESULT: PASS

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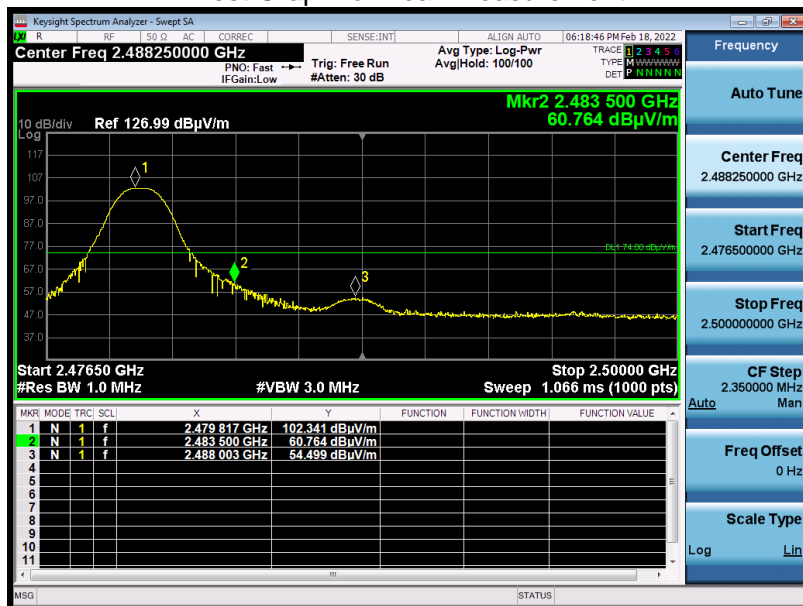
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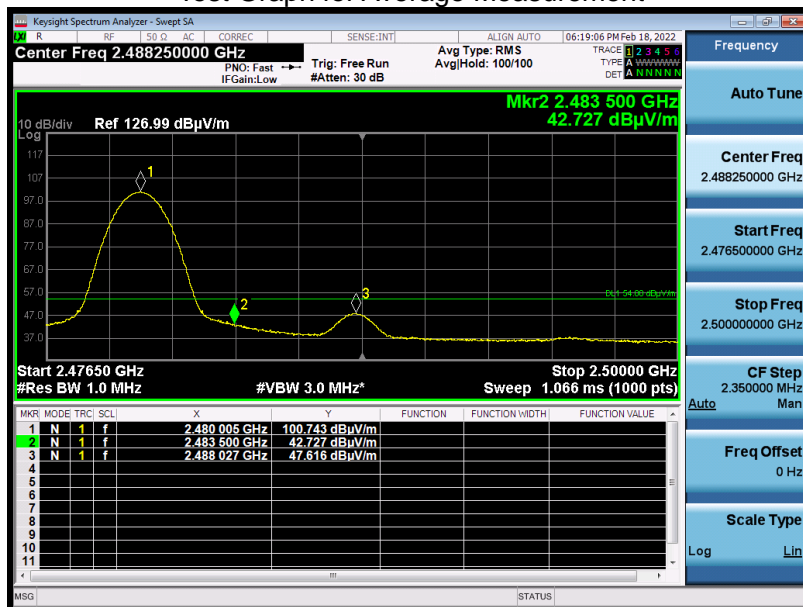
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|             |         |                   |                |
|-------------|---------|-------------------|----------------|
| EUT         | ANNA-B4 | Model Name        | ANNA-B402      |
| Temperature | 25°C    | Relative Humidity | 55%            |
| Pressure    | 985hPa  | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 3  | Antenna           | Horizontal     |

