

## FCC Test Report Amended


**Prepared for:** Lynq Technologies

**Address:** 4760 Walnut St Ste 108  
Boulder, CO 80301

**Product:** LNQ2900

**FCC ID:** 2ARHMLNQ2900  
**IC ID:** 24896-LNQ2900

**Test Report No:** R20220216-20-E1B

**Approved by:**   
Blake Winter  
EMC Test Engineer  
iNARTE EMC-50662-E

**DATE:** July 1, 2024

**Total Pages:** 41

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Report Number: R230330-00-E1B


Rev

B

Prepared for: Lynq Technologies


## REVISION PAGE

| Rev. No. | Date          | Description  |
|----------|---------------|--|
| 0        | 4 April 2024  | Issued by BWinter<br>Reviewed by KVepuri<br>Prepared by BWinter  |
| A        | 18 April 2024 | Revision A by BWinter<br><br>1. Page 9, unrestricted band edge, change relative units from dBm or dBuV to dB because it is relative. |
| B        | 1 July 2024   | Revision B by BWinter<br><br>Cover Page: add FCC ID and IC ID.   |

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## 1.0 SUMMARY OF TEST RESULTS


The worst-case measurements were reported in this report. Summary of test results presented in this report correspond to the following section:

### FCC Part 15.247

The EUT has been tested according to the following specifications:

- (1) US Code of Federal Regulations, Title 47, Part 15

| APPLIED STANDARDS AND REGULATIONS                         |                                |        |
|---|--------------------------------|--------|
| Standard Section  | Test Type                      | Result |
| FCC Part 15.247(b)(3)                                     | Peak output power              | Pass   |
| FCC Part 15.247(a)(2)                                     | Bandwidth                      | Pass   |
| FCC Part 15.209   | Receiver Radiated Emissions    | Pass   |
| FCC Part 15.209 (restricted bands), 15.247 (unrestricted) | Transmitter Radiated Emissions | Pass   |
| FCC Part 15.247(e)  | Power Spectral Density         | Pass   |
| FCC Part 15.209, 15.247(d)                                | Band Edge Measurement          | Pass   |
| FCC Part 15.207   | Conducted Emissions            | Pass   |

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## 2.0 EUT DESCRIPTION

### 2.1 EQUIPMENT UNDER TEST

#### Summary and Operating Condition:

|                               |   |
|-------------------------------|---|
| <b>Manufacturer</b>           | Lynq Technologies   |
| <b>EUT</b>                    | Lynq LNQ2900  |
| <b>EUT Received</b>           | 10 November 2023  |
| <b>EUT Tested</b>             | 22 November 2023- 19 March 2024   |
| <b>Serial No.</b>             | NCEE 011481 (Radiated Measurements)<br>NCEE 011480 (Conducted Measurements) |
| <b>Operating Band</b>         | 902 – 928 MHz   |
| <b>Device Type</b>            | LORA DTS  |
| <b>Power Supply / Voltage</b> | USB Power Supply, SN P161400162A1   |

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual.

### 2.2 DESCRIPTION OF TEST MODES

The following channels were tested:

| Channel | Frequency |
|---------|-----------|
| Low     | 902.5 MHz |
| Mid     | 915 MHz   |
| High    | 927.4 MHz |

These are the only representative channels tested in the frequency range according to FCC Part 15.31. See the operational description for a list of all channel frequencies and designations.

### 2.3 DESCRIPTION OF SUPPORT UNITS

USB Power Supply.

### 3.0 LABORATORY AND GENERAL TEST DESCRIPTION

#### 3.1 LABORATORY DESCRIPTION

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)  
4740 Discovery Drive  
Lincoln, NE 68521

A2LA Certificate Number: 1953.01  
FCC Accredited Test Site Designation No: US1060  
Industry Canada Test Site Registration No: 4294A-1  
NCC CAB Identification No: US0177

Environmental conditions varied slightly throughout the tests.



#### 3.2 TEST PERSONNEL

| No. | PERSONNEL      | TITLE         | ROLE               |
|-----|----------------|---------------|--------------------|
| 1   | Karthik Vepuri | Test Engineer | Review             |
| 2   | Blake Winter   | Test Engineer | Testing and Report |

**Notes:**

All personnel are permanent staff members of NCEE Labs. No testing or review was sub-contracted or performed by sub-contracted personnel.



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### 3.3 TEST EQUIPMENT

| DESCRIPTION AND MANUFACTURER                              | MODEL NO.                      | SERIAL NO.           | LAST CALIBRATION DATE | CALIBRATION DUE DATE |
|---|--------------------------------|----------------------|-----------------------|----------------------|
| Keysight MXE Signal Analyzer (44GHz)**                    | N9038A                         | MY59050109           | July 17, 2023         | July 17, 2025        |
| Keysight MXE Signal Analyzer (26.5GHz)**                  | N9038A                         | MY56400083           | July 17, 2023         | July 17, 2025        |
| SunAR RF Motion   | JB1                            | A091418              | July 26, 2023         | July 26, 2024        |
| ETS EMCO Red Horn Antenna                                 | 3115                           | 00218576             | July 31, 2023         | July 31, 2024        |
| ETS EMCO Amplifier*                                       | 3115-PA                        | 00218576             | January 22, 2024      | January 22, 2026     |
| Trilithic High Pass Filter*                               | 6HC330                         | 23042                | June 5, 2023          | June 5, 2025         |
| ETS – Lindgren- VSWR on 10m Chamber***                    | 10m Semi-anechoic chamber-VSWR | 4740 Discovery Drive | July 30, 2020         | July 30, 2024        |
| NCEE Labs-NSA on 10m Chamber*                             | 10m Semi-anechoic chamber-NSA  | NCEE-001             | May 25, 2022          | May 25, 2024         |
| TDK Emissions Lab Software                                | V11.25                         | 700307               | NA                    | NA                   |
| RF Cable (preamplifier to antenna)*                       | MFR-57500                      | 90-195-040           | June 5, 2023          | June 5, 2025         |
| RF Cable (antenna to 10m chamber bulkhead)*               | FSCM 64639                     | 01E3872              | June 5, 2023          | June 5, 2025         |
| RF Cable (10m chamber bulkhead to control room bulkhead)* | FSCM 64639                     | 01E3864              | June 5, 2023          | June 5, 2025         |
| RF Cable (control room bulkhead to test receiver)*        | FSCM 64639                     | 01F1206              | June 5, 2023          | June 5, 2025         |
| N connector bulkhead (10m chamber)*                       | PE9128                         | NCEEBH1              | June 5, 2023          | June 5, 2025         |
| N connector bulkhead (control room)*                      | PE9128                         | NCEEBH2              | June 5, 2023          | June 5, 2025         |


\*Internal Characterization

\*\*2 Year Cal Cycle

\*\*\*4 Year Cal Cycle

**Notes:**

All equipment is owned by NCEE Labs and stored permanently at NCEE Labs facilities.

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### 3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMENTS

Measurement type presented in this report (Please see the checked box below):

#### Conducted ☒

The conducted measurements were performed by connecting the output of the transmitter directly into a spectrum analyzer using an impedance matched cable and connector soldered to the EUT in place of the antenna. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

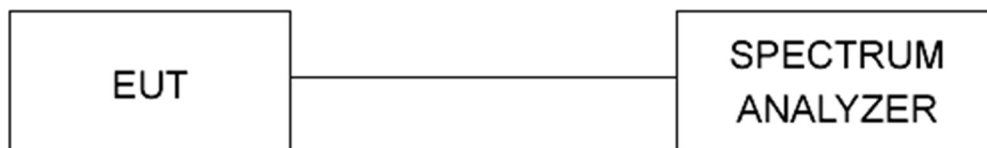


Figure 1 - Bandwidth Measurements Test Setup

#### Radiated ☒

All the radiated measurements were taken at a distance of 3m from the EUT. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

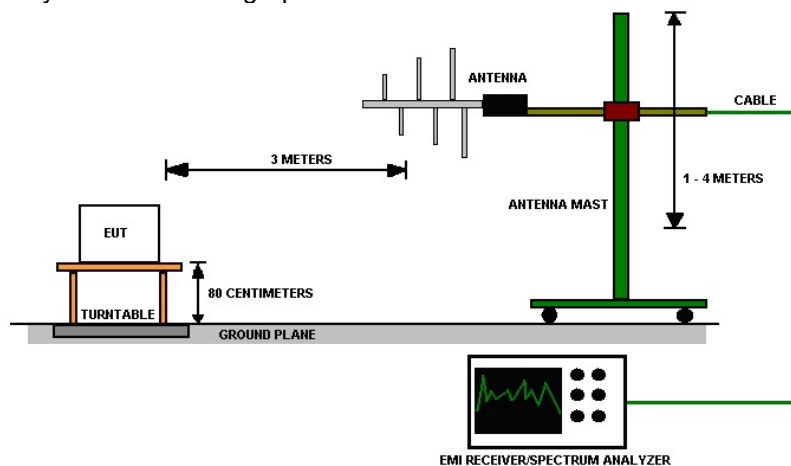


Figure 2 - Radiated Emissions Test Setup, 30MHz – 1GHz



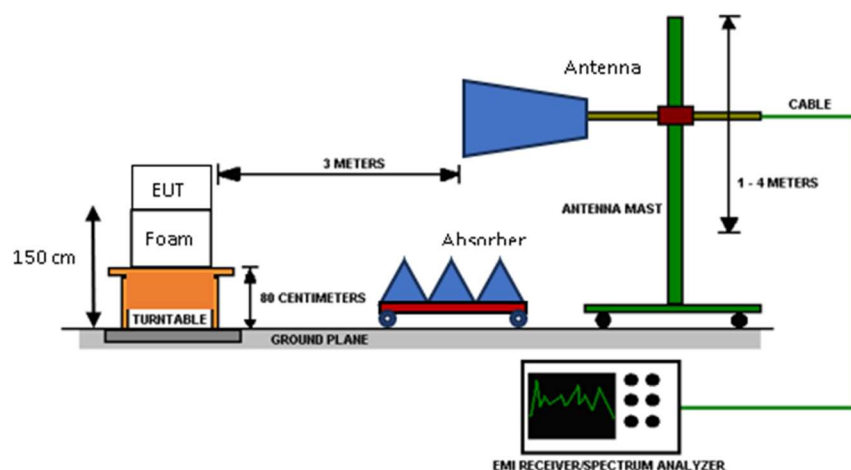


Figure 3 - Radiated Emissions Test Setup, 1GHz – 18GHz

## 4.0 RESULTS

| DTS Radio Measurements   |  |  |                           |  |                |        |
|--|--|--|---------------------------|--|----------------|--------|
| CHANNEL  | Occupied Bandwidth (kHz)               | 6 dB Bandwidth (MHz)                     | Peak OUTPUT POWER (dBm)   | Peak OUTPUT POWER (mW)                         | PSD (dBm)      | RESULT |
| Low  | 495.5                                  | 503.1                                    | 26.61                     | 458.1  | 7.42           | PASS   |
| Mid  | 495.8                                  | 503.2                                    | 26.62                     | 459.2  | 7.02           | PASS   |
| High   | 495.8                                  | 503.3                                    | 26.71                     | 468.8  | 7.45           | PASS   |
| Occupied Bandwidth = N/A; 6dB Bandwidth Limit = 500 kHz                          |  |  |                           | Output Power Limit = 30 dBm; PSD Limit = 8 dBm |                |        |
|  |  |  |                           |  |                |        |
| Unrestricted Band-Edge   |  |  |                           |  |                |        |
| CHANNEL  | Band edge /Measurement Frequency (MHz) | Relative Highest out of band level (dB)  | Relative Fundamental (dB) | Delta (dB)                                     | Min Delta (dB) | Result |
| Low  | 902.0                                  | -55.96                                   | -32.19                    | 23.77  | 20.00          | PASS   |
| High   | 928.0                                  | 72.67                                    | 106.81                    | 34.14  | 20.00          | PASS   |
| Radiated Peak Restricted Band-Edge   |  |  |                           |  |                |        |
| CHANNEL  | Band edge /Measurement Frequency (MHz) | Highest out of band level (dBµV /m @ 3m) | Measurement Type*         | Limit (dBµV/m @ 3m)                            | Margin         | Result |
| Low  | 610.0                                  | 32.13                                    | Peak                      | 46.02  | 13.89          | PASS   |
| High   | 977.2                                  | 38.84                                    | Peak                      | 53.98  | 15.14          | PASS   |
| *The peak measurement is expected to be greater than the quasi-peak measurement. |  |  |                           |  |                |        |

\*The peak measurement is expected to be greater than the quasi-peak measurement.

