# Report on the Testing of the

# Cobham Satcom

# Model: Yahsat T-TAC Maritime
# Part Number: 408065A-41000

# FCC ID:ROJ-8065A

# In accordance with:
# FCC 47 CFR Part 25

Prepared for: Cobham Satcom
Lundtoftegaardsvej 93 D
DK-2800, Kgs. Lyngby, Denmark

America

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## COMMERCIAL-IN-CONFIDENCE

Document Number: NC721001137.3 | Issue: 7

| SIGNATURE | | | |
|---|---|---|---|
| | | | |
| **NAME** | **JOB TITLE** | **RESPONSIBLE FOR** | **ISSUE DATE** |
| Sean Sellergren | Sr. EMC Engineer | **Authorized Signatory** | 03 December 2024 |

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD America, Inc. document control rules.

| | |
|---|---|
| FCC Accreditation Designation Number US1148 New Brighton, MN Test Laboratory | Innovation, Science, and Economic Development Canada Accreditation Site Number 4512A New Brighton, MN Test Laboratory |

**EXECUTIVE SUMMARY**
A sample of this product was tested and found to be compliant with the standards listed above and the tests shown in Table 1.3.1 of this report.

A2LA Cert. No. 2955.11



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# Contents



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# 1 Report Summary

## 1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

**Table 1.1-1 – Modification Record**

| Issue | Description of Change | Date of Issue |
|---|---|---|
| 1 | First Issue | 04 December 2024 |
| 2 | - Corrected frequency typo in Section 1.5.2<br>- Updated verbiage in all test section's Environmental Conditions description<br>- Added a statement in the Test Results section of Occupied Bandwidth to better reflect that the signal characteristics are taken using a Viper signal generator and that the data dose not limit the use of devices with 5kHz and 25kHz channels<br>- Testing was redone for Frequency Stability and this section was updated with those results. | 06 December 2024 |
| 3 | - Updated data in Section 2.5<br>- Updated standard references in Section 1.2 | 15 January 2025 |
| 4 | - Add statement to Section 2.5.4 mentioning that a GPS signal was not present during testing. | 22 January 2025 |
| 5 | - Updated data in section 2.1 RF output power with data from the TUV SUD San Diego lab<br>- Updated data in section 2.3 conducted spurious emissions<br>- Add TUV SUD San Diego lab's address to section 1.8 Test Locations | 12 February 2025 |
| 6 | - Updated data in section 2.1 RF output power with data from the TUV SUD San Diego lab | 13 February 2025 |
| 7 | - Update Technical description in section 1.5.1 and data in section 2.1 RD output Power | 14 February 2025 |

## 1.2 Introduction

| | |
|---|---|
| Applicant | Cobham Satcom |
| Applicant's Email Address | reetika.bishnoi@cobhamsatcom.com |
| Model Number(s) | Yahsat T-TAC Maritime |
| Part Number(s) | 408065A-41000 |
| Number of Samples Tested | 1 |
| Test Specification/Issue/Date | FCC 47 CFR Part 15.25 |
| Order Number | 721001137 |

| | |
|---|---|
| Date of Receipt of EUT | 07 October 2024 |
| Start of Test | 07 October 2024 |
| Finish of Test | 14 February 2025 |
| Related Document(s) | ANSI C63.26 2015 |

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## 1.3 Scope of Testing

To perform certification testing to confirm that the wireless device(s) meet the requirements of the applicable standards and guidance documents.

## 1.4 Summary of Results

A summary of the tests carried out in accordance with the specifications shown below.

**Table 1.4-1 – Summary of Results**

| Section | Specification Clause | Test Description | Accreditation | Base Standard |
|---|---|---|---|---|
| 2.1 | 25.204(a) / 2.1046 | RF Output Power | A2LA | ANSI C63.26:2015 |
| 2.2 | 25.1049 | Occupied Bandwidth | A2LA | ANSI C63.26:2015 |
| 2.3 | 25.202(f) / 2.1051 | Conducted Spurious Emissions | A2LA | ANSI C63.26:2015 |
| 2.4 | 25.202(f) / 2.1053 | Radiated Spurious Emissions | A2LA | ANSI C63.26:2015 |
| 2.5 | 25.202(d) / 2.1055 | Frequency Stability | A2LA | ANSI C63.26:2015 |
| 2.6 | 25.216(c)(h)(i) | Protection of Aeronautical Radio Navigation Satellite Service | A2LA | ANSI C63.26:2015 |

**Table 1.4-2 – Test Accreditation**

| Test Name | Name of Tester(s) | Results / Comments |
|---|---|---|
| RF Output Power | Miguel Rabago | Pass |
| Occupied Bandwidth | Sean Sellergren | Pass |
| Conducted Spurious Emissions | Miguel Rabago | Pass |
| Radiated Spurious Emissions | Sean Sellergren | Pass |
| Frequency Stability | Sean Sellergren | Pass |
| Protection of Aeronautical Radio Navigation Satellite Service | Sean Sellergren | Pass |

## 1.5 Product Information

### 1.5.1 Technical Description

**Table 1.5-1 – Wireless Module Technical Information**

| Detail | Description |
|---|---|
| FCC ID | ROJ-8065A |
| Transceiver Model # | 408065A-41000 |
| Operating Frequency | 1626.5 MHz – 1660.5 MHz |
| Modulation Format | N/A |
| Antenna Type / Gain: | 1dBi |

Note: The EUT receives a signal from another source in the 400MHz range and upconverts the signal to the appropriate 1626.5 – 1660.5MHz signal, the modulation and other signal characteristics are all derived from the source transmitter that is not part of the EUT system.

A full description and detailed product specification details are available from the manufacturer.

### 1.5.2 Modes of Operation

The tested mode of operation was:

| | |
|---|---|
| Low Channel / Mode | 1626.5 MHz |
| Mid Channel / Mode | 1643.5 MHz |
| High Channel / Mode | 1660.5 MHz |

Note: all transmitted frequencies were derived using an external transmitter source connected via RF cable to the EUT. The following frequencies were used by the source transmitter: low ch 448MHz, mid ch 440MHz and high ch 453MHz.

## 1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

## 1.7 EUT Modification Record

The table below details modifications made to the EUT during the test program. The modifications incorporated during each test are recorded on the appropriate test pages.

**Table 1.7-1 – Modification Record**

| Modification State | Description of Modification still fitted to EUT | Modification Fitted By | Date Modification Fitted |
|---|---|---|---|
| 0 | Initial State | | |

## 1.8 Test Location

For tests in sections 2.2 & 2.4 - 2.6:

TÜV SÜD conducted the following tests at our New Brighton, MN Test Laboratory.

Office address:

TÜV SÜD America
141 14th Street NW
New Brighton, MN 55112 USA

For tests in sections 2.1 & 2.3:

TÜV SÜD America Inc. (Mira Mesa)
10040 Mesa Rim Road
San Diego, CA 92121-2912
Phone: (858) 678 1400 Fax: (858) 546 0364.

# 2 Test Details

## 2.1 RF Output Power

### 2.1.1 Specification Reference

FCC 47 CFR Part 25.204(a) / 2.1046

### 2.1.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.1.3 Date of Test

14 February 2025

### 2.1.4 Test Method

In bands shared coequally with terrestrial radio communication services, the equivalent isotropically radiated power transmitted in any direction towards the horizon by an earth station, other than an ESV, operating in frequency bands between 1 and 15 GHz, shall not exceed the following limits except as provided for in paragraph (c) of this section:

- + 40 dBW in any 4 kHz band for θ ≤0°
- + 40 + 3θ dBW in any 4 kHz band for 0° <θ ≤5°

where θ is the angle of elevation of the horizon viewed from the center of radiation of the antenna of the earth station and measured in degrees as positive above the horizontal plane and negative below it.

### 2.1.5 Environmental Conditions

All tests are performed within the ambient climatic conditions of the laboratory.

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### 2.1.6 Test Results

**Table 2.1-1 – Peak Conducted Output Power Results**

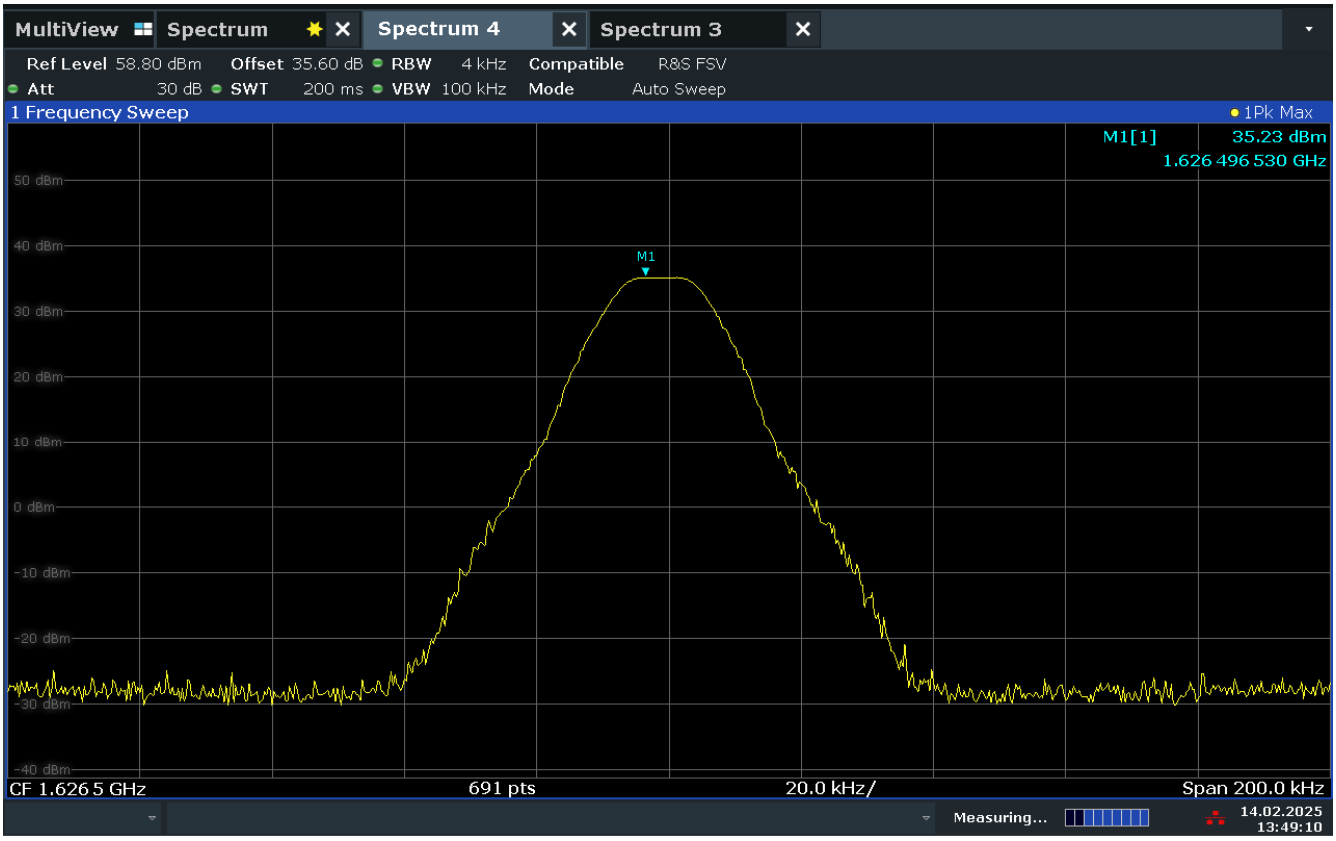
| Frequency (MHz) | Measured Output Power EIRP (dBm) | Antenna Gain dBi | Output Power Limit (dBm) | Result |
|---|---|---|---|---|
| 1626.5 | 35.23 | 0.6 | 70 | Pass |
| 1643.5 | 34.79 | 0.6 | 70 | Pass |
| 1660.5 | 35.21 | 06 | 70 | Pass |

**Test Note:** Measured output power includes the antenna gain of 1.8dBi, more stringent limit of +40dbW converted to dBm was used (70 dBm) instead of + 40 + 3θ dBW

**Test Summary**: An RF attenuator was used between the EUT output and the measurement receiver during testing. All measurement correction factors were entered into the receiver as an offset to provide corrected measurement results. EUT operated as intended before, during, and after testing.

**Test Result: Pass**

See data below for detailed results.