Test Graph for Peak Measurement



Test Graph for Average Measurement



RESULT: PASS

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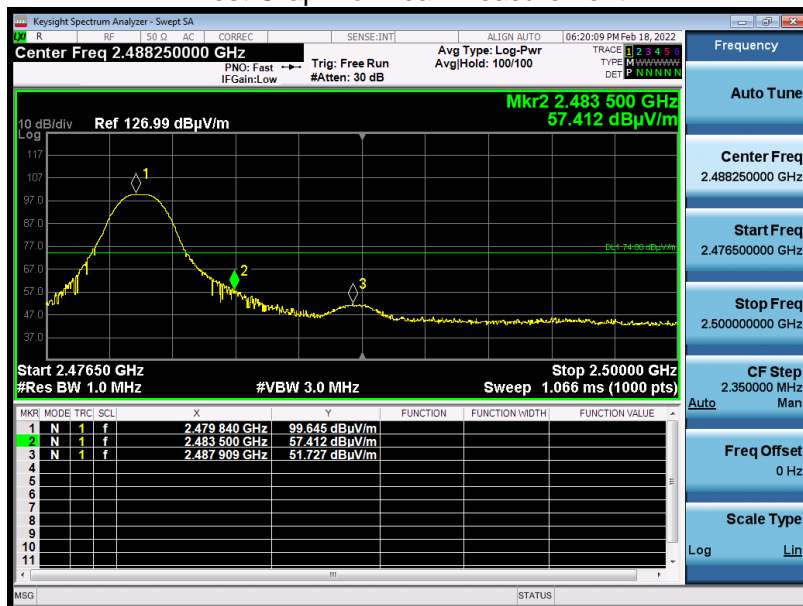
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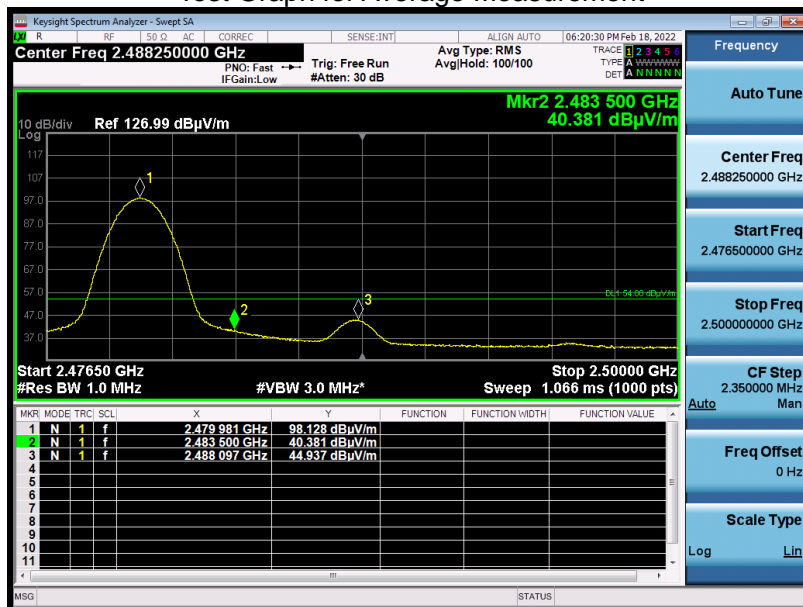


|             |         |                   |                |
|-------------|---------|-------------------|----------------|
| EUT         | ANNA-B4 | Model Name        | ANNA-B402      |
| Temperature | 25°C    | Relative Humidity | 55%            |
| Pressure    | 985hPa  | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 3  | Antenna           | Vertical       |

Test Graph for Peak Measurement



Test Graph for Average Measurement



## RESULT: PASS

Note: The factor had been edited in the “Input Correction” of the Spectrum Analyzer.