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#### 4.1 OUTPUT POWER

**Test Method:** Power measurements were performed using ANSI C63.10, Section 11.9.2.2.2.

**Limits of power measurements:**

**For FCC Part 15.247 Device:**

The maximum allowed output power is 30 dBm.

**Test procedures:**

Details can be found in section 3.4 of this report.

**Deviations from test standard:**

No deviation.

**Test setup:**

Details can be found in section 3.4 of this report.

**EUT operating conditions:**

Details can be found in section 2.1 of this report.

**Test results:**

**Pass**

Comments:

1. All the output power plots can be found in Appendix C.
2. All the measurements were found to be compliant.
3. The measurements are listed in the tables in section 4.0.

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## 4.2 BANDWIDTH

**Test Method:** All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

### Limits of bandwidth measurements:

#### For FCC Part 15.247 Device:

The 99% occupied bandwidth is for informational purposes only. The 6dB bandwidth of the signal must be greater than 500 kHz.

#### Test procedures:

Details can be found in section 3.4 of this report.

#### Deviations from test standard:

No deviation.

#### Test setup:

Test setup details can be found in section 3.4 of this report.

#### EUT operating conditions:

Details can be found in section 2.1 of this report.

#### Test results:

### PASS

Comments:

1. All the bandwidth plots can be found in Appendix C.
2. All the measurements were found to be compliant.
3. The measurements are listed in the tables in section 4.0.



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### 4.3 DUTY CYCLE

The transmitter had a duty cycle of >98%.

#### 4.4 RADIATED EMISSIONS

**Test Method:** ANSI C63.10-2013, Section 6.5, 6.6

**Limits for radiated emissions measurements:**

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

| FREQUENCIES (MHz) | FIELD STRENGTH (μV/m) | MEASUREMENT DISTANCE (m) |
|-------------------|-----------------------|--------------------------|
| 0.009-0.490       | 2400/F(kHz)           | 300                      |
| 0.490-1.705       | 24000/F(kHz)          | 30                       |
| 1.705-30.0        | 30                    | 3                        |
| 30-88             | 100                   | 3                        |
| 88-216            | 150                   | 3                        |
| 216-960           | 200                   | 3                        |
| Above 960         | 500                   | 3                        |

**NOTE:**

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 \* log \* Emission level (μV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.
4. The EUT was tested for spurious emissions while running off of battery power.

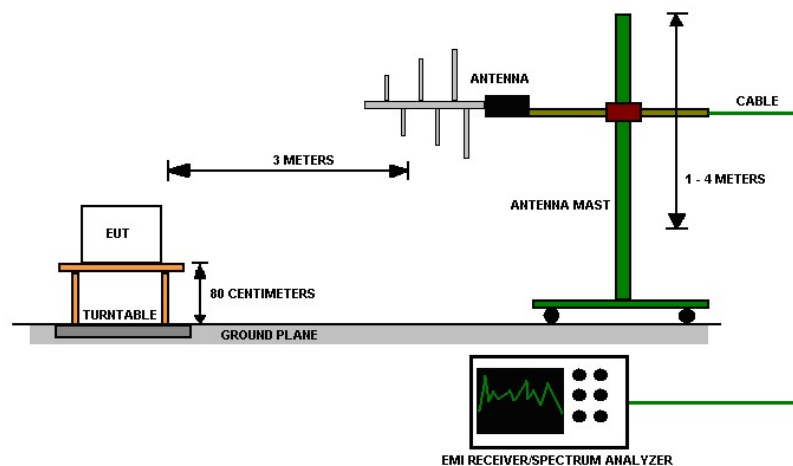


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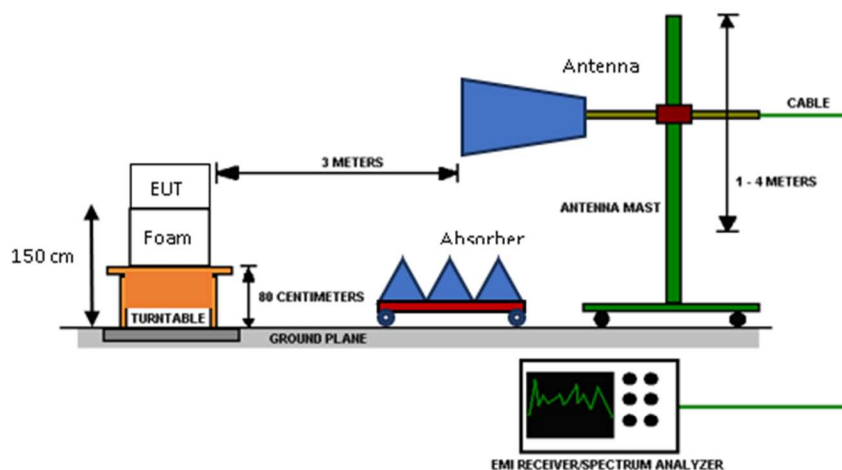
**Test procedures:**

- a. The EUT was placed on the top of a rotating table above the ground plane in a 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements from 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.
- 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 was a broadband antenna, and its 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 used to make the measurement.
- d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.
- e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.
- f. If the emission level of the EUT in peak mode was 6dB 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 6 dB 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. The EUT was maximized in all 3 orthogonal positions. The results are presented for the axis that had the highest emissions.

### Test setup:



**Figure 4 - Radiated Emissions Test Setup, 30MHz – 1GHz**



**Figure 5 - Radiated Emissions Test Setup, 1GHz – 18GHz**

### NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.
2. The resolution bandwidth was 1 MHz for all measurements and at frequencies above 1GHz, A peak and RMS detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

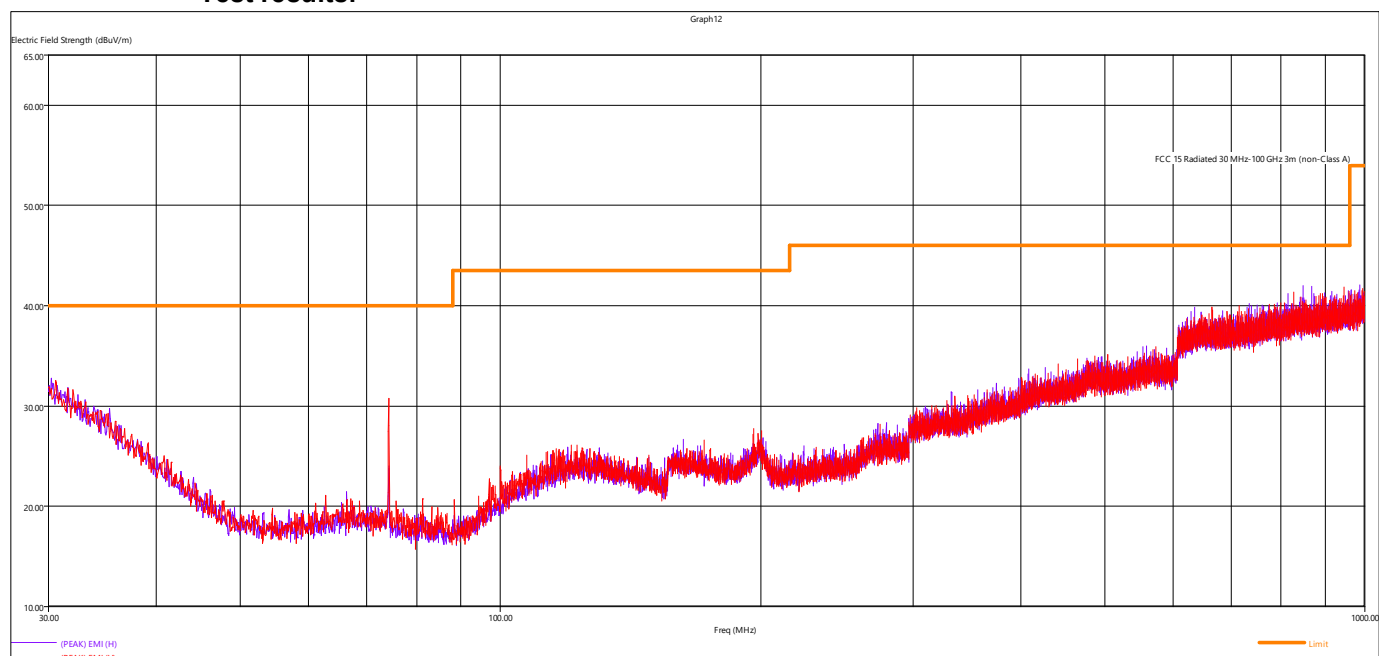
### Deviations from test standard:

No deviation.

### EUT operating conditions

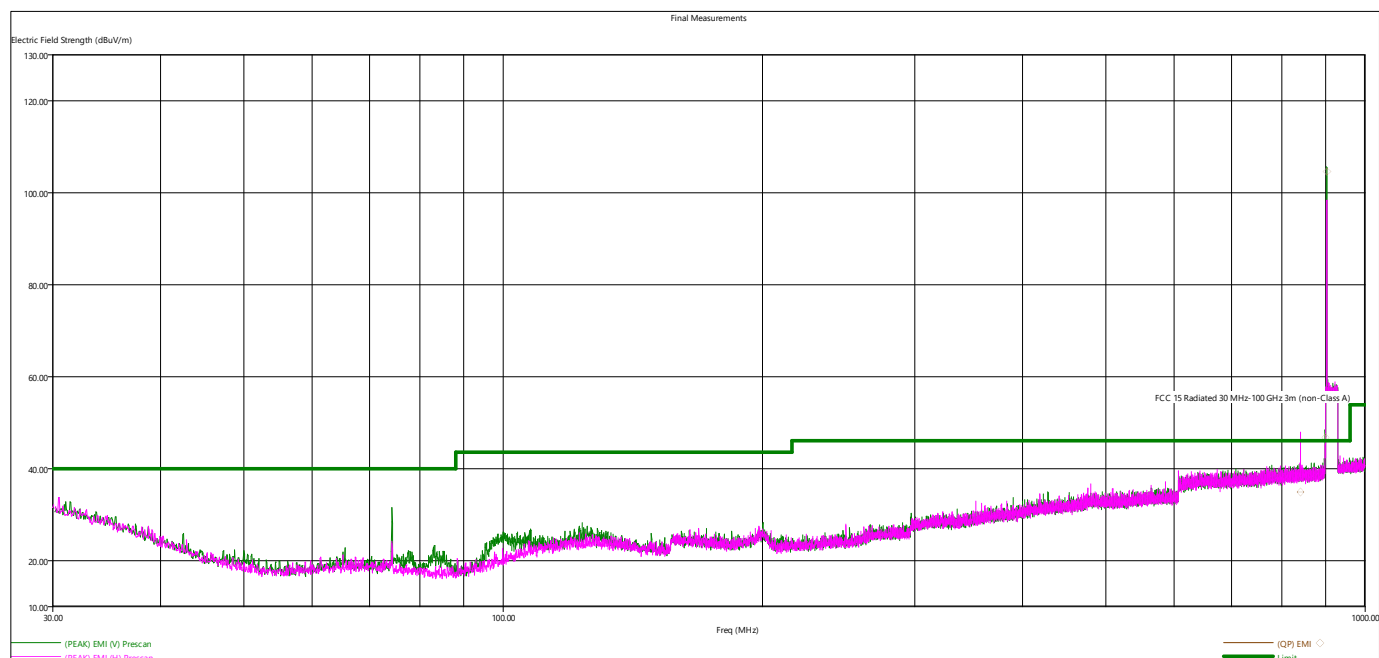
Details can be found in section 2.1 of this report.