**13:49:10 14.02.2025**

**Figure 2-1 – Peak Conducted Output Power – Low Channel**

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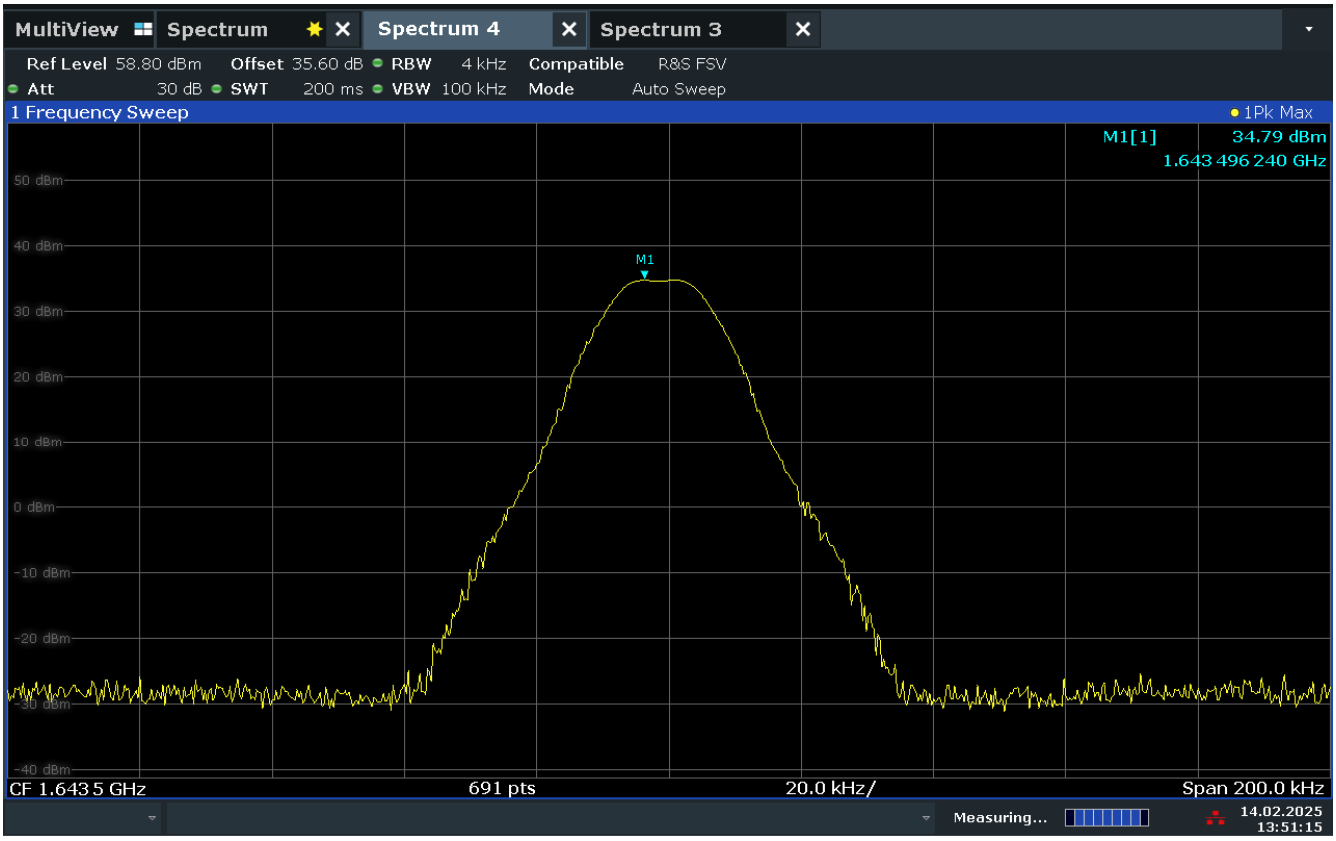


**13:51:16 14.02.2025**

**Figure 2-2 – Peak Conducted Output Power – Middle Channel**

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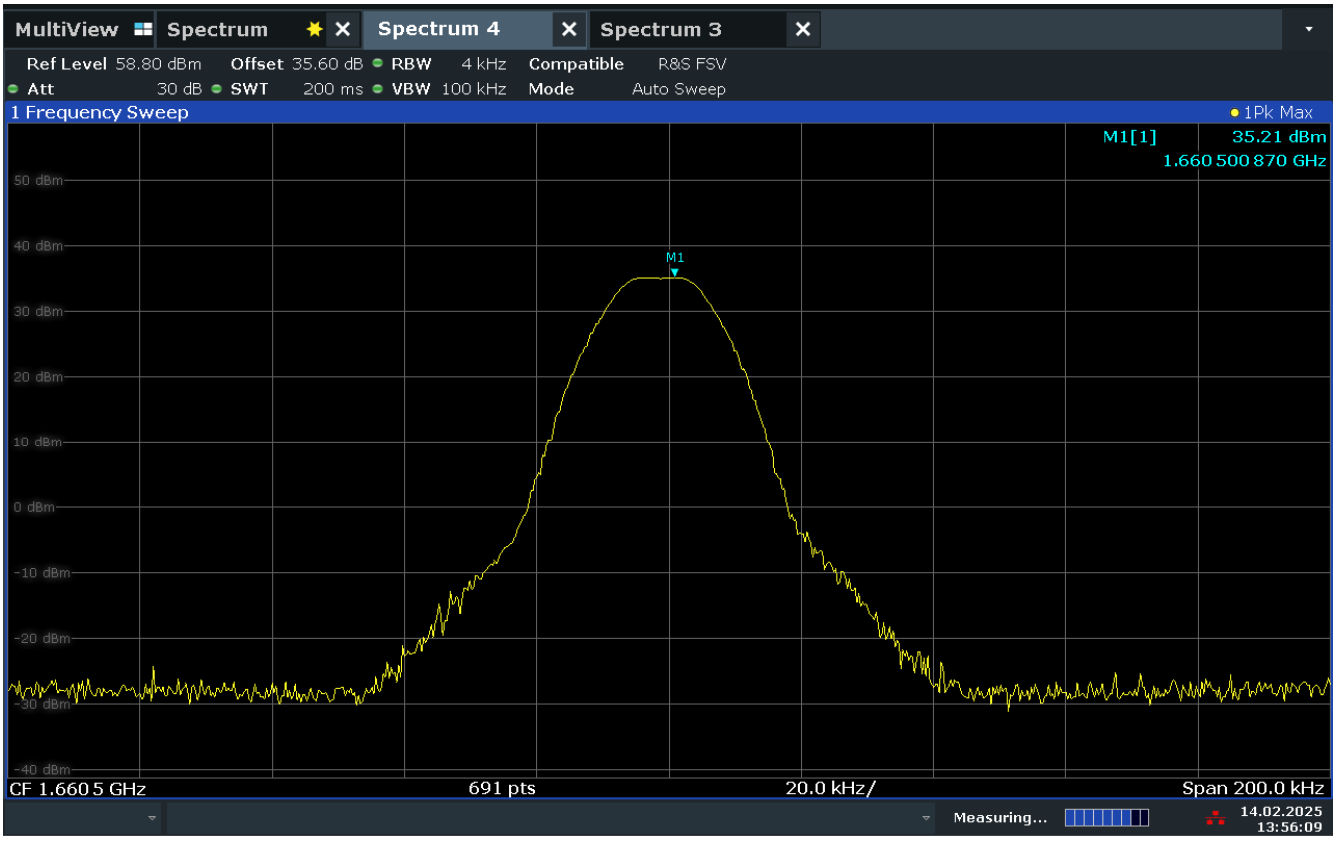


**Figure 2-3 – Peak Conducted Output Power – High Channel**

### 2.1.7 Test Location and Test Equipment Used

The tests were carried out in San Deigo CA.

**Table 2.1-2 – Conducted Emissions Test Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| SDGE07611 | Rohde & Schwarz | Signal & Spectrum Analyzer | FSW26 | 102017 | G | 02/16/2024 | 02/16/2025 |
| SDGE53504 | Micro-Coax Utiflex Cables | RF Cable | UFA210A | 503070-C | B | 04/07/2023 | 04/07/2025 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

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## 2.2 Occupied Bandwidth

### 2.2.1 Specification Reference

FCC 47 CFR Part 2.1049

### 2.2.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.2.3 Date of Test

08 October 2024

### 2.2.4 Test Method

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth value. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The RBW to 1-5% of the occupied bandwidth and the VBW set to ≥ 3 times the RBW.

### 2.2.5 Environmental Conditions

All tests are performed within the ambient climatic conditions of the laboratory.

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### 2.2.6 Test Results

**Table 2.2-1 – Occupied Bandwidth Results**

| Frequency (MHz) | Occupied Bandwidth (kHz) |
|---|---|
| 1626.5 | 17.887 |
| 1643.5 | 17.783 |
| 1660.5 | 17.799 |

**Test Summary**: The EUT does not supply its own transmit signal but performs upconversion and downconversion on a signal from an outside source. For testing the signal used was a Viper generator that was provided for the purposes of testing. The occupied bandwidth is not limiting the operation of devices with the use of 5kHz 25kHz channels. and The EUT operated as intended before, during, and after testing.

**Test Result: Pass**

See data below for detailed results.