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## 12. LINE CONDUCTED EMISSION TEST

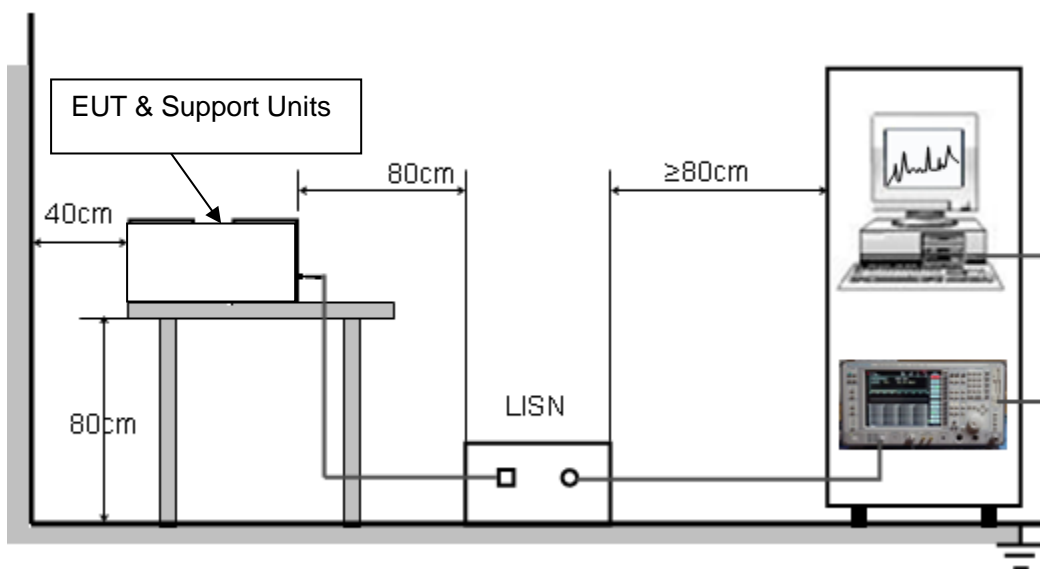
### 12.1. LIMITS OF LINE CONDUCTED EMISSION TEST

| Frequency     | Maximum RF Line Voltage |               |
|---------------|-------------------------|---------------|
|               | Q.P.(dBuV)              | Average(dBuV) |
| 150kHz~500kHz | 66-56                   | 56-46         |
| 500kHz~5MHz   | 56                      | 46            |
| 5MHz~30MHz    | 60                      | 50            |

Note: 1. The lower limit shall apply at the transition frequency.

2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

### 12.2. BLOCK DIAGRAM OF LINE CONDUCTED EMISSION TEST



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### 12.3. PRELIMINARY PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. When the EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.
2. Support equipment, if needed, was placed as per ANSI C63.10.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
4. All support equipment received AC120V/60Hz power from a LISN, if any.
5. The EUT received DC 3.3V power from control board which received AC120V/60Hz power from a LISN.
6. The test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.
9. The test mode(s) were scanned during the preliminary test.

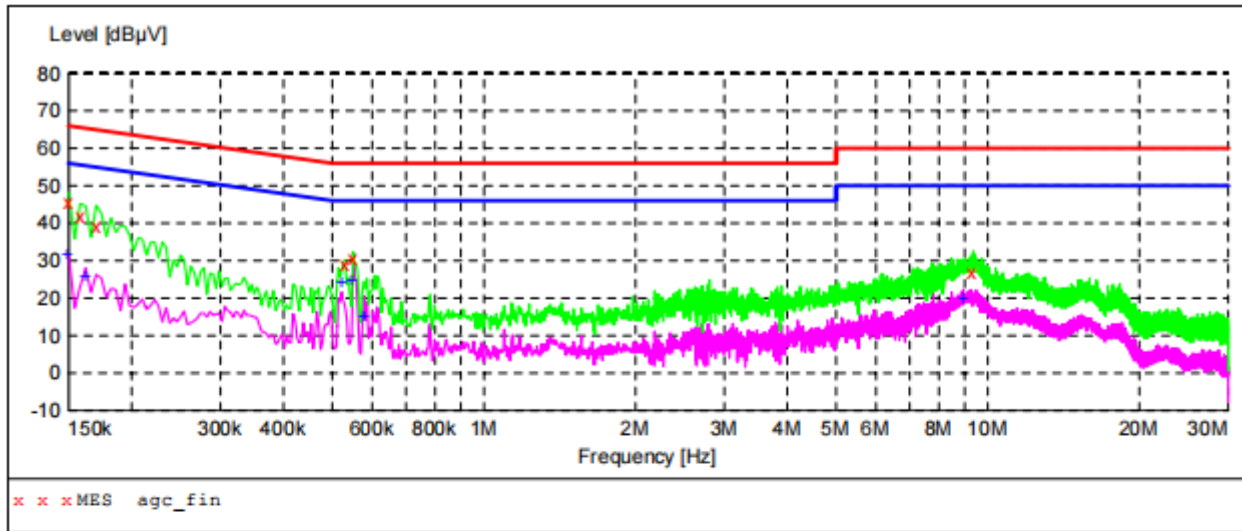
Then, the EUT configuration and cable configuration of the above highest emission level were recorded for reference of final testing.