### Test results:



**Figure 6 - Radiated Emissions Plot, Receive**

No peak emissions were within 6dB of the limit, and the emissions from this plot are not tabulated.



**Figure 7 - Radiated Emissions Plot, Low Channel**



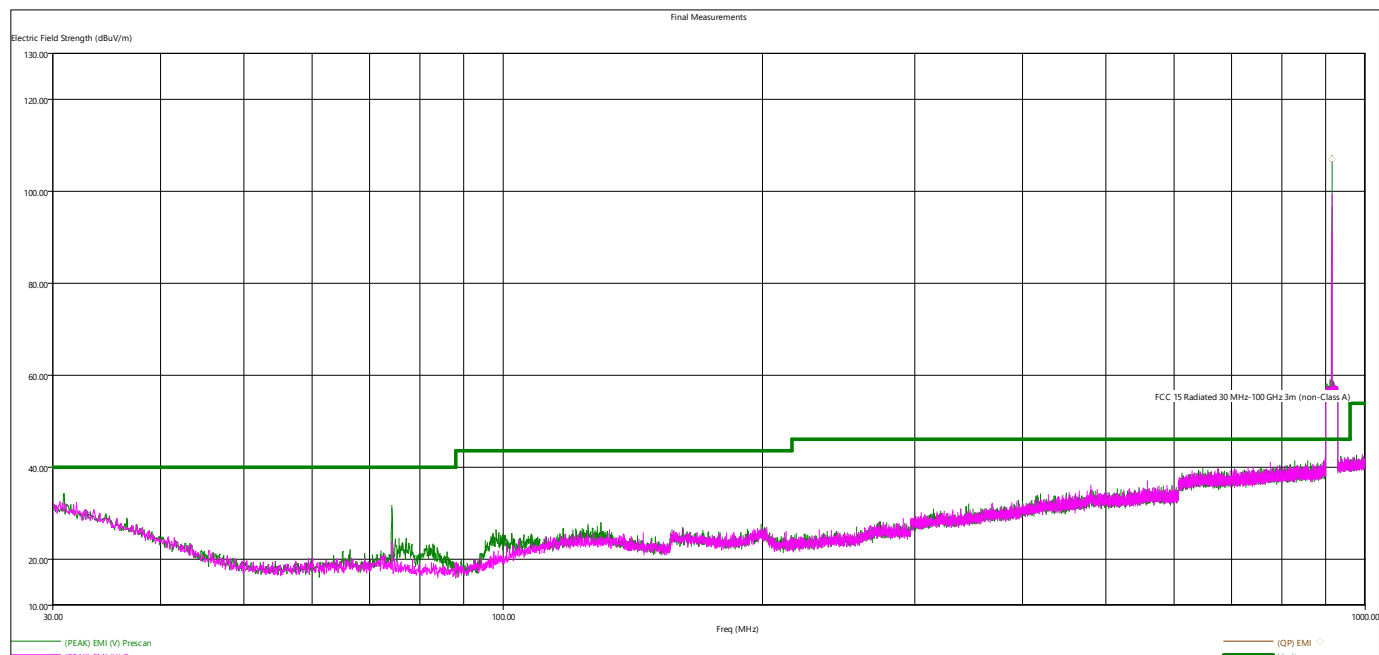


Figure 8 - Radiated Emissions Plot, Mid Channel

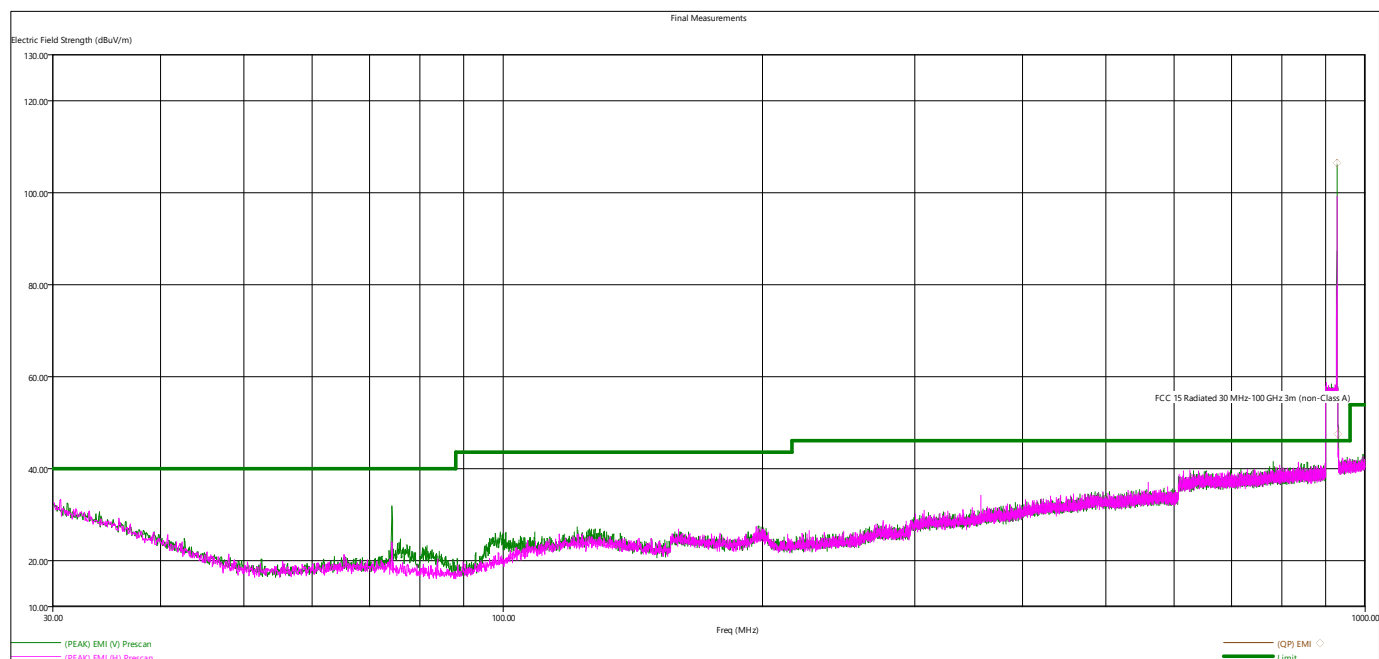


Figure 9 - Radiated Emissions Plot, High Channel

**REMARKS:**

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value - Emission level



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| Quasi-Peak Measurements, 30 MHz – 1GHz, DTS |              |              |        |        |        |     |         |
|---|--------------|--------------|--------|--------|--------|-----|---------|
| Frequency                                   | Level        | Limit        | Margin | Height | Angle  | Pol | Channel |
| MHz   | dB $\mu$ V/m | dB $\mu$ V/m | dB     | cm.    | deg.   |     |         |
| 841.329840                                  | 35.02        | 46.02        | 11.00  | 303.74 | 54.75  | H   | Low     |
| 899.770800                                  | 46.90        | 46.02        | -0.88  | 190.07 | 198.75 | V   | Low     |
| 902.525040                                  | 104.62       | 46.02        | -58.60 | 191.68 | 201.75 | V   | Low     |
| 915.160560                                  | 107.10       | 46.02        | -61.08 | 125.00 | 350.00 | V   | Mid     |
| 927.180000                                  | 106.50       | 46.02        | -60.48 | 125.00 | 350.00 | V   | High    |
| 930.380400                                  | 47.61        | 46.02        | -1.59  | 173.47 | 206.75 | V   | High    |

| Peak Measurements, 1GHz – 18GHz, DTS |        |        |        |        |        |     |         |
|--------------------------------------|--------|--------|--------|--------|--------|-----|---------|
| Frequency                            | Level  | Limit  | Margin | Height | Angle  | Pol | Channel |
| MHz                                  | dBμV/m | dBμV/m | dB     | cm.    | deg.   |     |         |
| 1805.314000                          | 39.33  | 73.98  | 34.65  | 196.94 | 359.50 | H   | Low     |
| 3610.354000                          | 43.44  | 73.98  | 30.54  | 99.98  | 27.75  | H   | Low     |
| 6316.518000                          | 52.90  | 73.98  | 21.08  | 200.04 | 63.75  | H   | Low     |
| 8121.476000                          | 48.68  | 73.98  | 25.30  | 300.22 | 6.75   | H   | Low     |
| 9023.922000                          | 51.59  | 73.98  | 22.39  | 300.16 | 27.25  | V   | Low     |
| 1829.982000                          | 38.30  | 73.98  | 35.68  | 267.14 | 0.00   | H   | Mid     |
| 6403.284000                          | 49.58  | 73.98  | 24.40  | 400.04 | 6.75   | H   | Mid     |
| 3660.000000                          | 44.58  | 73.98  | 29.40  | 200.04 | 332.00 | V   | Mid     |
| 9150.386000                          | 51.91  | 73.98  | 22.07  | 200.10 | 176.25 | V   | Mid     |
| 5564.760000                          | 47.26  | 73.98  | 26.72  | 400.10 | 14.25  | H   | High    |
| 3708.746000                          | 46.97  | 73.98  | 27.01  | 300.22 | 357.75 | V   | High    |
| 9272.320000                          | 52.73  | 73.98  | 21.25  | 200.10 | 168.25 | V   | High    |

The worst-case is shown in the plot and table above.  
All other measurements were found to be at least 6 dB Below the limit.

| Average Measurements, 1GHz – 18GHz, DTS |        |        |        |        |        |     |      |
|---|--------|--------|--------|--------|--------|-----|------|
| Frequency                               | Level  | Limit  | Margin | Height | Angle  | Pol | Ch.  |
| MHz                                     | dBμV/m | dBμV/m | dB     | cm.    | deg.   |     |      |
| 1805.314000                             | 31.61  | 53.98  | 21.48  | 196.94 | 359.50 | H   | Low  |
| 3610.354000                             | 32.50  | 53.98  | 21.48  | 99.98  | 27.75  | H   | Low  |
| 6316.518000                             | 40.32  | 53.98  | 19.27  | 200.04 | 63.75  | H   | Low  |
| 8121.476000                             | 34.71  | 53.98  | 17.01  | 300.22 | 6.75   | H   | Low  |
| 9023.922000                             | 36.97  | 53.98  | 21.48  | 300.16 | 27.25  | V   | Low  |
| 1829.982000                             | 30.77  | 53.98  | 23.21  | 267.14 | 0.00   | H   | Mid  |
| 6403.284000                             | 34.67  | 53.98  | 19.31  | 400.04 | 6.75   | H   | Mid  |
| 3660.000000                             | 34.13  | 53.98  | 19.85  | 200.04 | 332.00 | V   | Mid  |
| 9150.386000                             | 37.76  | 53.98  | 16.22  | 200.10 | 176.25 | V   | Mid  |
| 5564.760000                             | 34.87  | 53.98  | 19.11  | 400.10 | 14.25  | H   | High |
| 3708.746000                             | 35.45  | 53.98  | 18.53  | 300.22 | 357.75 | V   | High |
| 9272.320000                             | 38.72  | 53.98  | 15.26  | 200.10 | 168.25 | V   | High |

The worst-case is shown in the plot and table above.  
All other measurements were found to be at least 6 dB Below the limit.