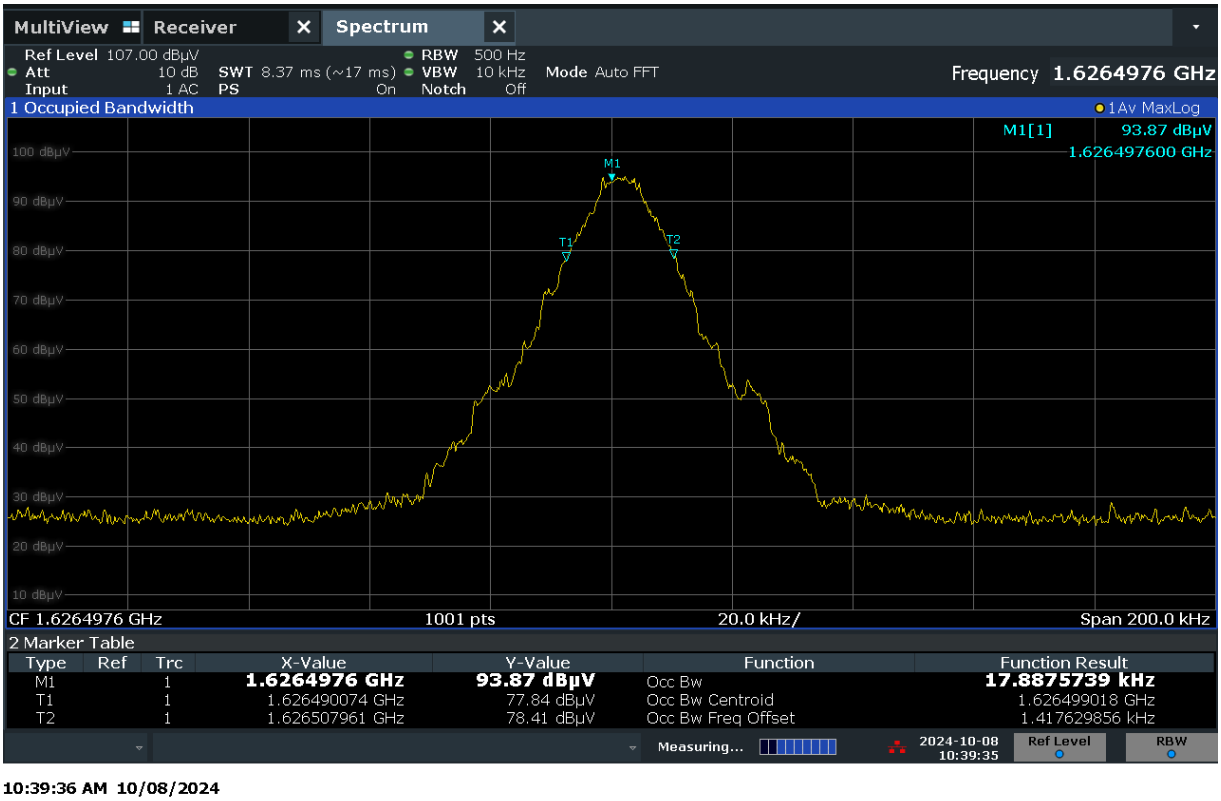


**Figure 2-4 – Occupied Bandwidth – Low Channel**

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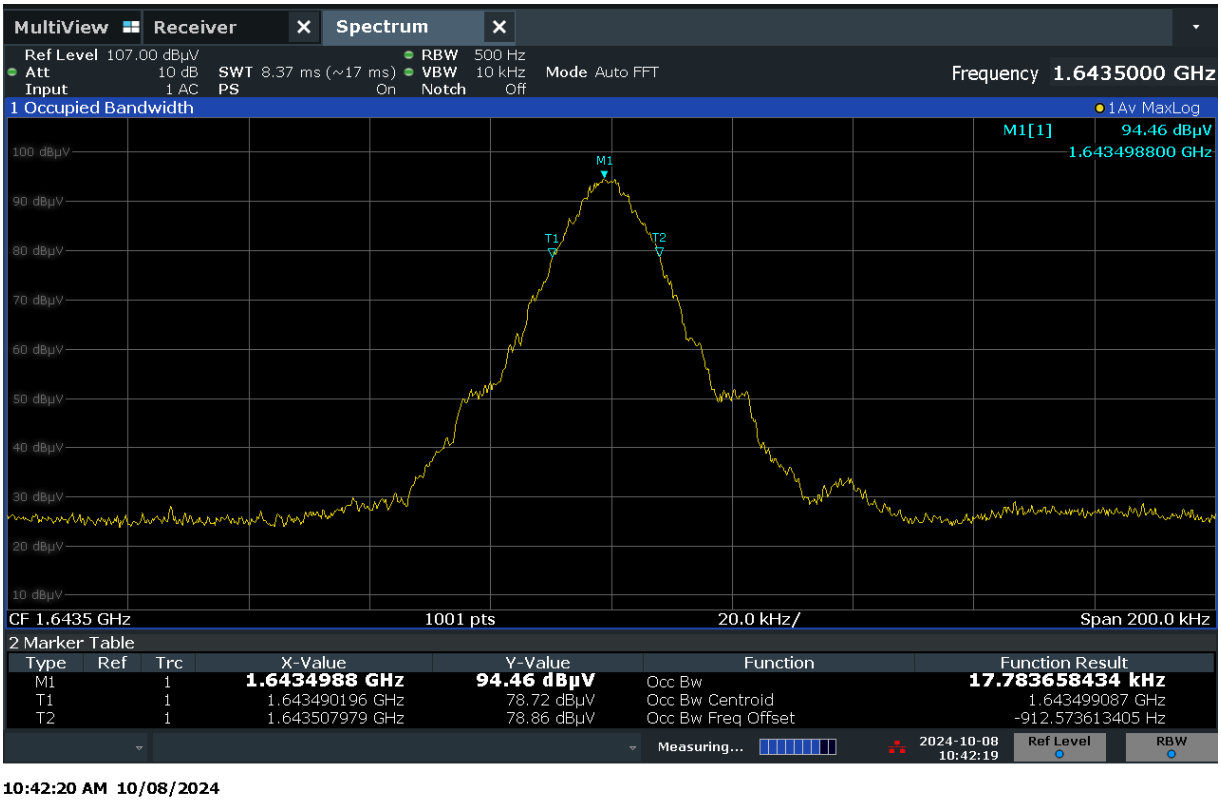


**Figure 2-5 – Occupied Bandwidth – Middle Channel**

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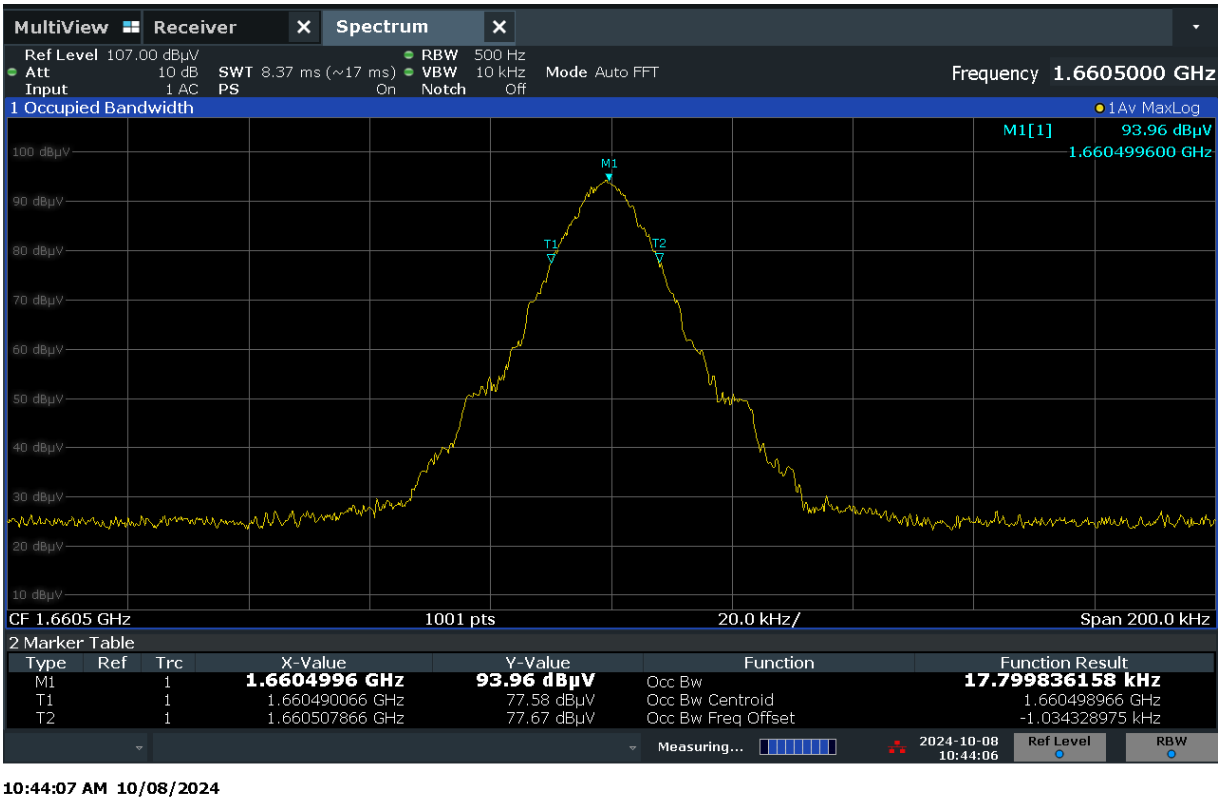


**Figure 2-6 – Occupied Bandwidth – High Channel**

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### 2.2.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: 3mSAC

**Table 2.2-2 – Conducted Emissions Test Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| NBLE11088 | Inmet | Attenuator, 20 dB | 18N50W-20dB | 11088 | B | 07/20/2024 | 07/20/2025 |
| NBLE11555 | Rohde & Schwarz | Receiver, 2 Hz-44 GHz | ESW44 (SAP 21006053) | 101537 | G | 01/26/2024 | 01/26/2025 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

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## 2.3 Conducted Spurious Emissions

### 2.3.1 Specification Reference

FCC 47 CFR Part 25.202(f) / 2.1051

### 2.3.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.3.3 Date of Test

12 February 2025

### 2.3.4 Test Method

The maximum peak conducted output power was measured in accordance with the ANSI C63.26. The RF output of the EUT was directly connected to the input of the spectrum analyzer along with a suitable external attenuator. The RBW of the spectrum analyzer was set to 4kHz and the VBW was set to ≥ 3 times the RBW. The spectrum analyzer span was set to cover the entire frequency range of 9kHz to 20GHz and the trace was set to max hold using the average detector to provide the mean output power.

The limit used for the entire frequency range is -13dBm which is equal to 43 dB plus 10*log(transmit power in W).

### 2.3.5 Environmental Conditions

All tests are performed within the ambient climatic conditions of the laboratory.

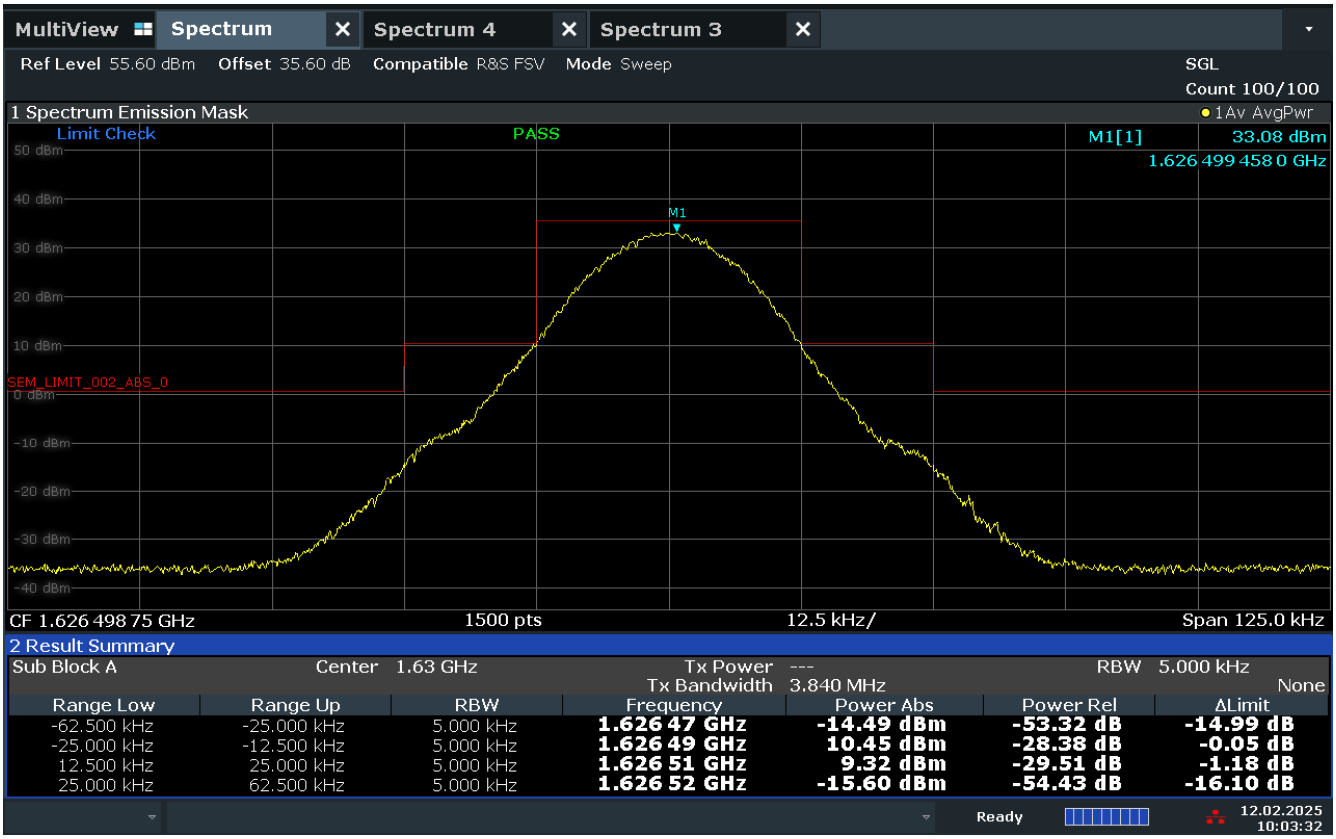
### 2.3.6 Test Results

**Test Summary**: An RF attenuator was used between the EUT output and the measurement receiver during testing. All measurement correction factors were entered into the receiver as an offset to provide corrected measurement results. EUT operated as intended before, during, and after testing.

.

**Test Result: Pass**

See data below for detailed results.