### 12.4. FINAL PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. EUT and support equipment was set up on the test bench as per step 2 of the preliminary test.
2. A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. If EUT emission level was less – 2dB to the A.V. limit in Peak mode, then the emission signal was re-checked using Q.P and Average detector.
3. The test data of the worst case condition(s) was reported on the Summary Data page.

## 12.5. TEST RESULT OF LINE CONDUCTED EMISSION TEST

### Line Conducted Emission Test Line 1-L



#### MEASUREMENT RESULT: "agc\_fin"

2022/1/11 9:39

| Frequency<br>MHz | Level<br>dBμV | Transd<br>dB | Limit<br>dBμV | Margin<br>dB | Detector | Line | PE  |
|------------------|---------------|--------------|---------------|--------------|----------|------|-----|
| 0.150000         | 45.40         | 6.9          | 66            | 20.6         | QP       | L1   | GND |
| 0.158000         | 41.80         | 6.8          | 66            | 23.8         | QP       | L1   | GND |
| 0.170000         | 38.90         | 6.8          | 65            | 26.1         | QP       | L1   | GND |
| 0.530000         | 28.80         | 5.4          | 56            | 27.2         | QP       | L1   | GND |
| 0.550000         | 30.40         | 5.4          | 56            | 25.6         | QP       | L1   | GND |
| 9.362000         | 27.10         | 6.8          | 60            | 32.9         | QP       | L1   | GND |

#### MEASUREMENT RESULT: "agc\_fin2"

2022/1/11 9:39

| Frequency<br>MHz | Level<br>dBμV | Transd<br>dB | Limit<br>dBμV | Margin<br>dB | Detector | Line | PE  |
|------------------|---------------|--------------|---------------|--------------|----------|------|-----|
| 0.150000         | 31.70         | 6.9          | 56            | 24.3         | AV       | L1   | GND |
| 0.162000         | 26.00         | 6.8          | 55            | 29.4         | AV       | L1   | GND |
| 0.522000         | 24.20         | 5.4          | 46            | 21.8         | AV       | L1   | GND |
| 0.550000         | 24.80         | 5.4          | 46            | 21.2         | AV       | L1   | GND |
| 0.578000         | 15.30         | 5.4          | 46            | 30.7         | AV       | L1   | GND |
| 8.942000         | 20.00         | 6.8          | 50            | 30.0         | AV       | L1   | GND |