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#### 4.5 CONDUCTED SPURIOUS EMISSIONS

**Test Method:** ANSI C63.10-2013, Section 6.7

**Limits of spurious emissions:**

From FCC Part 15.247:

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

**Test procedures:**

The highest emissions level was measured and recorded. All spurious measurements were evaluated to 30dB below the fundamental. More details can be found in section 3.4 of this report. The line shown in the plots is a reference line placed at -20dBm.

**Deviations from test standard:**

NA

**Test setup:**

Test setup details can be found in section 3.4 of this report.

**EUT operating conditions:**

Details can be found in section 2.1 of this report.

**Test results:**

Data rates and channels were investigated, and worst case was reported, no emissions exceeded the limits.

There was no distinguishable difference between low and high data rate.

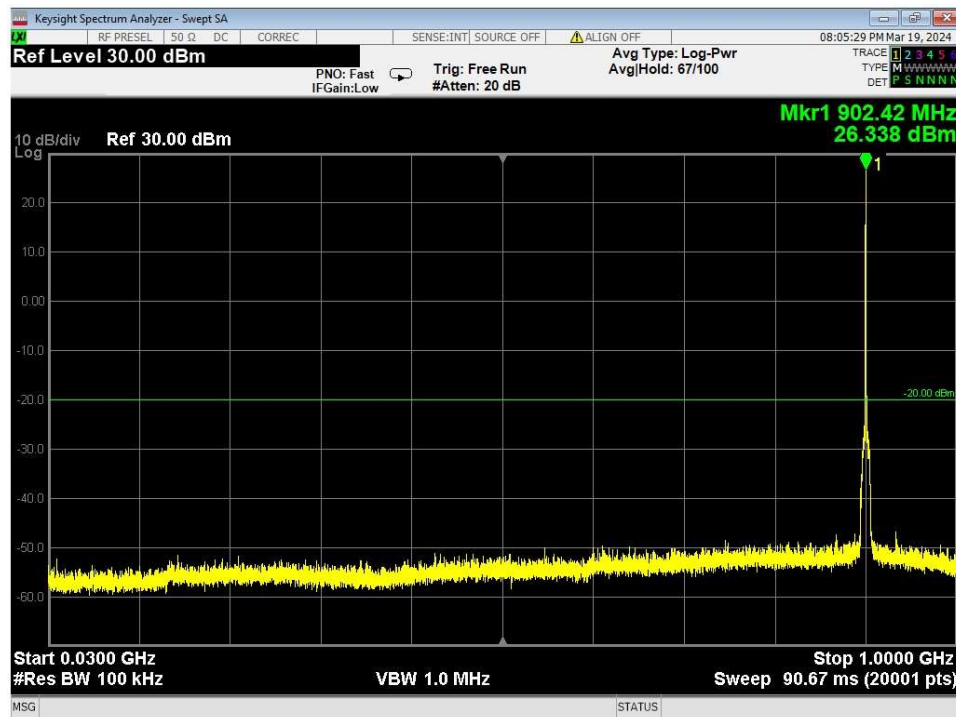


Figure 10 - Conducted Spurious Emissions, DTS, 30MHz – 1GHz, Low Channel

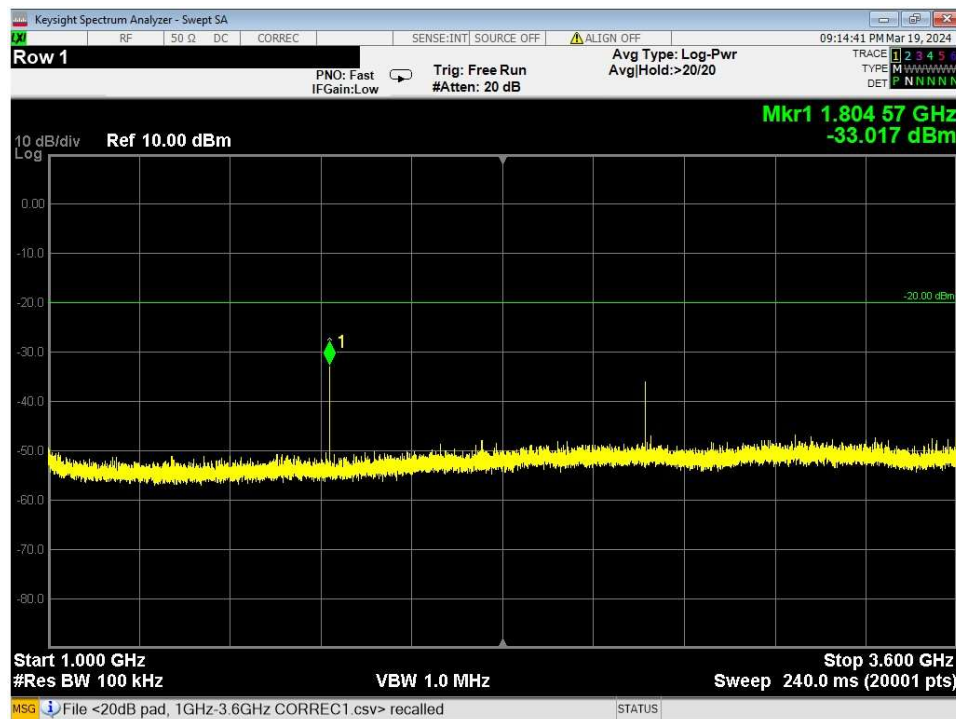


Figure 11 - Conducted Spurious Emissions, DTS, 1GHz – 3.6GHz, Low Channel

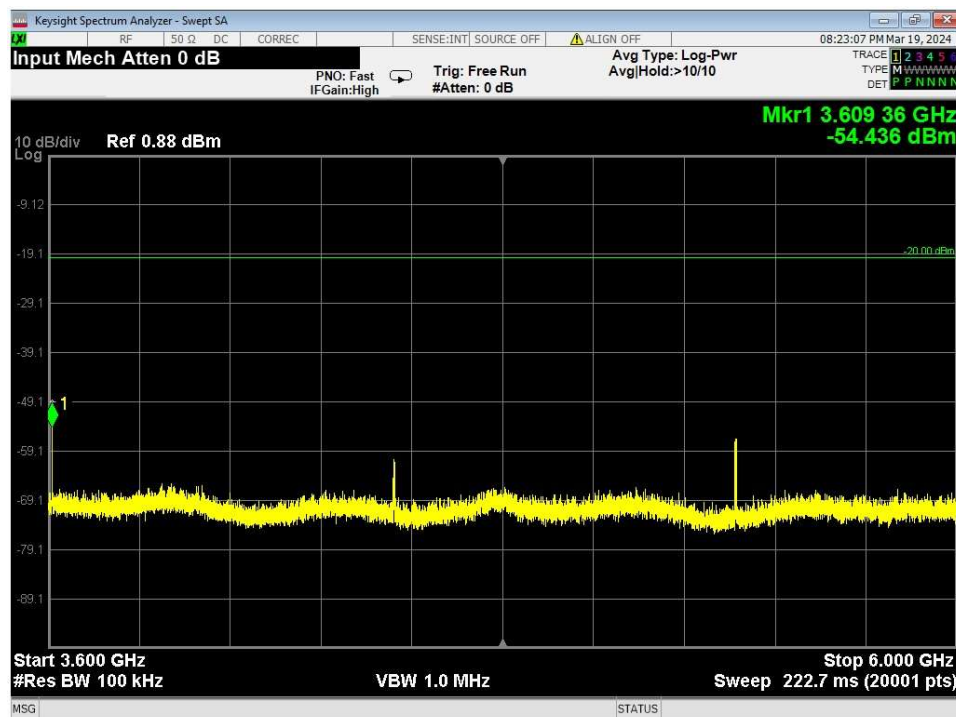


Figure 12 - Conducted Spurious Emissions, DTS, 3.6GHz – 6GHz, Low Channel

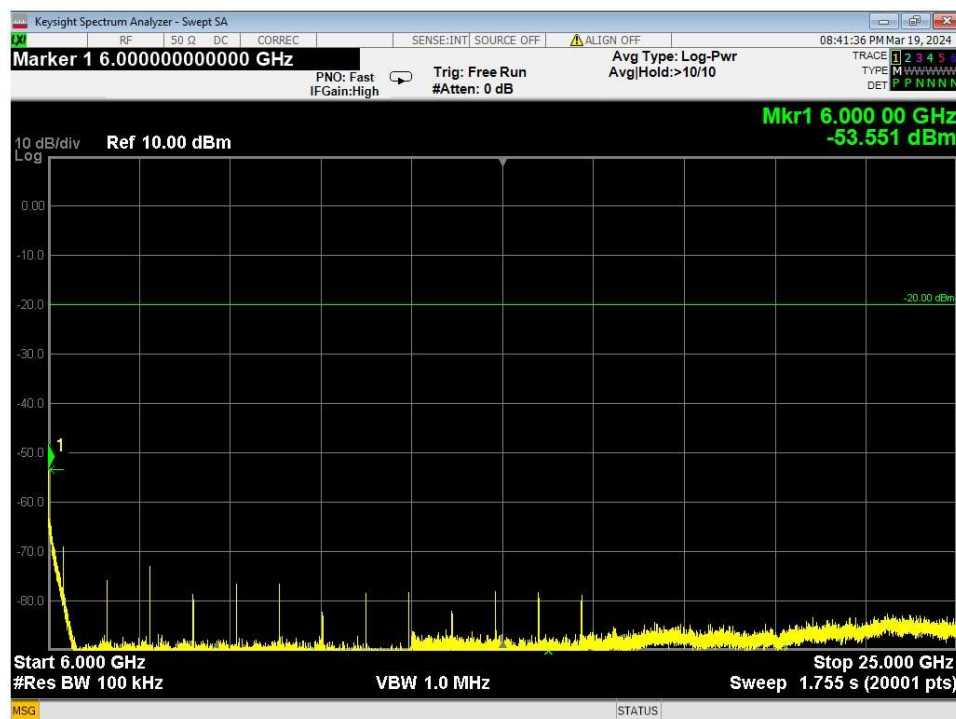


Figure 13 - Conducted Spurious Emissions, DTS, 6GHz – 25GHz, Low Channel

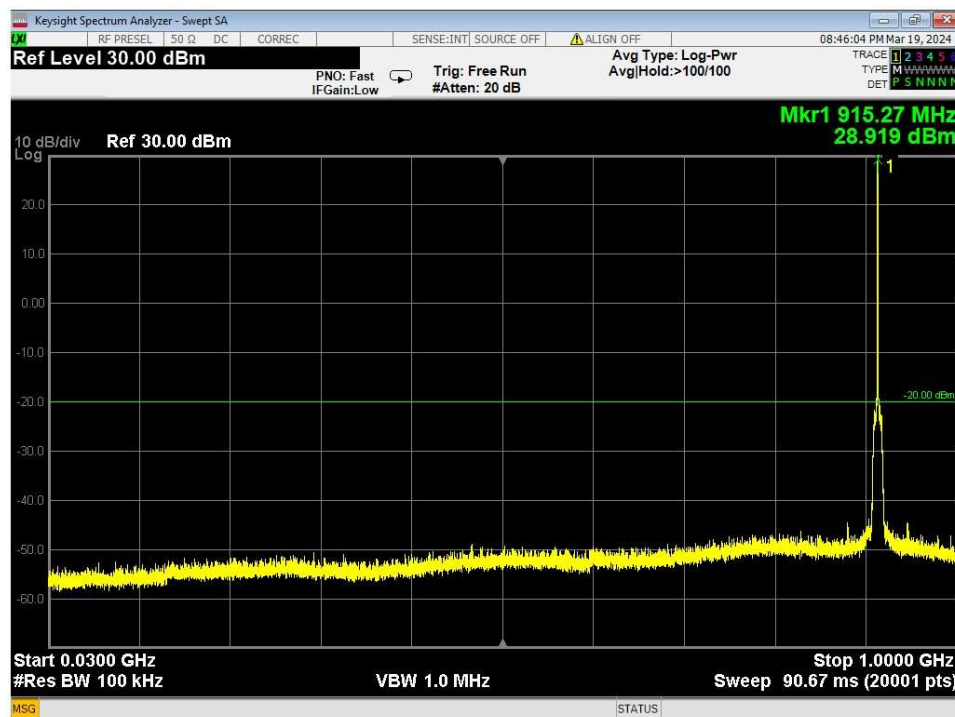


Figure 14 - Conducted Spurious Emissions, DTS, 30MHz – 1GHz, Mid Channel

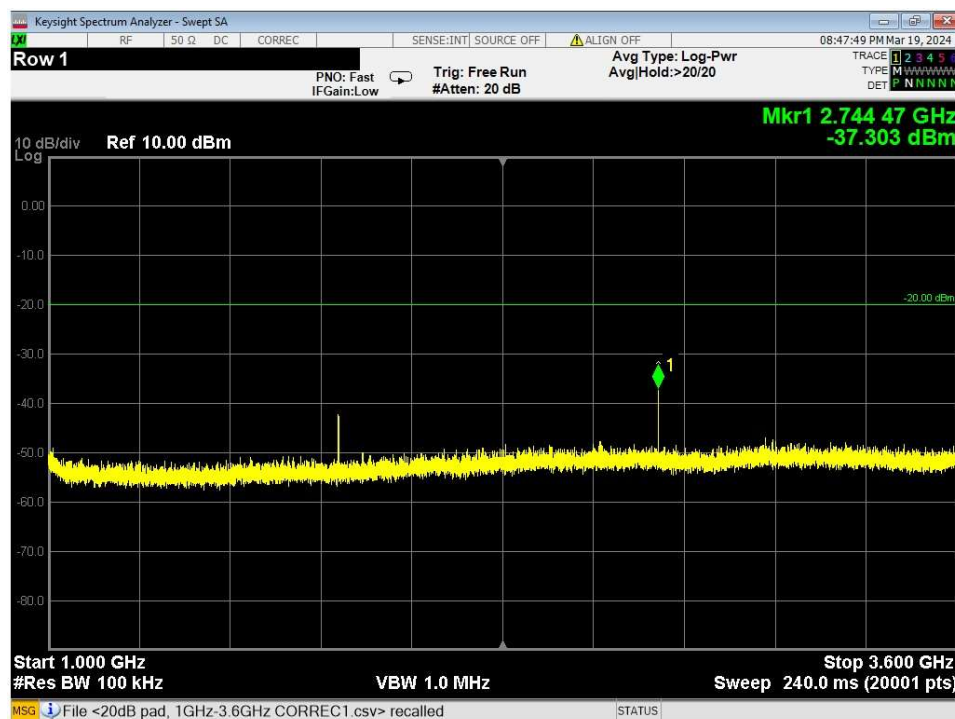


Figure 15 - Conducted Spurious Emissions, DTS, 1GHz – 3.6GHz, Mid Channel

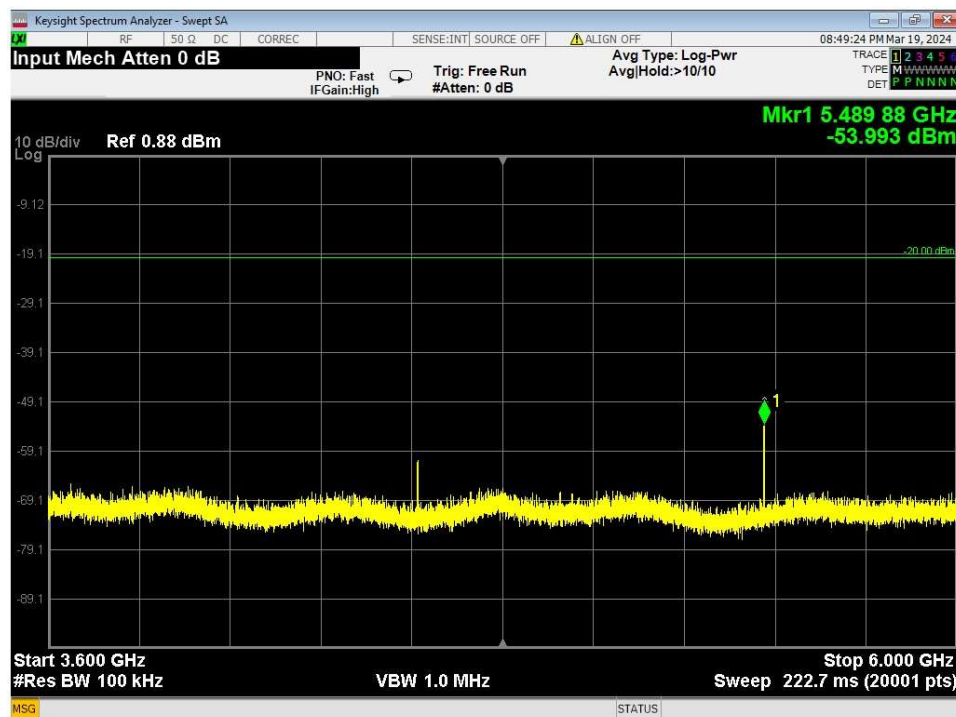


Figure 16 - Conducted Spurious Emissions, DTS, 3.6GHz – 6GHz, Mid Channel

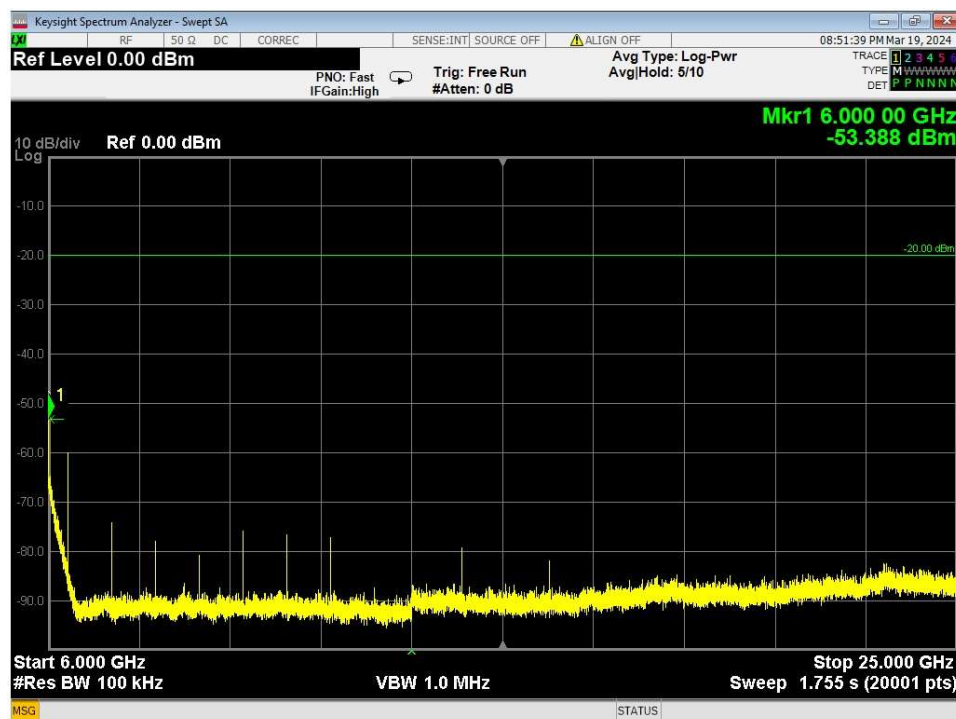


Figure 17 - Conducted Spurious Emissions, DTS, 6GHz – 25GHz, Mid Channel









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#### 4.6 BAND EDGES

**Test Method:** All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

**Limits of band-edge measurements:**

**For FCC Part 15.247 Device:**

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

**Test procedures:**

The highest emissions level beyond the band-edge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209. More details can be found in section 3.4 of this report.

**Deviations from test standard:**

No deviation.

**Test setup:**

Test setup details can be found in section 3.4 of this report.