**10:03:32 12.02.2025**

**Figure 2-7 – Emission Mask – Low Channel**

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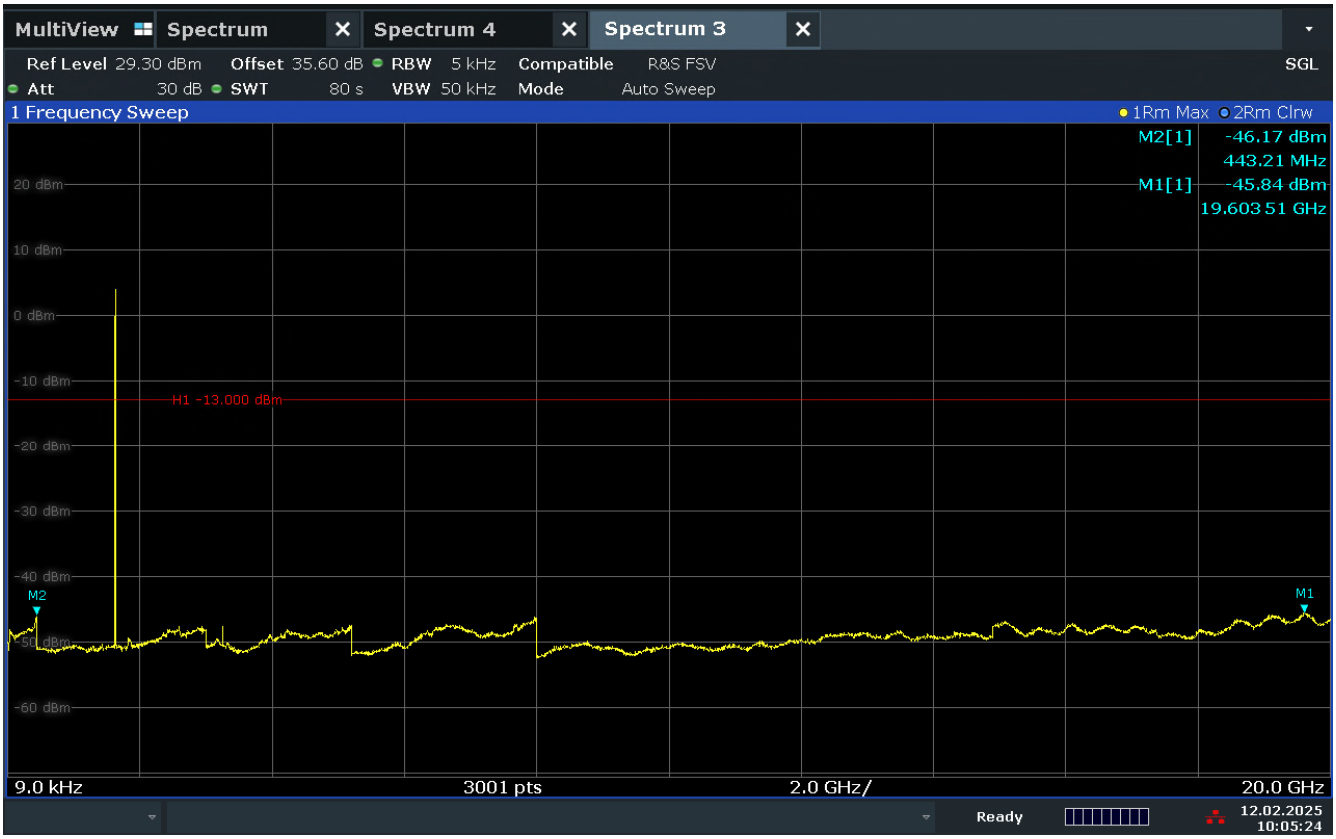
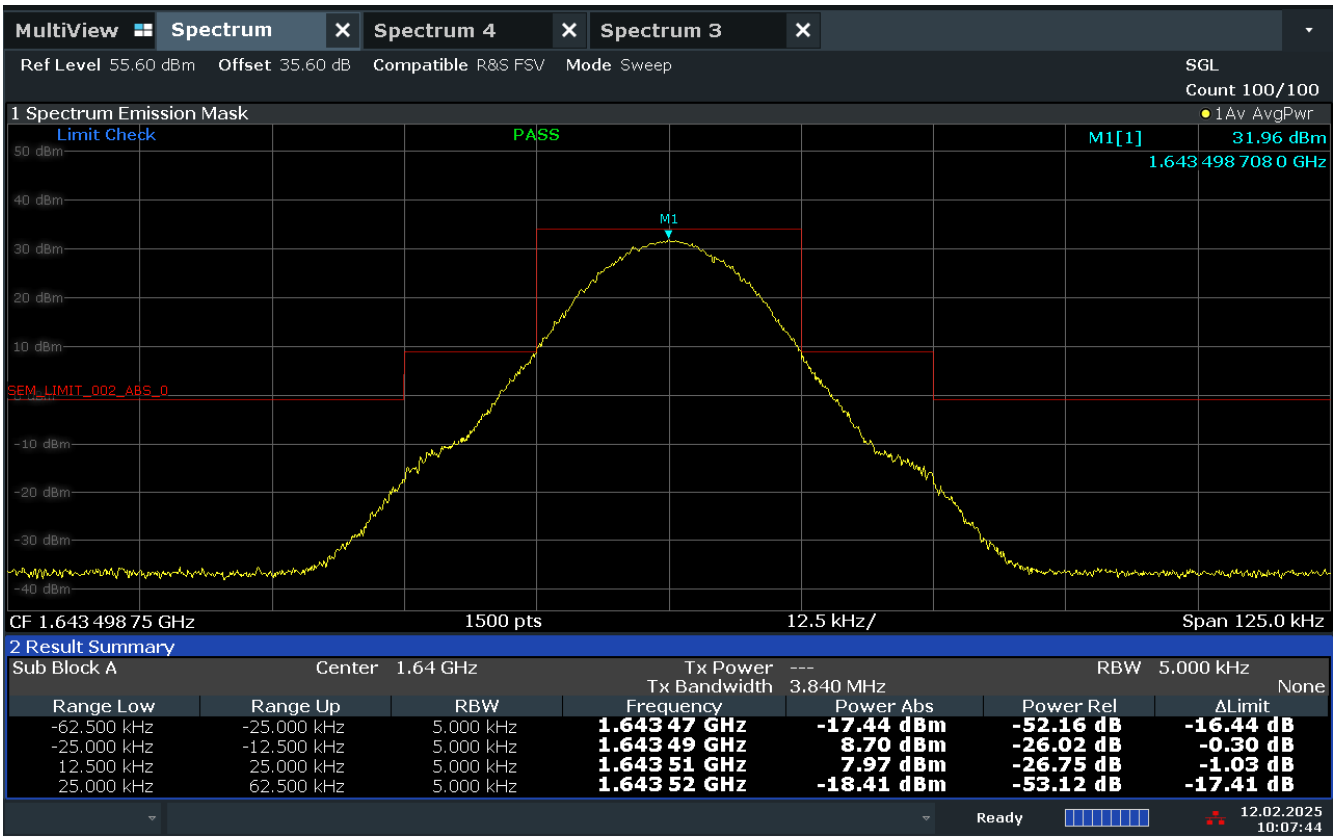



**10:05:25 12.02.2025**

**Figure 2-8 – Conducted Spurious Emissions 9 kHz – 20GHz – Low Channel**




**10:07:44 12.02.2025**

**Figure 2-9 – Emission Mask – Mid Channel**

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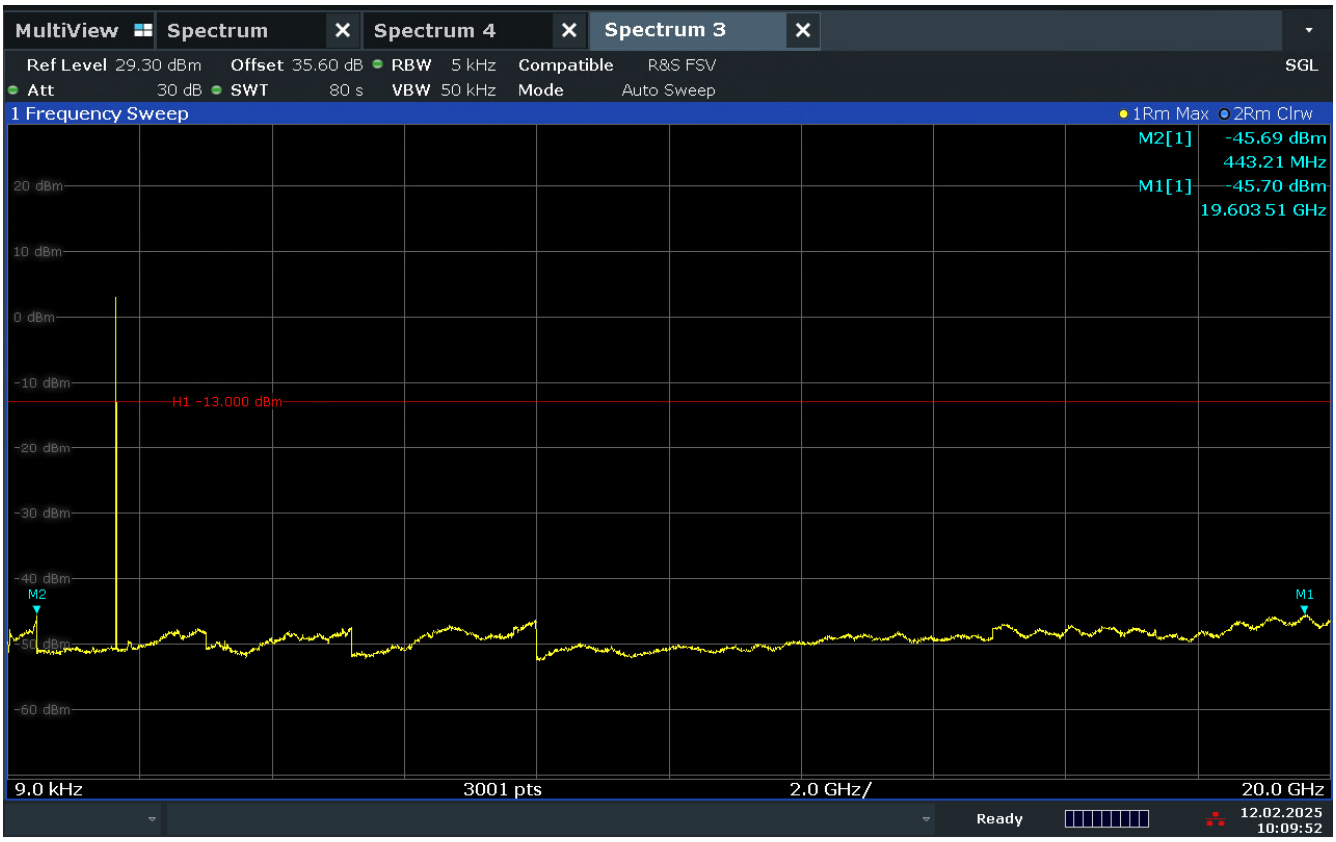


**Figure 2-10 – Conducted Spurious Emissions 9 kHz – 20GHz – Mid Channel**

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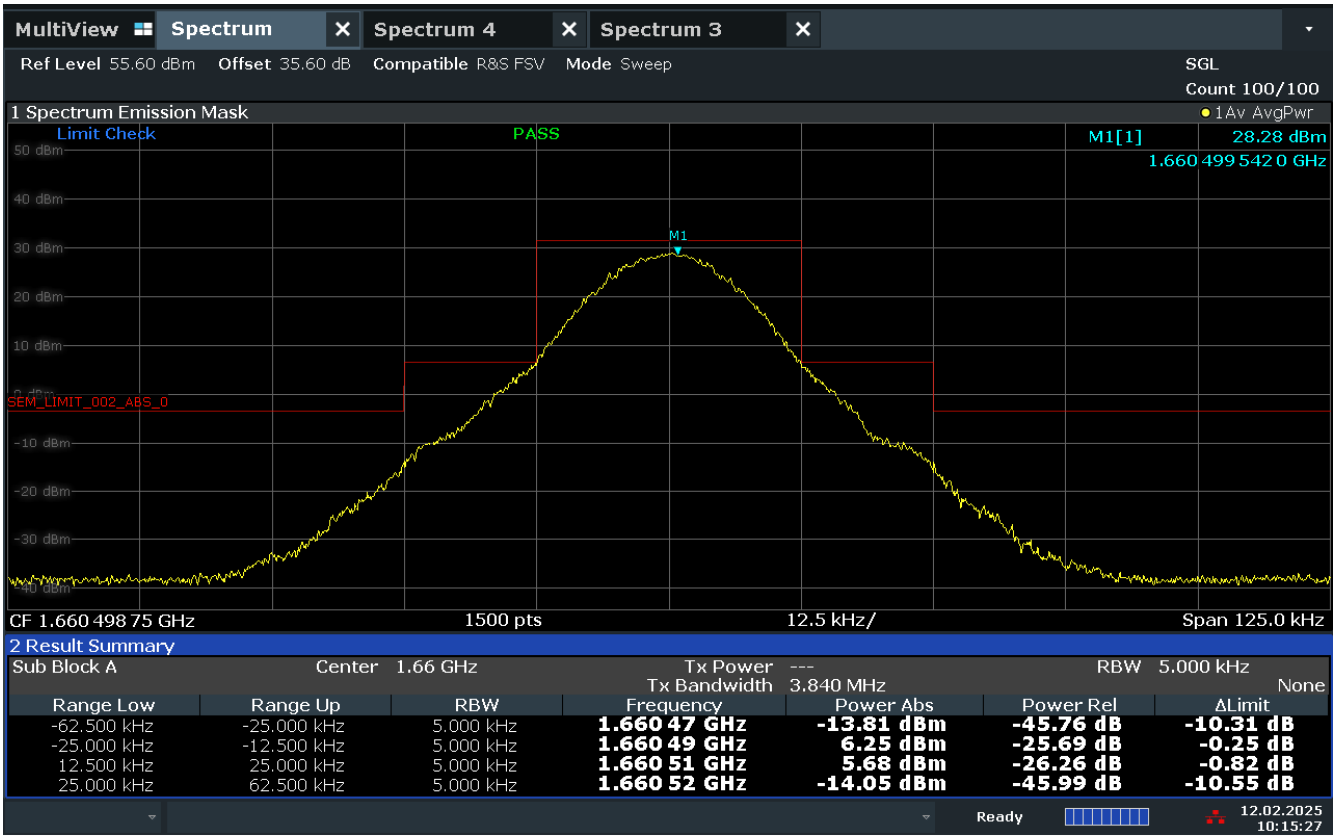