**RESULT: PASS**

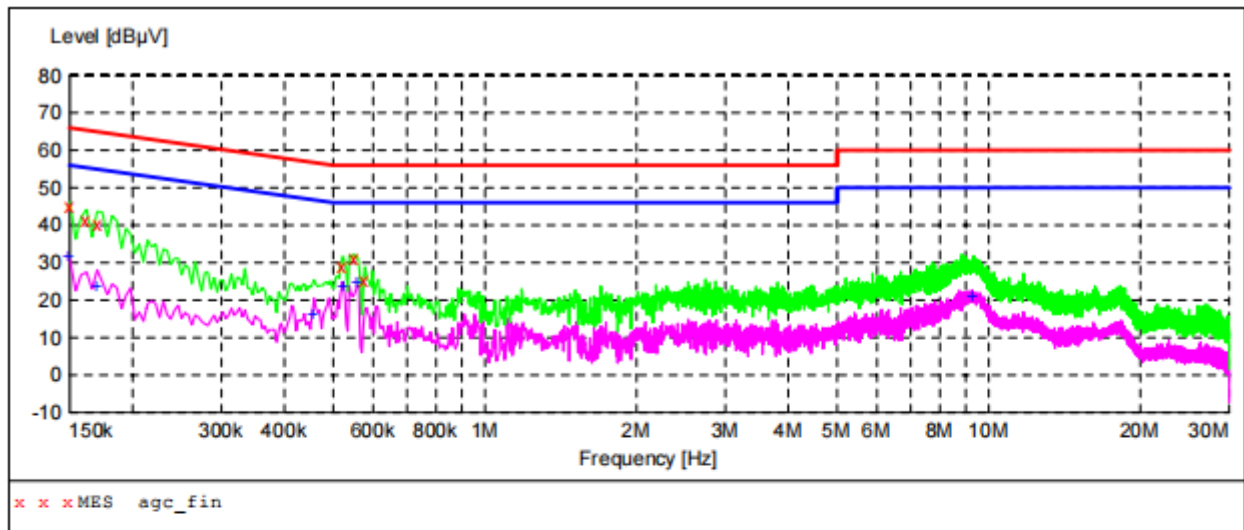
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Line Conducted Emission Test Line 2-N



**MEASUREMENT RESULT: "agc\_fin"**

2022/1/11 9:35

| Frequency<br>MHz | Level<br>dBμV | Transd<br>dB | Limit<br>dBμV | Margin<br>dB | Detector | Line | PE  |
|------------------|---------------|--------------|---------------|--------------|----------|------|-----|
| 0.150000         | 44.80         | 6.9          | 66            | 21.2         | QP       | N    | GND |
| 0.162000         | 41.40         | 6.8          | 65            | 24.0         | QP       | N    | GND |
| 0.170000         | 40.10         | 6.8          | 65            | 24.9         | QP       | N    | GND |
| 0.522000         | 29.20         | 5.4          | 56            | 26.8         | QP       | N    | GND |
| 0.550000         | 31.40         | 5.4          | 56            | 24.6         | QP       | N    | GND |
| 0.578000         | 25.40         | 5.4          | 56            | 30.6         | QP       | N    | GND |

**MEASUREMENT RESULT: "agc\_fin2"**

2022/1/11 9:35

| Frequency<br>MHz | Level<br>dBμV | Transd<br>dB | Limit<br>dBμV | Margin<br>dB | Detector | Line | PE  |
|------------------|---------------|--------------|---------------|--------------|----------|------|-----|
| 0.150000         | 31.90         | 6.9          | 56            | 24.1         | AV       | N    | GND |
| 0.170000         | 23.90         | 6.8          | 55            | 31.1         | AV       | N    | GND |
| 0.458000         | 16.10         | 5.5          | 47            | 30.6         | AV       | N    | GND |
| 0.522000         | 23.60         | 5.4          | 46            | 22.4         | AV       | N    | GND |
| 0.558000         | 24.60         | 5.4          | 46            | 21.4         | AV       | N    | GND |
| 9.258000         | 20.90         | 6.8          | 50            | 29.1         | AV       | N    | GND |

**RESULT: PASS**

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## **APPENDIX A: PHOTOGRAPHS OF TEST SETUP**

Refer to the Report No.: AGC00174211202AP02

## **APPENDIX B: PHOTOGRAPHS OF EUT**

Refer to the Report No.: AGC00174211202AP03

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





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