**EUT operating conditions:**

Details can be found in section 2.1 of this report.



|                |                   |     |   |
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**Test results:**

**Pass**

Comments:

1. All the band edge plots can be found in Appendix C.
2. If the device falls under FCC Part 15.247 (Details can be found in summary of test results), compliance is shown in the unrestricted band edges by showing minimum delta of 20 dB between peak and the band edge.
3. The restricted band edge compliance is shown by comparing it to the general limit defined in Part 15.209. The limit shown in the graph accounts for the antenna gain of the device.



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## 4.7 POWER SPECTRAL DENSITY

**Test Method:** All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

**Limits of power measurements:**

**For FCC Part 15.247 Device:**

The maximum PSD allowed is 8 dBm.

**Test procedures:**

Details can be found in section 3.4 of this report.

**Deviations from test standard:**

No deviation.

**Test setup:**

Details can be found in section 3.4 of this report.

**EUT operating conditions:**

Details can be found in section 2.1 of this report.

**Test results:**

**Pass**

Comments:

1. All the Power Spectral Density (PSD) plots can be found in Appendix C.
2. All the measurements were found to be compliant.
3. The measurements are listed in the tables in section 4.0.

## 4.8 CONDUCTED AC MAINS EMISSIONS

**Test Method:** ANSI C63.10-2013, Section(s) 6.2

**Limits for conducted emissions measurements:**

| FREQUENCY OF EMISSION<br>(MHz) | CONDUCTED LIMIT<br>(dB $\mu$ V) |          |
|--------------------------------|---------------------------------|----------|
|                                | Quasi-peak                      | Average  |
| 0.15-0.5                       | 66 to 56                        | 56 to 46 |
| 0.5-5                          | 56                              | 46       |
| 5-30                           | 60                              | 50       |

**Notes:**

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

**Test Procedures:**

- a. The EUT was placed 0.8m above a ground reference plane and 0.4 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference as well as the ground.
- c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10dB under the prescribed limits are not reported.
- d. Results were compared to the 15.207 limits.