10:15:28 12.02.2025

**Figure 2-11 – Emission Mask – High Channel**

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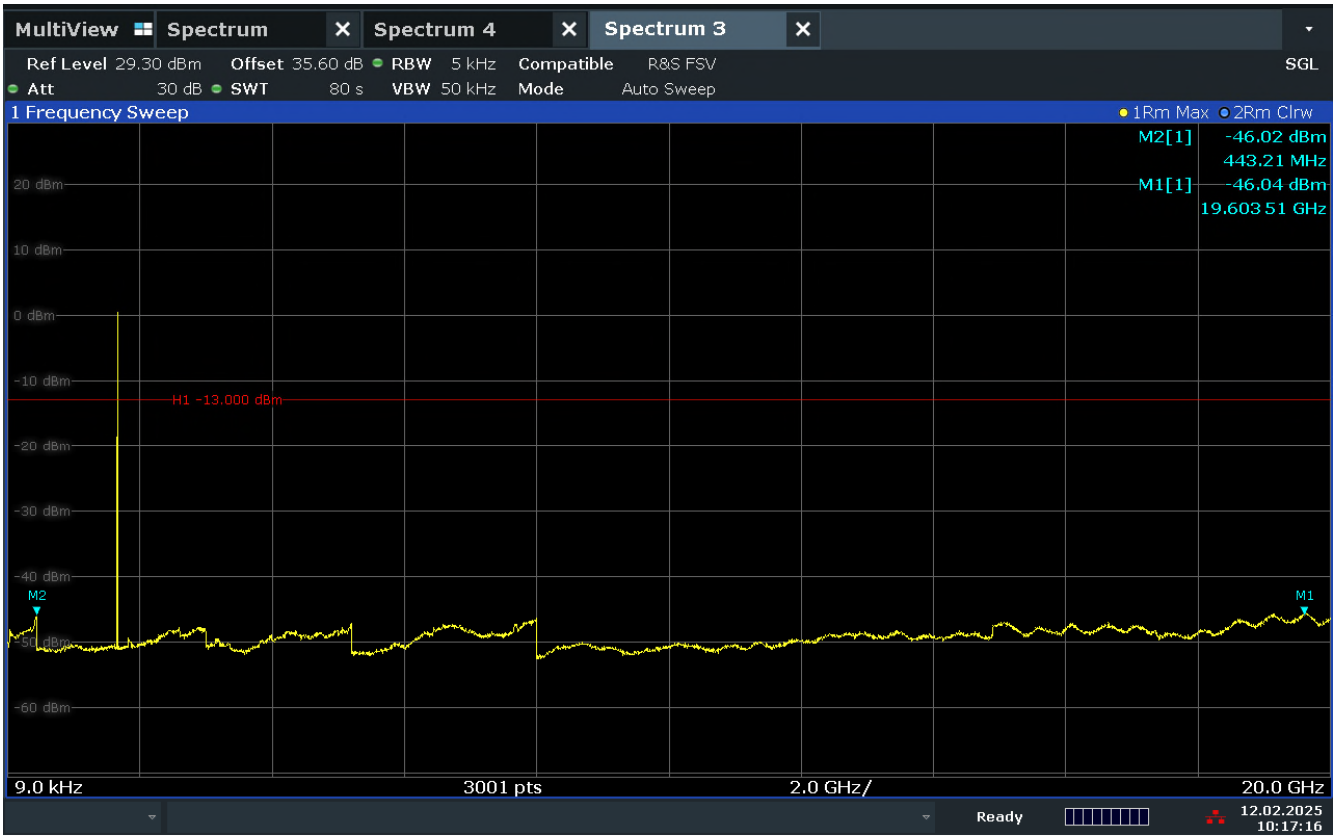


**10:17:17 12.02.2025**

**Figure 2-12 – Conducted Spurious Emissions 9kHz – 20GHz – High Channel**

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### 2.3.7 Test Location and Test Equipment Used

The tests were carried out in San Deigo CA.

**Table 2.3-1 – Conducted Emissions Test Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| SDGE07611 | Rohde & Schwarz | Signal & Spectrum Analyzer | FSW26 | 102017 | G | 02/16/2024 | 02/16/2025 |
| SDGE08825 | Weinschel Corp | 20dB Attenuator | bk 5773 | 46-20-34 | B | 07/19/2024 | 07/19/2025 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment

## 2.4 Radiated Spurious Emissions

### 2.4.1 Specification Reference

FCC 47 CFR Part 25.205(f) / 2.1053

### 2.4.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.4.3 Date of Test

22 – 25 October 2024

### 2.4.4 Test Method

The EUT was set up in a semi-anechoic chamber on a remotely controlled turntable and placed on a non-conductive table 0.8 m above a reference ground plane for 30-1000 MHz and 1.5m above the ground plane for above 1 GHz.

For 30-1000 MHz a pre-scan of the EUT emissions profile was made while varying the antenna-to-EUT azimuth and antenna-to-EUT polarization using an average detector; measurements were taken at a 3m distance.

For above 1 GHz a pre-scan of the EUT emissions profile was made while varying the antenna-to-EUT azimuth and antenna-to-EUT polarization using average detectors; measurements were taken at a 3m distance.

For all frequency ranges the final readings were maximized by adjusting the antenna height, polarization and turntable azimuth, in accordance with the specification. Final measurements were re-measured with an average detector.

The EUT was assessed against the limits specified in FCC 47 CFR Part 25.205(f).

### 2.4.5 Environmental Conditions

All tests are performed within the ambient climatic conditions of the laboratory.

### 2.4.6 Additional Observations

The highest frequency to which the DUT was measured in accordance with §15.33(a)(1).

Automated measurements used BAT-EMC (v3.18) software. Measurements were done at a 3m distance. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only.

### 2.4.7 Sample Computation (Radiated Emissions)

| | | | |
|---|---|---|---|
| Measuring equipment raw measurement (dBµV) @ 30 MHz | | | 20.0 |
| Correction Factor (dB) | Cable 2 | 0.24 | 18.94 |
| | TEMC00011 (antenna) | 18.70 | |
| | | | |
| | | | |
| | | | |
| Reported Quasi-peak Final Measurement (dBµV/m) @ 30 MHz | | | 38.94 |

### 2.4.8 Test Results

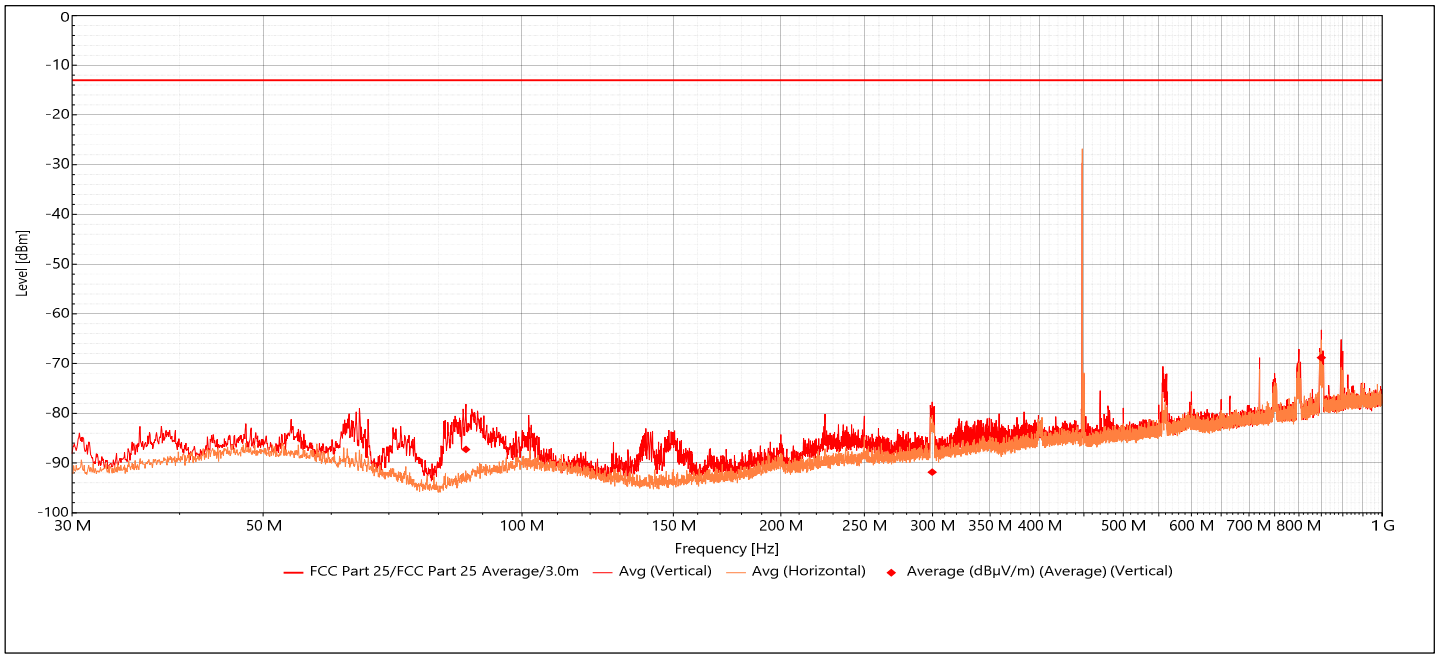
**Test Summary**: An RF attenuator was used at the input to the RF pre-amp during testing. EUT operated as intended before, during, and after testing.

**Test Result: Pass**

See data below for detailed results.

## Spurious Emissions 30M-1GHz - Low Channel 1626.5MHz - MannPack

| Frequency Range | Antenna Distance | Antenna Polarization | RBW | Step Size | Sweep Time |
|---|---|---|---|---|---|
| *30 MHz - 1 GHz* | 3m | *Vertical* | 100 kHz | *18001 Pts* | *Auto* |
| *30 MHz - 1 GHz* | 3m | *Horizontal* | 100 kHz | *18001 Pts* | *Auto* |




| Limit: | Test Date: | Test Results: |
|---|---|---|
| FCC Part 25/FCC Part 25 | 10/22/2024 | Pass |

Test Notes: Low Channel 1626.5M, Aux Viper Equipment at 448M

**Figure 2-13 – RE Spurious Emissions 30-1000 MHz – Low Channel**

**Table 2.4-1 – RE Spurious Emissions 30-1000 MHz – Low Channel**

| Frequency (MHz) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Average Margin (dB) | Azimuth (°) | Height (m) | Polarity | Result |
|---|---|---|---|---|---|---|---|
| 86.044 | -87.27 | -13.00 | -74.27 | 109.00 | 1.12 | Vertical | Pass |
| 299.876 | -91.83 | -13.00 | -78.83 | 109.00 | 1.12 | Vertical | Pass |
| 849.973 | -68.83 | -13.00 | -55.83 | 54.00 | 1.12 | Vertical | Pass |