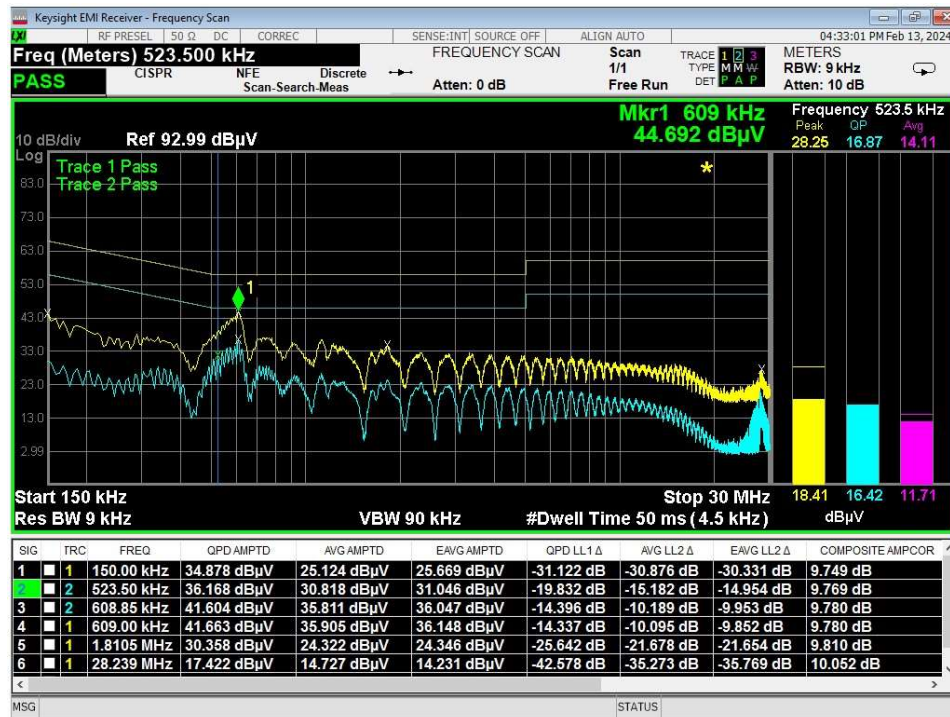
**Deviation from the test standard:**

No deviation

**EUT operating conditions:**

Details can be found in section 2.1 of this report. USB power supply was used for AC Conducted Emissions.

# Test Results:



. Figure 22 - Conducted Emissions, Line

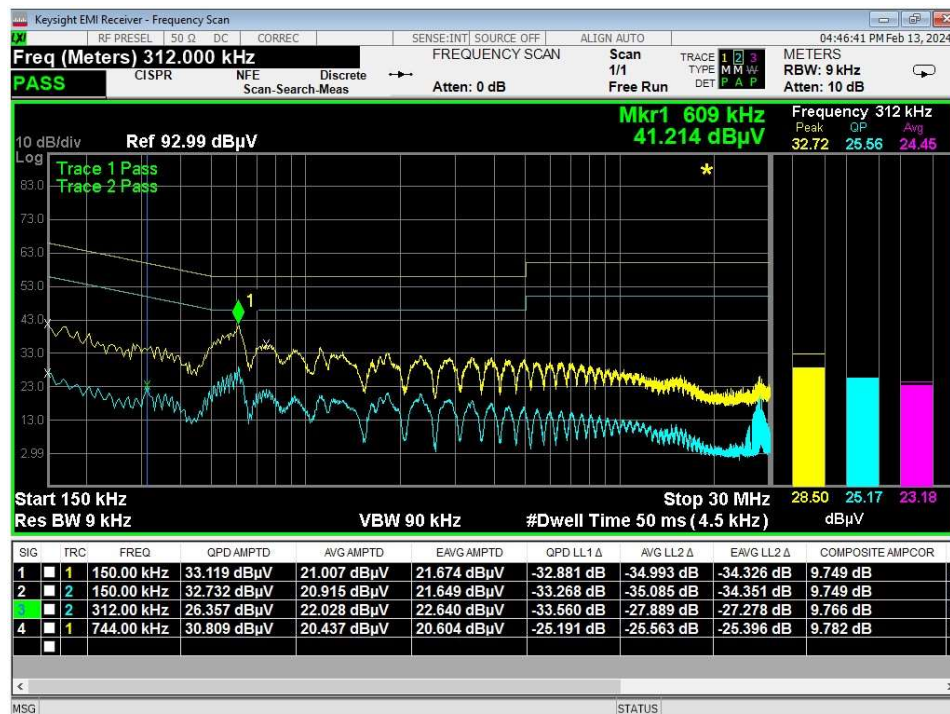



Figure 23 - Conducted Emissions, Neutral

|  |                |                   |     |   |
|--|----------------|-------------------|-----|---|
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## ANNEX A: MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels apply to tests performed in this test report:

| Test                        | Frequency Range | NCEE Labs Uncertainty Value (dB) | Maximum Uncertainty Values per<br>CISPR 16-4-2:2011/A1:2018 |
|-----------------------------|-----------------|----------------------------------|---|
| AC Line Conducted Emissions | 150kHz - 30MHz  | 3.03                             | 3.60  |
| Radiated Emissions, 3m      | 30MHz - 1GHz    | 4.19                             | 5.34  |
| Radiated Emissions, 3m      | 1GHz – 18GHz    | 5.08                             | 5.48  |

Expanded uncertainty values are calculated to a confidence level of 95%.

NCEE Labs meets the maximum uncertainty requirements per CISPR 16-4-2:2011/A1:2018, and therefore does not require a minimum passing margin to state that an EUT is less than the field strength limits of the applicable CISPR, IEC or EN limit per CISPR 16-4-2:2011/A1:2018, Section 4.1.

NCEE Labs employs tilting when testing at 3m test distance. The maximum uncertainty associated with this method is used.

Maximum uncertainty values show the worse-case of all test distances used.





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## ANNEX B: SAMPLE FIELD STRENGTH CALCULATION

### ***Radiated Emissions***

The field strength is calculated in decibels (dB) by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = R + AF - (-CF + AG)$$

where FS = Field Strength

R = Receiver Amplitude Receiver reading in dB $\mu$ V

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Preamplifier Amplifier Gain

Assume a receiver reading of 55.00 dB $\mu$ V is obtained. The Antenna Factor of 12.00 and a Cable Factor of 1.10 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.10 dB $\mu$ V/m.

$$FS = 55.00 + 12.00 - (-1.10 + 20.00) = 48.1 \text{ dB}\mu\text{V/m}$$

The 48.1 dB $\mu$ V/m value can be mathematically converted to its corresponding level in  $\mu$ V/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(48.1 \text{ dB}\mu\text{V/m})/20] = 254.1 \mu\text{V/m}$$

### ***Conducted Emissions***

Receiver readings are compared directly to the conducted emissions limits in decibels (dB) by adding the cable loss and LISN insertion loss to the receiver reading. The basic equations with a sample calculation is as follows;

$$FS = R + IL - (-CF)$$

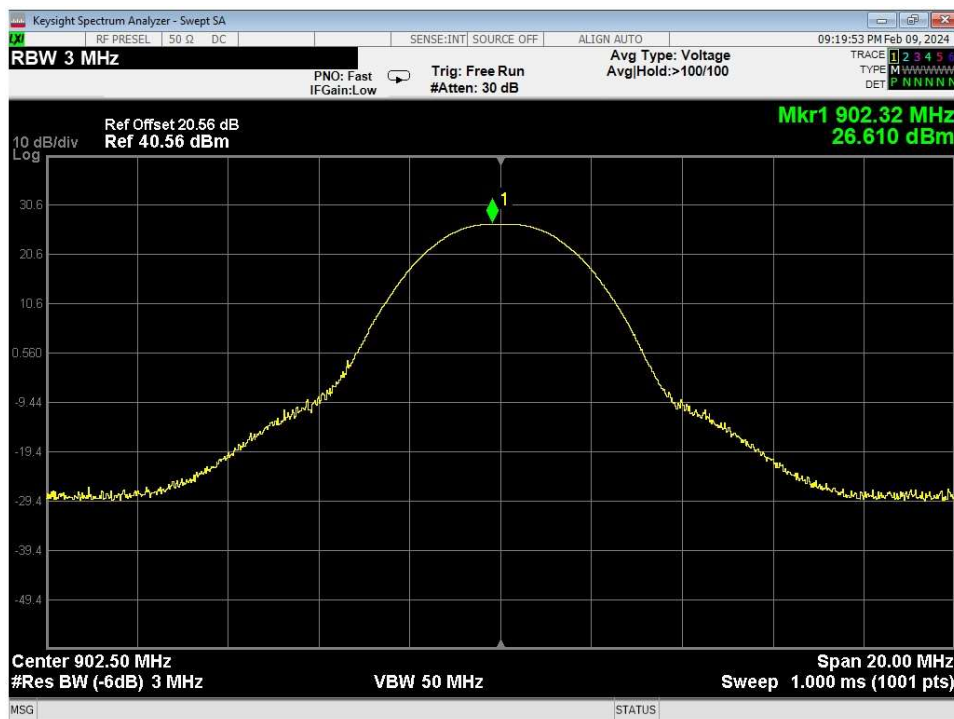
where V = Conducted Emissions Voltage Measurement