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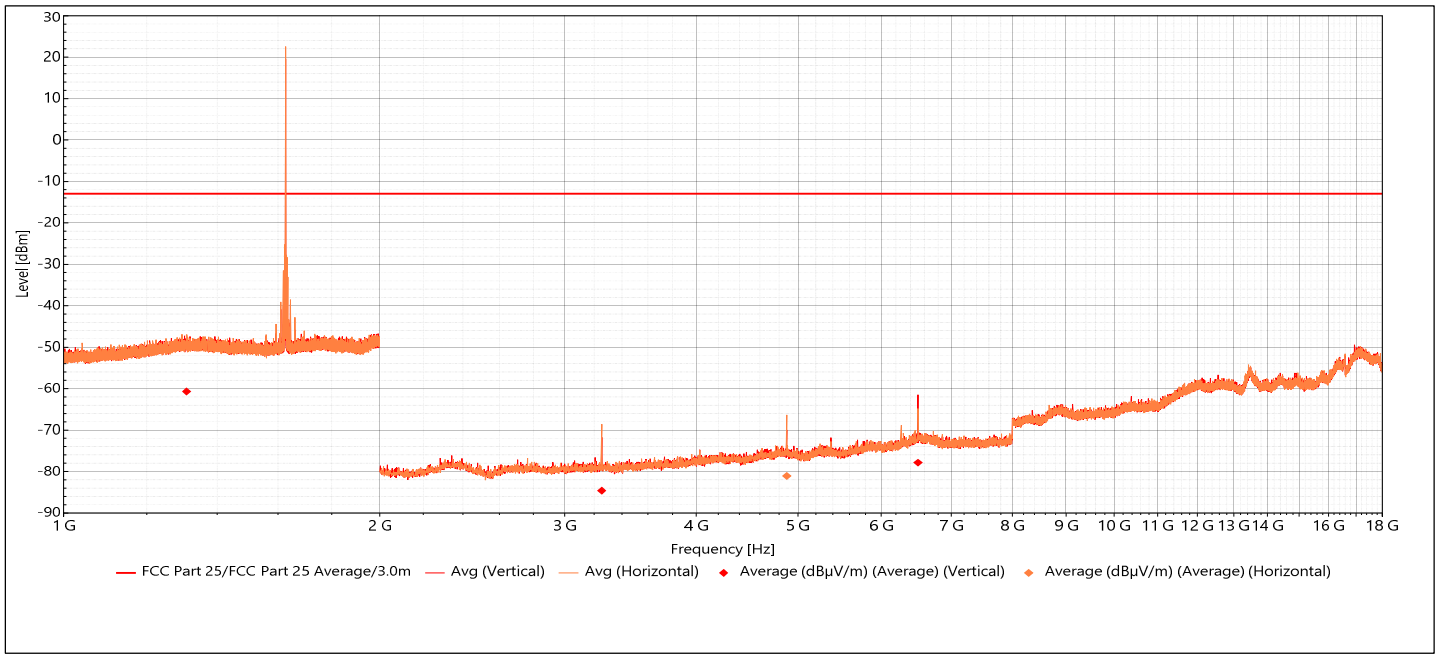
## Spurious Emissions 1 - 18GHz - Low Channel 1626.5MHz

| Frequency Range | Antenna Distance | Antenna Polarization | RBW | Step Size | Sweep Time |
|---|---|---|---|---|---|
| *1 GHz - 18 GHz* | 3m | *Vertical* | 100 kHz | *18001 Pts* | *Auto* |
| *1 GHz - 18 GHz* | 3m | *Horizontal* | 100 kHz | *18001 Pts* | *Auto* |
| *1 GHz - 18 GHz* | 3m | *Vertical* | 100 kHz | *18001 Pts* | *Auto* |
| *1 GHz - 18 GHz* | 3m | *Horizontal* | 100 kHz | *18001 Pts* | *Auto* |




| Limit: | Test Date: | Test Results: |
|---|---|---|
| FCC Part 25/FCC Part 25 | 10/18/2024 | Pass |

Test Notes: Low Channel 1626.5M, 1-2 GHz has 30dB Attenuator, 2-18 GHz has 2GHz High Pass Filter

**Figure 2-14 – RE Spurious Emissions 1-18 GHz – Low Channel**

**Table 2.4-2 – RE Spurious Emissions 1-18 GHz – Low Channel**

| Frequency (MHz) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Average Margin (dB) | Azimuth (°) | Height (m) | Polarity | Result |
|---|---|---|---|---|---|---|---|
| 1309.278 | -60.69 | -13.00 | -47.69 | 12.00 | 2.23 | Vertical | Pass |
| 3252.444 | -84.64 | -13.00 | -71.64 | 125.00 | 4.00 | Vertical | Pass |
| 6505.778 | -77.87 | -13.00 | -64.87 | 125.00 | 1.00 | Vertical | Pass |
| 4879.111 | -81.07 | -13.00 | -68.07 | 252.00 | 3.94 | Horizontal | Pass |

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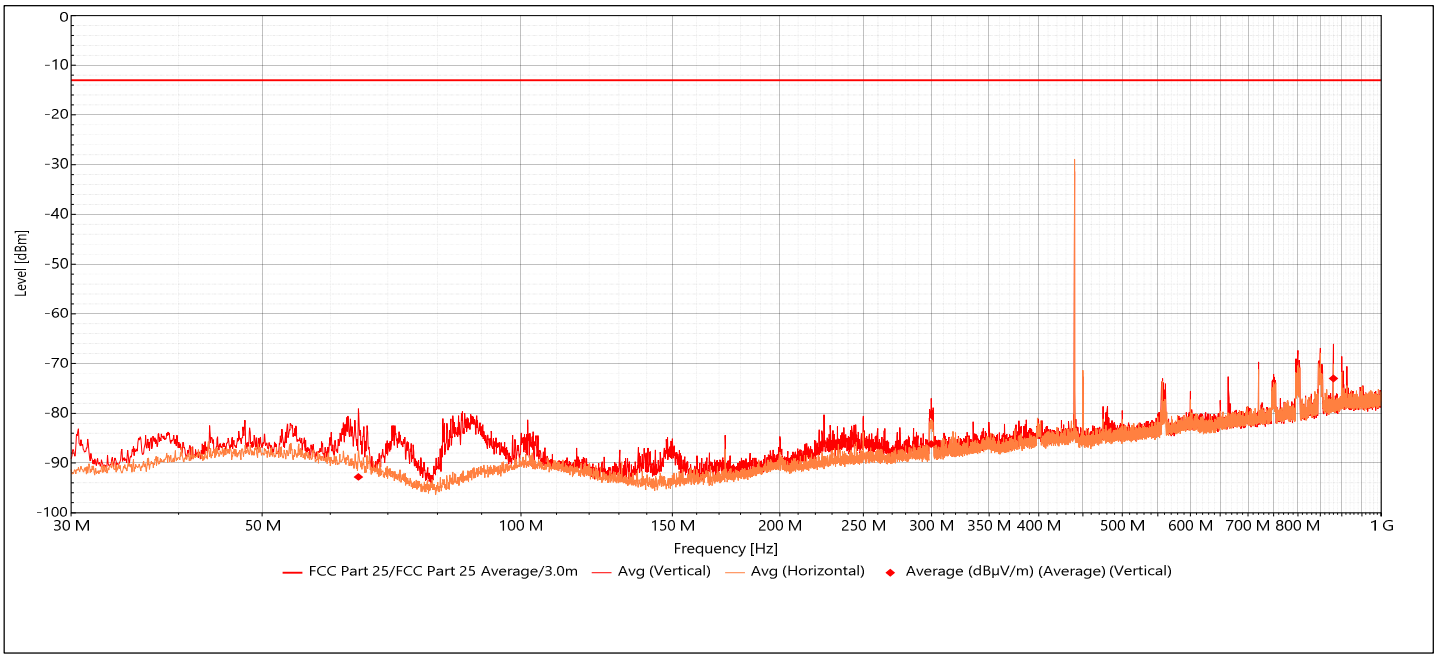
## Spurious Emissions 30M-1GHz - Mid Channel 1643.5MHz

| Frequency Range | Antenna Distance | Antenna Polarization | RBW | Step Size | Sweep Time |
|---|---|---|---|---|---|
| *30 MHz - 1 GHz* | 3m | *Vertical* | 100 kHz | *18001 Pts* | *Auto* |
| *30 MHz - 1 GHz* | 3m | *Horizontal* | 100 kHz | *18001 Pts* | *Auto* |




| Limit: | Test Date: | Test Results: |
|---|---|---|
| FCC Part 25/FCC Part 25 | 10/22/2024 | Pass |

Test Notes: Mid Channel 1643.5M, Aux Viper Equipment at 440M

**Figure 2-15 – RE Spurious Emissions 30-1000 MHz – Mid Channel**

**Table 2.4-3 – RE Spurious Emissions 30-1000 MHz – Mid Channel**

| Frequency (MHz) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Average Margin (dB) | Azimuth (°) | Height (m) | Polarity | Result |
|---|---|---|---|---|---|---|---|
| 64.704 | -92.80 | -13.00 | -79.80 | 303.00 | 1.12 | Vertical | Pass |
| 299.983 | -86.20 | -13.00 | -73.20 | 98.00 | 1.12 | Vertical | Pass |
| 879.989 | -73.00 | -13.00 | -60.00 | 220.00 | 1.12 | Vertical | Pass |

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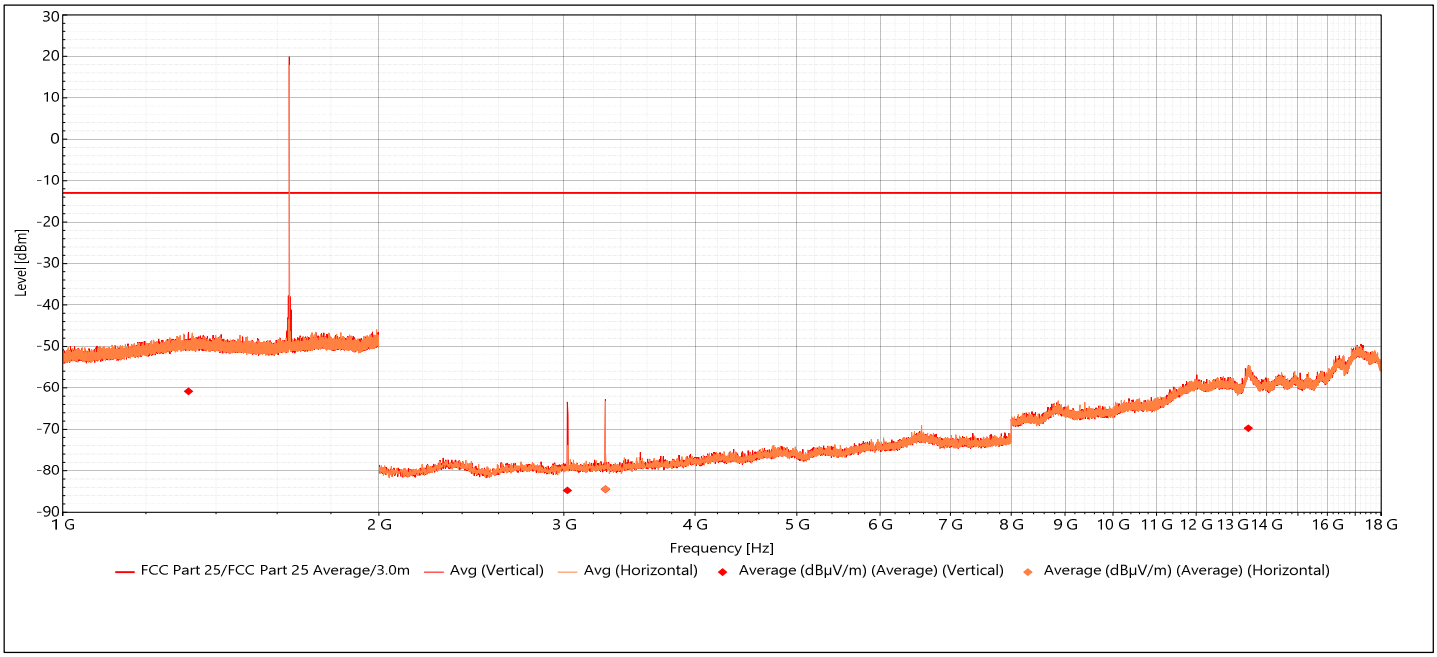
## Spurious Emissions 1 - 18GHz - Mid Channel 1643.5MHz

| Frequency Range | Antenna Distance | Antenna Polarization | RBW | Step Size | Sweep Time |
|---|---|---|---|---|---|
| *1 GHz - 18 GHz* | 3m | *Vertical* | 100 kHz | *18001 Pts* | *Auto* |
| *1 GHz - 18 GHz* | 3m | *Horizontal* | 100 kHz | *18001 Pts* | *Auto* |
| *1 GHz - 18 GHz* | 3m | *Vertical* | 100 kHz | *18001 Pts* | *Auto* |
| *1 GHz - 18 GHz* | 3m | *Horizontal* | 100 kHz | *18001 Pts* | *Auto* |




| Limit: | Test Date: | Test Results: |
|---|---|---|
| FCC Part 25/FCC Part 25 | 10/18/2024 | Pass |

Test Notes: Mid Channel 1643.5M, 1-2 GHz has 30dB Attenuator, 2-18 GHz has 2GHz High Pass Filter

**Figure 2-16 – RE Spurious Emissions 1-18 GHz – Mid Channel**

**Table 2.4-4 – RE Spurious Emissions 1-18 GHz – Mid Channel**

| Frequency (MHz) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Average Margin (dB) | Azimuth (º) | Height (m) | Polarity | Result |
|---|---|---|---|---|---|---|---|
| 1317.722 | -60.84 | -13.00 | -47.84 | 252.00 | 2.67 | Vertical | Pass |
| 3024.000 | -84.75 | -13.00 | -71.75 | 252.00 | 1.00 | Vertical | Pass |
| 3286.222 | -84.48 | -13.00 | -71.48 | 0.00 | 3.94 | Vertical | Pass |
| 13451.556 | -69.76 | -13.00 | -56.76 | 360.00 | 1.00 | Vertical | Pass |
| 3286.222 | -84.42 | -13.00 | -71.42 | 0.00 | 3.94 | Horizontal | Pass |

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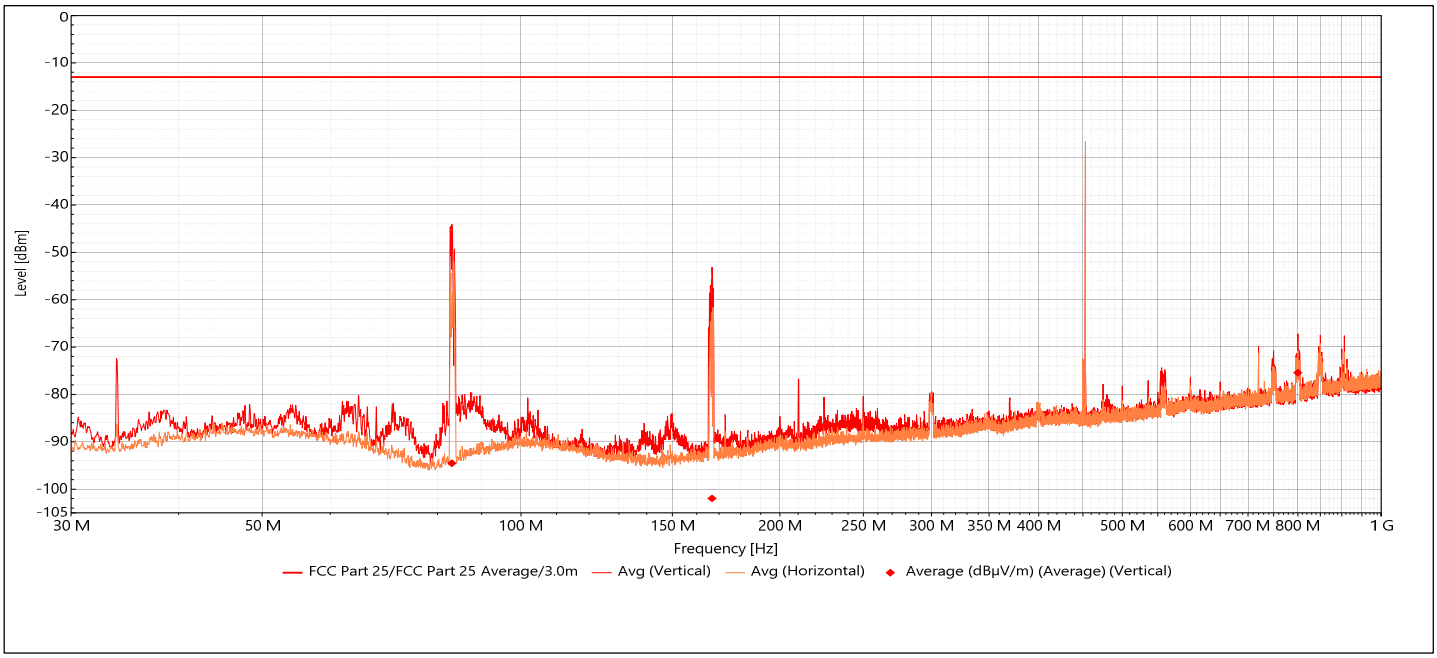
## Spurious Emissions 30M-1GHz - High Channel 1660.5MHz

| Frequency Range | Antenna Distance | Antenna Polarization | RBW | Step Size | Sweep Time |
|---|---|---|---|---|---|
| *30 MHz - 1 GHz* | 3m | *Vertical* | 100 kHz | *18001 Pts* | *Auto* |
| *30 MHz - 1 GHz* | 3m | *Horizontal* | 100 kHz | *18001 Pts* | *Auto* |




| Limit: | Test Date: | Test Results: |
|---|---|---|
| FCC Part 25/FCC Part 25 | 10/22/2024 | Pass |

Test Notes: High Channel 1660.5M, Aux Viper Equipment at 453M

**Figure 2-17 – RE Spurious Emissions 30-1000 MHz – High Channel**

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**Table 2.4-5 – RE Spurious Emissions 30-1000 MHz – High Channel**

| Frequency (MHz) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Average Margin (dB) | Azimuth (°) | Height (m) | Polarity | Result |
|---|---|---|---|---|---|---|---|
| 83.134 | -94.55 | -13.00 | -81.55 | 234.00 | 1.33 | Vertical | Pass |
| 166.716 | -101.97 | -13.00 | -88.97 | 167.00 | 1.12 | Vertical | Pass |
| 799.964 | -75.42 | -13.00 | -62.42 | 12.00 | 1.00 | Vertical | Pass |

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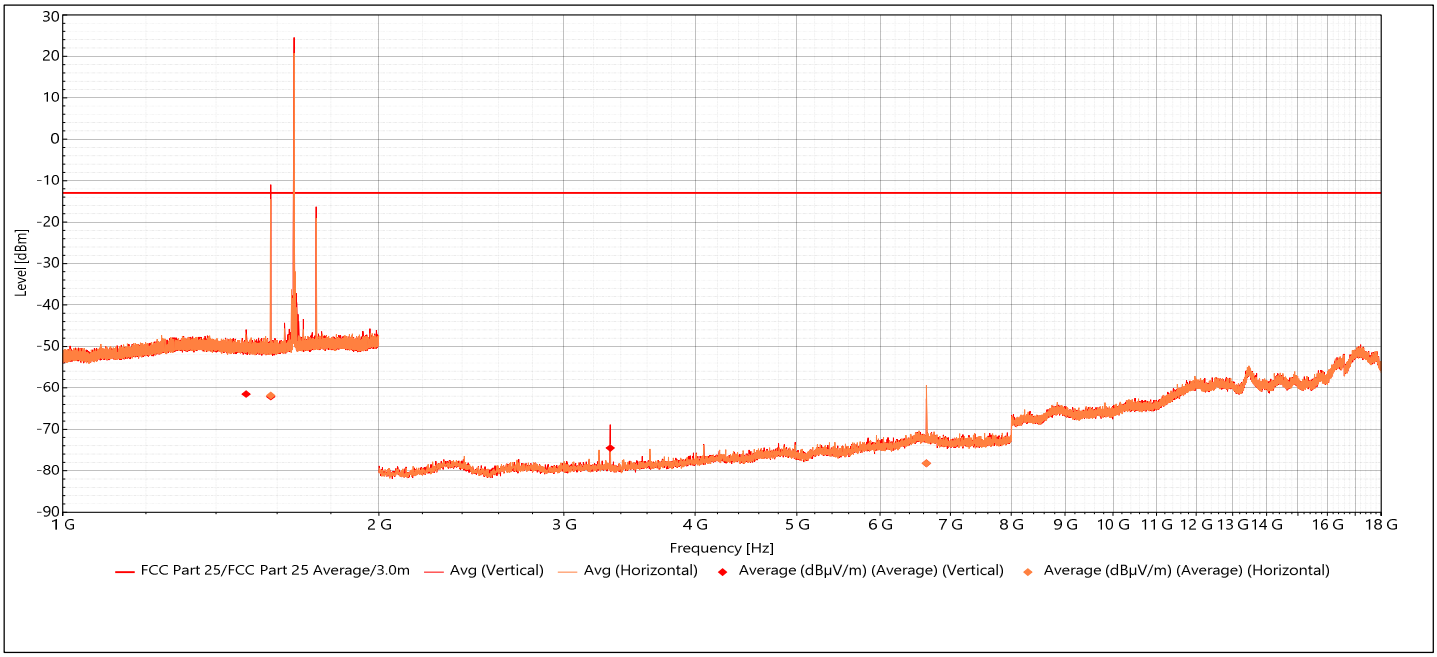
## Spurious Emissions 1 - 18GHz - High Channel 1660.5MHz

| Frequency Range | Antenna Distance | Antenna Polarization | RBW | Step Size | Sweep Time |
|---|---|---|---|---|---|
| *1 GHz - 18 GHz* | 3m | *Vertical* | 100 kHz | *18001 Pts* | *Auto* |
| *1 GHz - 18 GHz* | 3m | *Horizontal* | 100 kHz | *18001 Pts* | *Auto* |
| *1 GHz - 18 GHz* | 3m | *Vertical* | 100 kHz | *18001 Pts* | *Auto* |
| *1 GHz - 18 GHz* | 3m | *Horizontal* | 100 kHz | *18001 Pts* | *Auto* |




| Limit: | Test Date: | Test Results: |
|---|---|---|
| FCC Part 25/FCC Part 25 | 10/18/2024 | Pass |

Test Notes: High Channel 1660.5M, 1-2 GHz has 30dB Attenuator, 2-18 GHz has 2GHz High Pass Filter

**Figure 2-18 – RE Spurious Emissions 1-18 GHz – High Channel**

**Table 2.4-6 – RE Spurious Emissions 1-18 GHz – High Channel**

| Frequency (MHz) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Average Margin (dB) | Azimuth (°) | Height (m) | Polarity | Result |
|---|---|---|---|---|---|---|---|
| 1494.833 | -61.52 | -13.00 | -48.52 | 238.00 | 2.89 | Vertical | Pass |
| 1577.833 | -62.13 | -13.00 | -49.13 | 221.00 | 1.57 | Vertical | Pass |
| 1577.556 | -61.85 | -13.00 | -48.85 | 192.00 | 2.89 | Horizontal | Pass |
| 3320.889 | -74.54 | -13.00 | -61.54 | 252.00 | 3.94 | Vertical | Pass |
| 6641.778 | -78.23 | -13.00 | -65.23 | 360.00 | 4.00 | Vertical | Pass |
| 6641.778 | -78.21 | -13.00 | -65.21 | 360.00 | 1.00 | Horizontal | Pass |

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### 2.4.9 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: 3mSAC

**Table 2.4-7 – Radiated Emissions Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| NBLE11142 | Hewlett-Packard | Preamplifier, 0.1 to 1300 MHz | 8447D | 2727A05370 | B | 09/23/2024 | 09/23/2025 |
| NBLE11460 | ETS-Lindgren | Antenna, Horn 1-18 GHz | 3117 | 155005 | G | 02/09/2023 | 02/09/2025 |
| WRLE11119 | RF Precision Cables | Attenuator, 30 dB | ATX3396-30 | 11119 | B | 01/02/2024 | 01/02/2025 |
| WRLE11519 | Com-Power Corp. | Preamplifier, 500 MHz-18 GHz | PAM-118A | 18040002 | B | 02/05/2024 | 02/05/2025 |
| NBLE11555 | Rohde & Schwarz | Receiver, 2 Hz-44 GHz | ESW44 (SAP 21006053) | 101537 | G | 01/26/2024 | 01/26/2025 |
| NBLE11645 | Schwarzbeck | Antenna, Trilog, 30 MHz-7 GHz | VULB 9162 | 0254 | G | 04/25/2023 | 04/25/2025 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

## 2.5 Frequency Stability

### 2.5.1 Specification Reference

FCC Part 2.1055

### 2.5.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.5.3 Date of Test

17 – 18 October 2024

### 2.5.4 Test Method

The equipment under test is placed inside an environmental chamber. The RF output is directly coupled to the input of the measurement equipment and a power supply is attached to the primary supply voltage.

Frequency measurements were made at the extremes of the of temperature range -20º C to +50º C and at intervals of 10º C at normal supply voltage. Sufficient time to stabilize all components of the equipment was allowed at each frequency measurement. The maximum variation of frequency was recorded.

The data collected during testing was collected without a GPS signal present.