R = Receiver reading in dB $\mu$ V

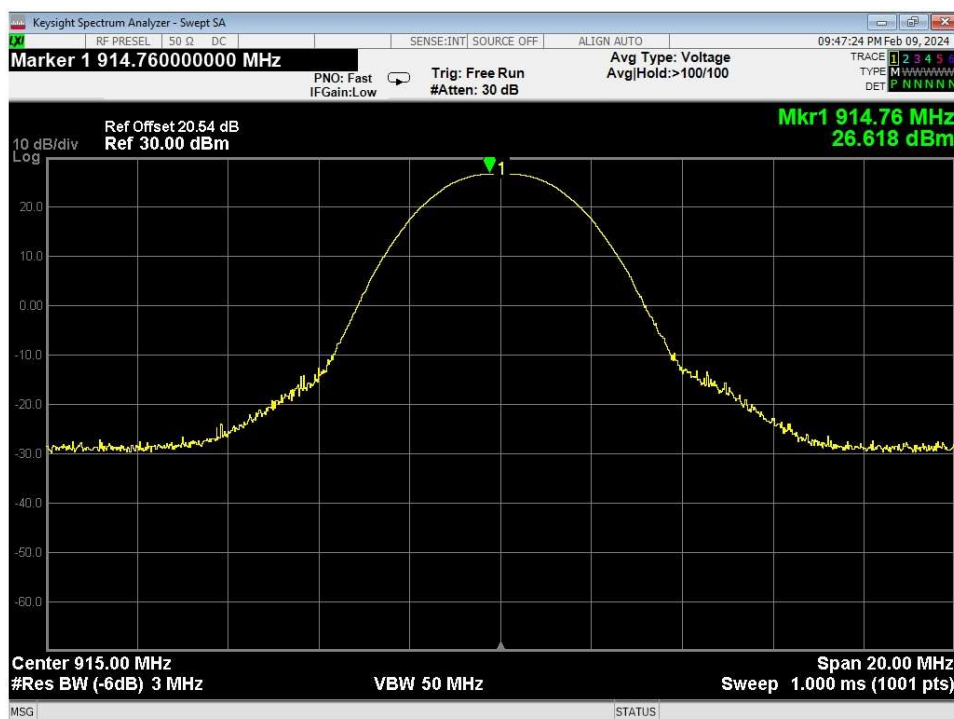
IL = LISN Insertion Loss

CF = Cable Attenuation Factor

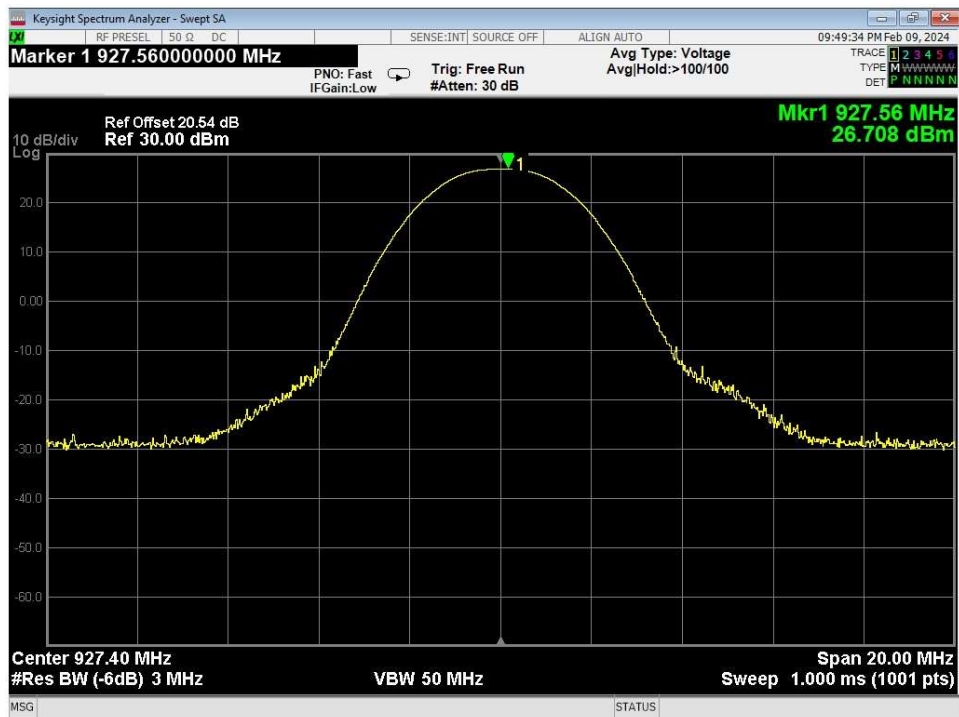
## APPENDIX C – GRAPHS AND TABLES



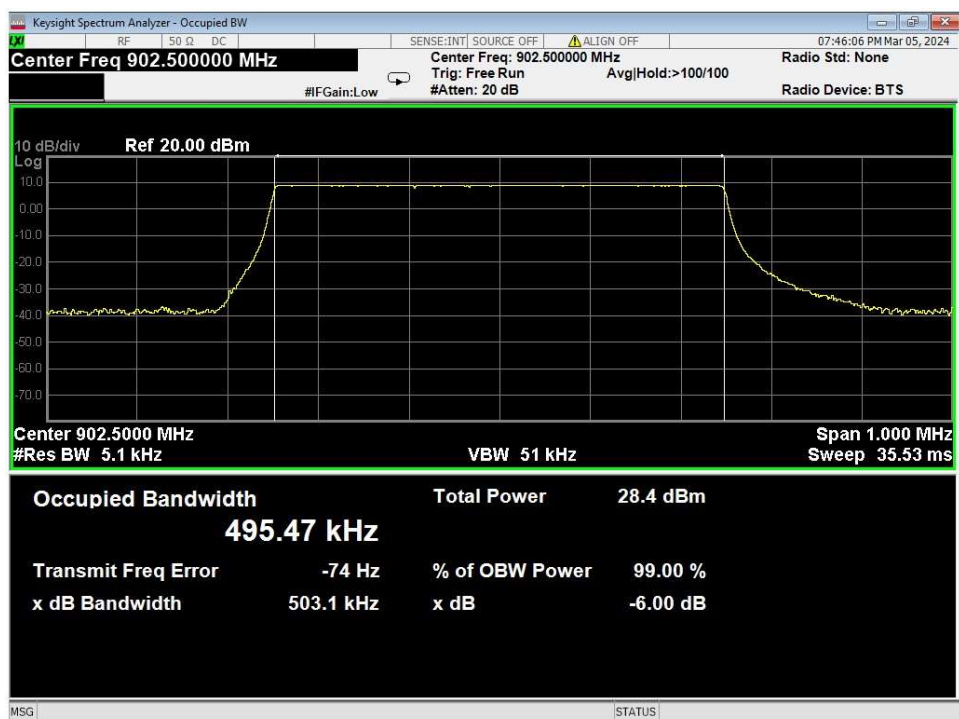
01 Average Power, Low, Conducted



02 Average Power, Mid, Conducted

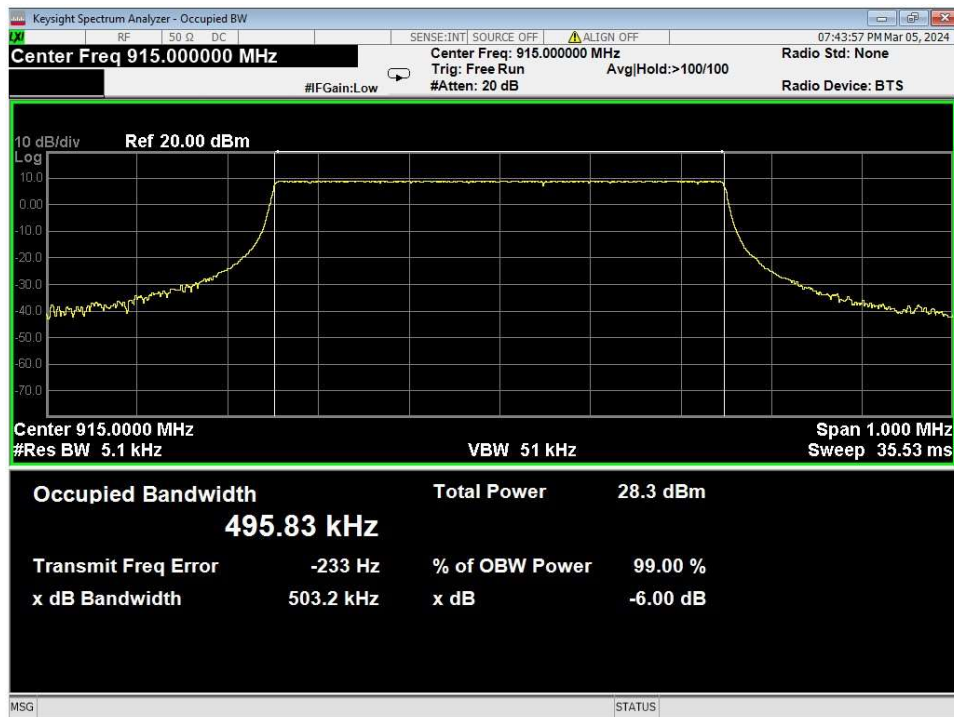


### 03 Average Power, High, Conducted

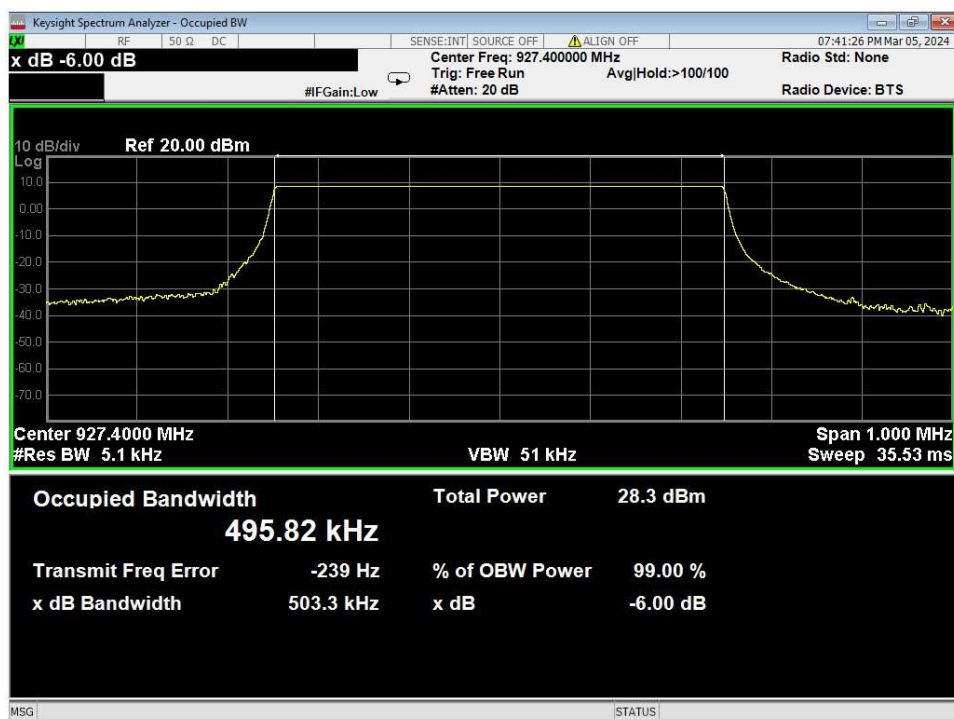


### 04 6dB Bandwidth, Low, Conducted


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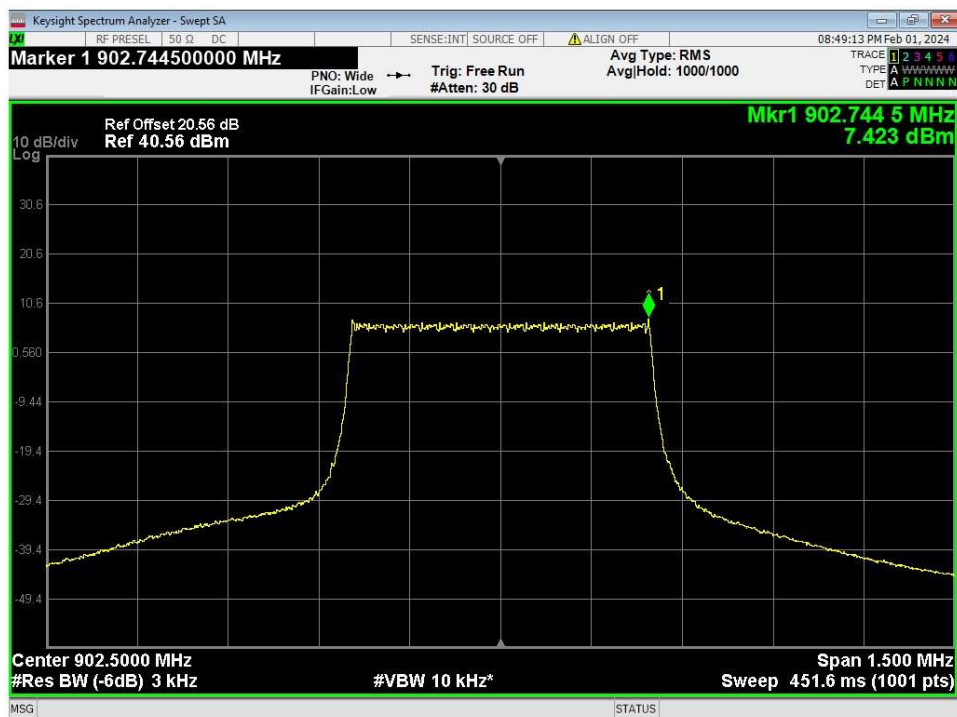


05 6dB Bandwidth, Mid, Conducted



06 6dB Bandwidth, High, Conducted

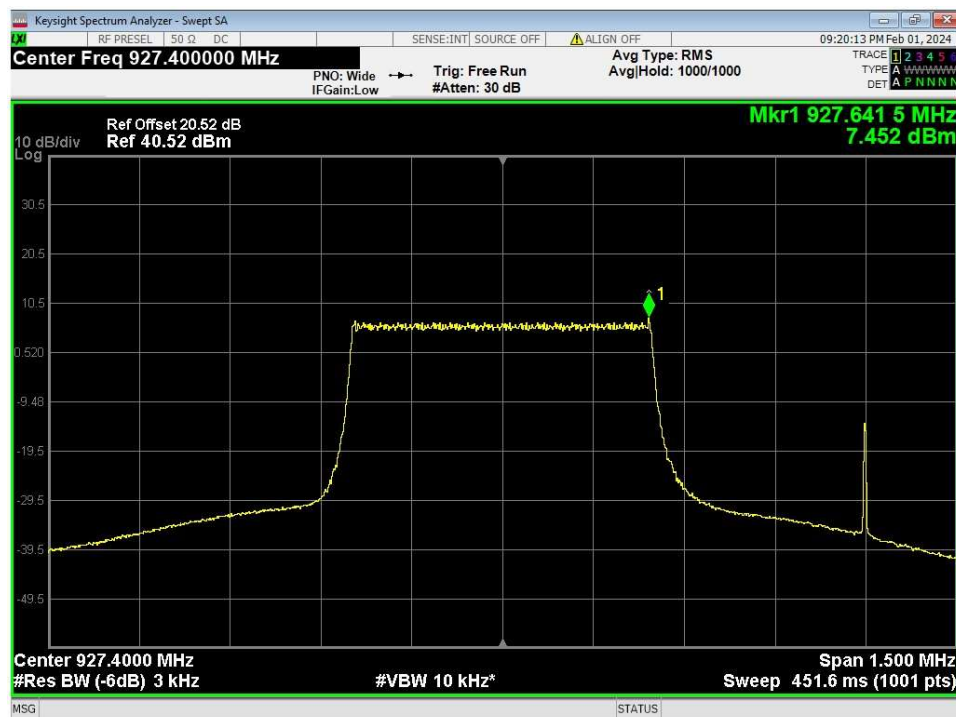
|  |                |                   |     |   |
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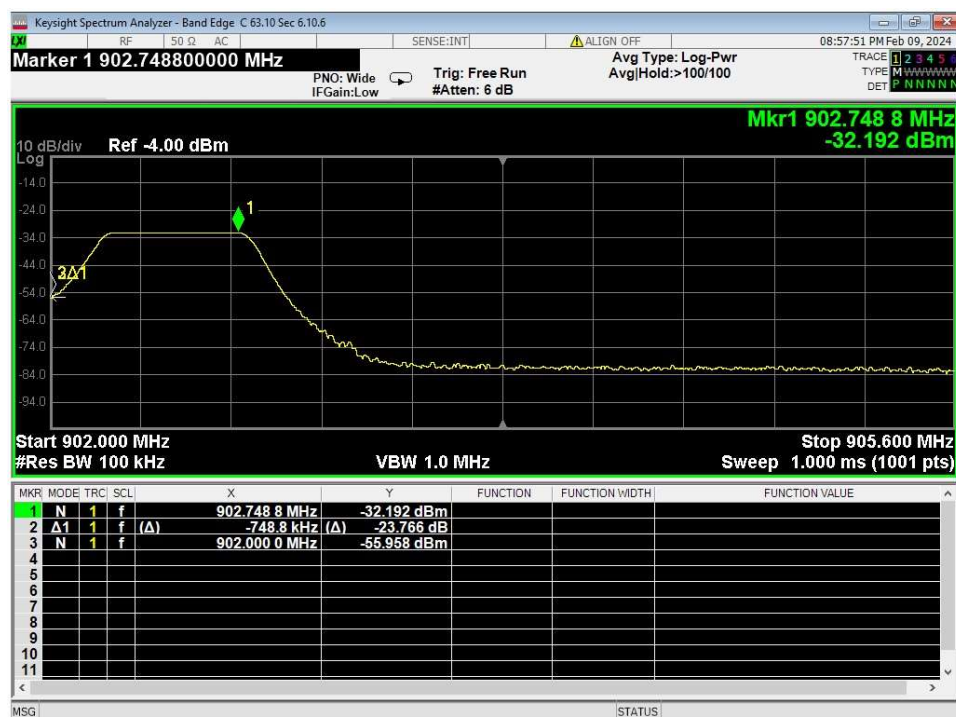
07 PSD, Low, Conducted



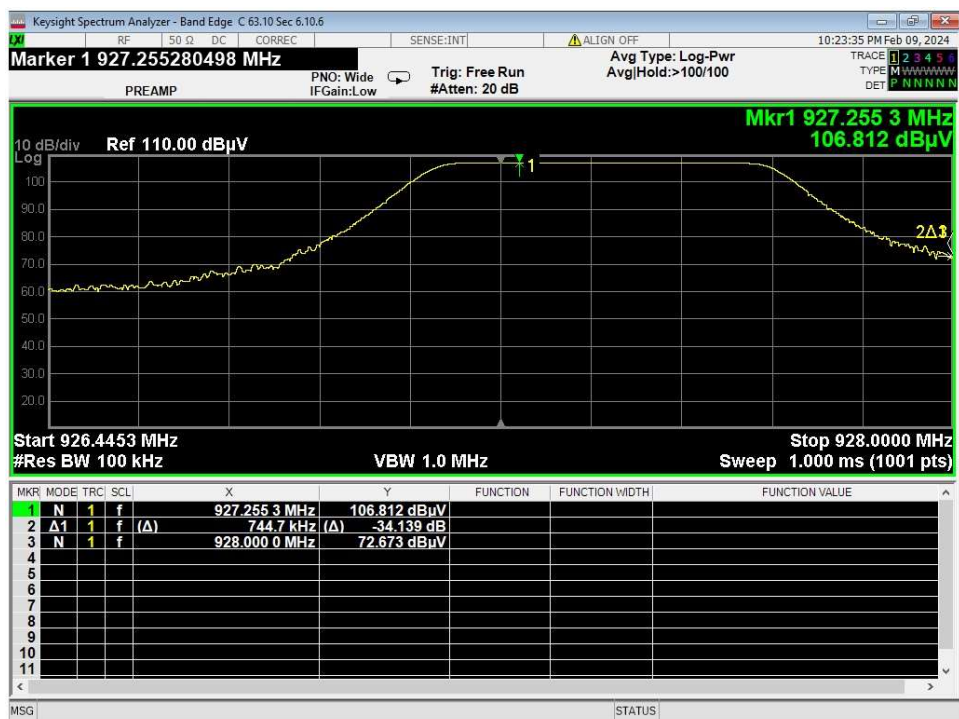
08 PSD, Mid, Conducted



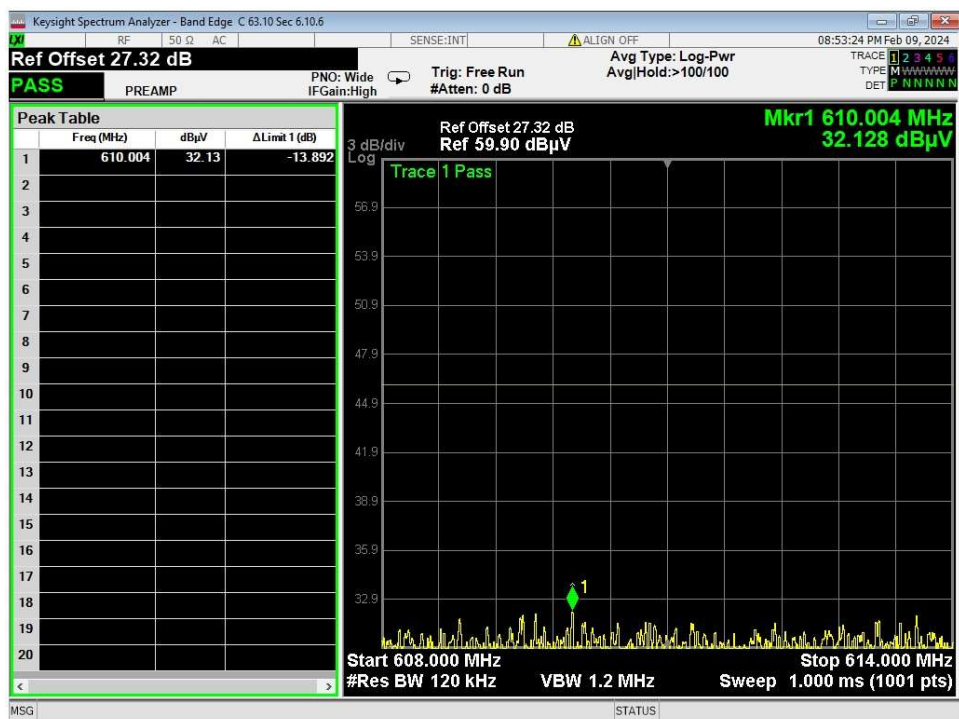
09 PSD, High, Conducted



10 Lower Bandedge, Unrestricted, Radiated



### 11 Higher Bandedge, Unrestricted, Radiated

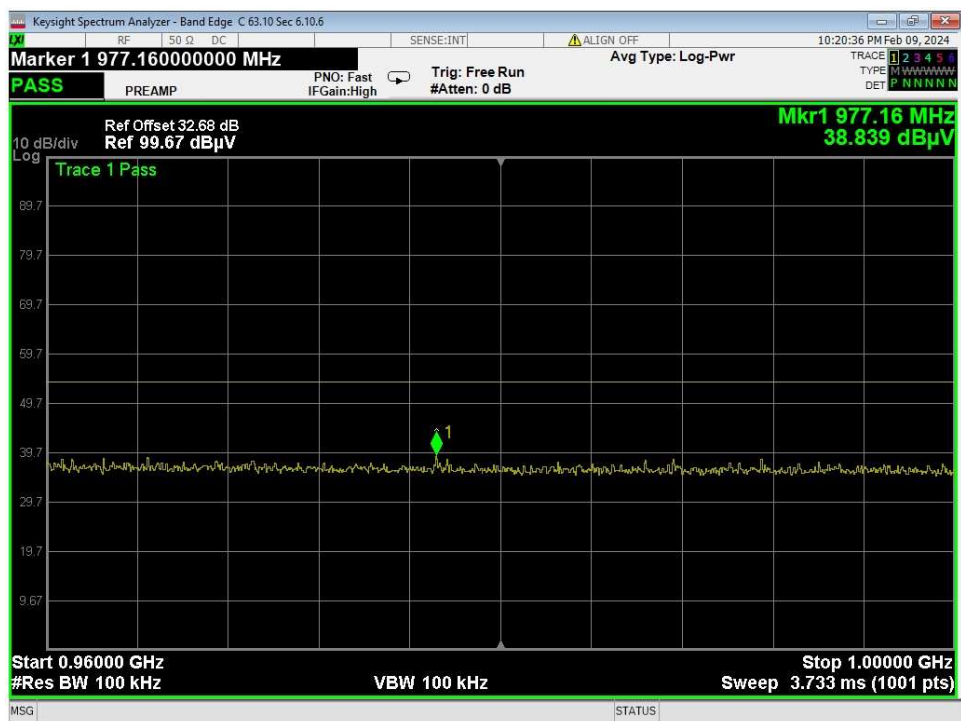


### 12 Lower Bandedge, Restricted, Radiated





|                |                   |     |   |
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13 Higher Bandedge, Restricted, Radiated





|                |                   |     |   |
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REPORT END