### 2.5.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.3°C |

### 2.5.6 Test Results

| Degrees C | Frequency (MHz) | ppm | Percentage (%) | ppm upper lim | ppm lower lim | Percentage Upper Limit (%) | Percentage Lower Limit (%) | Reference Frequency (MHz) |
|---|---|---|---|---|---|---|---|---|
| 50 | 1626.498933000 | -0.567 | 0.000057 | 10 | -10 | 0.001 | -0.001 | 1626.499856000 |
| 40 | 1626.499944000 | 0.054 | -0.000005 | 10 | -10 | 0.001 | -0.001 | 1626.499856000 |
| 30 | 1626.499989000 | 0.082 | -0.000008 | 10 | -10 | 0.001 | -0.001 | 1626.499856000 |
| 20 | 1626.499556000 | -0.184 | 0.000018 | 10 | -10 | 0.001 | -0.001 | 1626.499856000 |
| 10 | 1626.500378000 | 0.321 | -0.000032 | 10 | -10 | 0.001 | -0.001 | 1626.499856000 |
| 0 | 1626.500044000 | 0.116 | -0.000012 | 10 | -10 | 0.001 | -0.001 | 1626.499856000 |
| -10 | 1626.499378000 | -0.294 | 0.000029 | 10 | -10 | 0.001 | -0.001 | 1626.499856000 |
| -20 | 1626.500222000 | 0.225 | -0.000023 | 10 | -10 | 0.001 | -0.001 | 1626.499856000 |

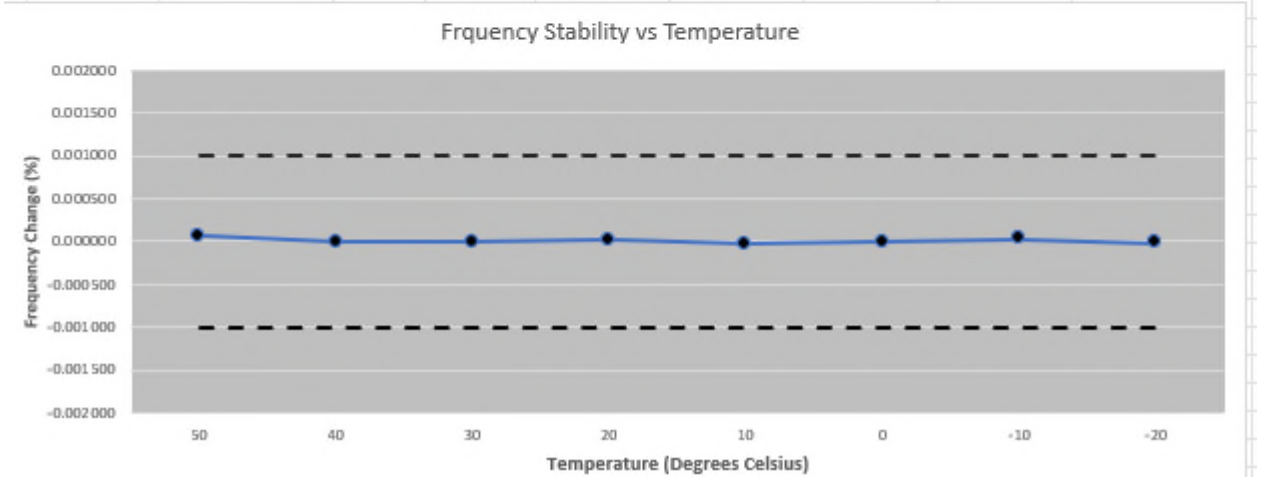
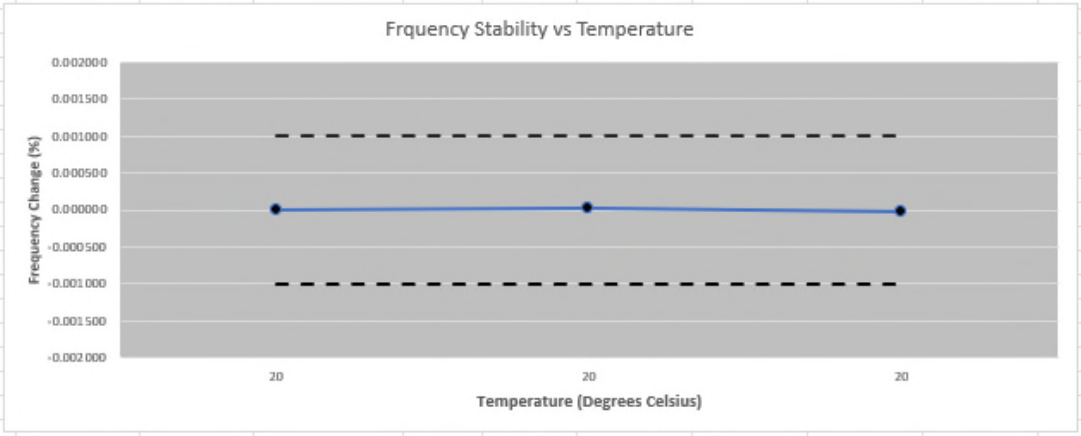



**Figure 2.6.6-1: Frequency Stability at Various Temperatures – Low Channel**

**Figure 2.6.6-2: Frequency Stability at Extreme Voltages – Low Channel**

| Voltage | Vdc | Degrees C | Frequency (MHz) | ppm | Percentage (%) | pm upper lim | pm lower lim | Percentage Upper Limit (%) | Percentage Lower Limit (%) | Reference Frequency (MHz) |
|---|---|---|---|---|---|---|---|---|---|---|
| nominal | 12.00 | 20 | 1626.499856000 | 0.000 | 0.000000 | 10 | -10 | 0.001 | -0.001 | 1626.499856000 |
| 85% | 10.20 | 20 | 1626.499556000 | -0.184 | 0.000018 | 10 | -10 | 0.001 | -0.001 | 1626.499856000 |
| 115% | 13.80 | 20 | 1626.500278000 | 0.259 | -0.000026 | 10 | -10 | 0.001 | -0.001 | 1626.499856000 |

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| Degrees C | Frequency (MHz) | ppm | Percentage (%) | ppm upper limit | ppm lower limit | Percentage Upper Limit | Percentage Lower Limit | Reference Frequency (MHz) |
|---|---|---|---|---|---|---|---|---|
| 50 | 1643.500622000 | 0.189 | -0.000019 | 10 | -10 | 0.001 | -0.001 | 1643.500311000 |
| 40 | 1643.498533000 | -1.082 | 0.000108 | 10 | -10 | 0.001 | -0.001 | 1643.500311000 |
| 30 | 1643.500267000 | -0.027 | 0.000003 | 10 | -10 | 0.001 | -0.001 | 1643.500311000 |
| 20 | 1643.500311000 | 0.000 | 0.000000 | 10 | -10 | 0.001 | -0.001 | 1643.500311000 |
| 10 | 1643.499556000 | -0.459 | 0.000046 | 10 | -10 | 0.001 | -0.001 | 1643.500311000 |
| 0 | 1643.499811000 | -0.304 | 0.000030 | 10 | -10 | 0.001 | -0.001 | 1643.500311000 |
| -10 | 1643.500167000 | -0.088 | 0.000009 | 10 | -10 | 0.001 | -0.001 | 1643.500311000 |
| -20 | 1643.498956000 | -0.824 | 0.000082 | 10 | -10 | 0.001 | -0.001 | 1643.500311000 |

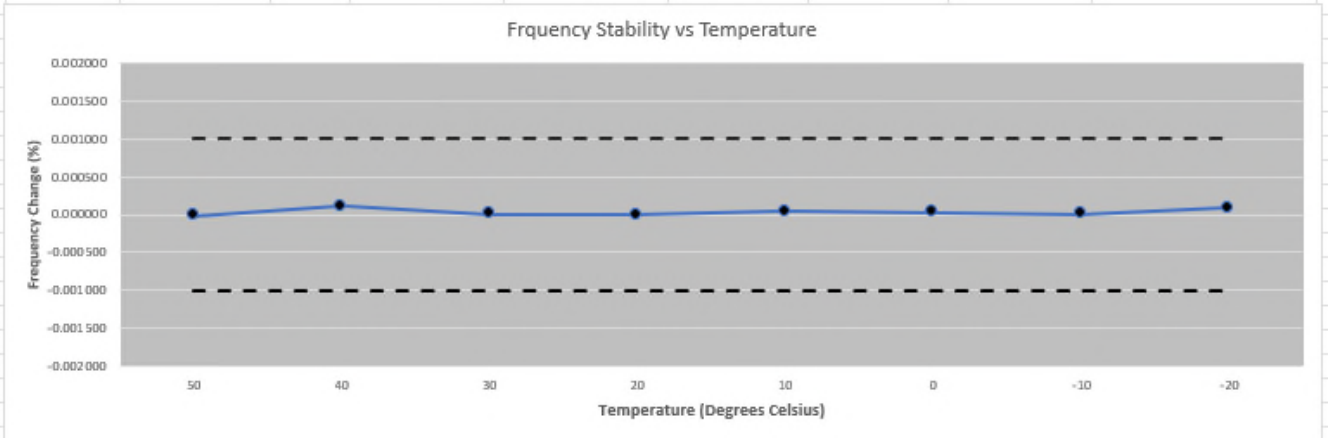


**Figure 2.6.6-3: Frequency Stability at Various Temperatures – Mid Channel**

| Voltage | Vdc | Degrees C | Frequency (MHz) | ppm | Percentage (%) | ppm upper limit | ppm lower limit | Percentage Upper Limit (%) | Percentage Lower Limit (%) | Reference Frequency (MHz) |
|---|---|---|---|---|---|---|---|---|---|---|
| nominal | 12.00 | 20 | 1643.500311000 | 0.000 | 0.000000 | 10 | -10 | 0.001 | -0.001 | 1643.500311000 |
| 85% | 10.20 | 20 | 1643.500367000 | 0.034 | -0.000003 | 10 | -10 | 0.001 | -0.001 | 1643.500311000 |
| 115% | 13.80 | 20 | 1643.499478000 | -0.507 | 0.000051 | 10 | -10 | 0.001 | -0.001 | 1643.500311000 |

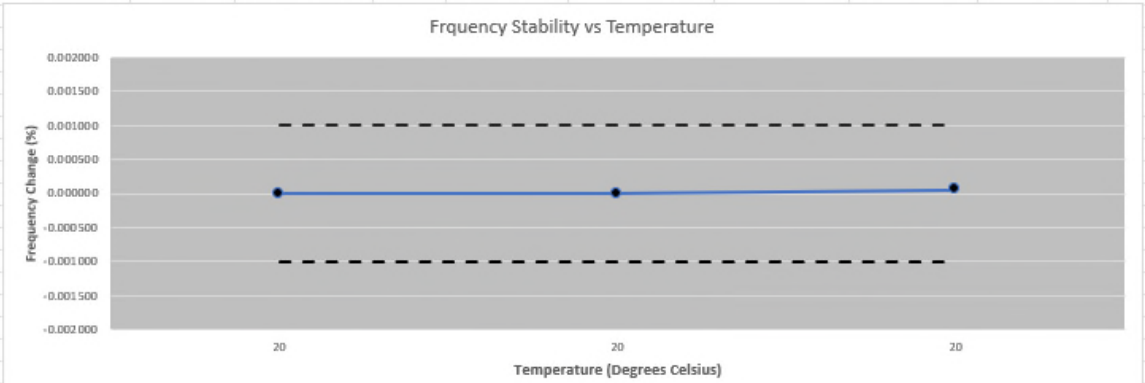


**Figure 2.6.6-4: Frequency Stability at Extreme Voltages – Mid Channel**

| Degrees C | Frequency (MHz) | ppm | Percentage (%) | ppm upper limit | ppm lower limit | Percentage Upper Limit (%) | Percentage Lower Limit (%) | Reference Frequency (MHz) |
|---|---|---|---|---|---|---|---|---|
| 50 | 1660.500633000 | -0.013 | 0.000001 | 10 | -10 | 0.001 | -0.001 | 1660.500655000 |
| 40 | 1660.499556000 | -0.662 | 0.000066 | 10 | -10 | 0.001 | -0.001 | 1660.500655000 |
| 30 | 1660.499878000 | -0.468 | 0.000047 | 10 | -10 | 0.001 | -0.001 | 1660.500655000 |
| 20 | 1660.500655000 | 0.000 | 0.000000 | 10 | -10 | 0.001 | -0.001 | 1660.500655000 |
| 10 | 1660.499522000 | -0.682 | 0.000068 | 10 | -10 | 0.001 | -0.001 | 1660.500655000 |
| 0 | 1660.500744000 | 0.054 | -0.000005 | 10 | -10 | 0.001 | -0.001 | 1660.500655000 |
| -10 | 1660.500678000 | 0.014 | -0.000001 | 10 | -10 | 0.001 | -0.001 | 1660.500655000 |
| -20 | 1660.499556000 | -0.662 | 0.000066 | 10 | -10 | 0.001 | -0.001 | 1660.500655000 |

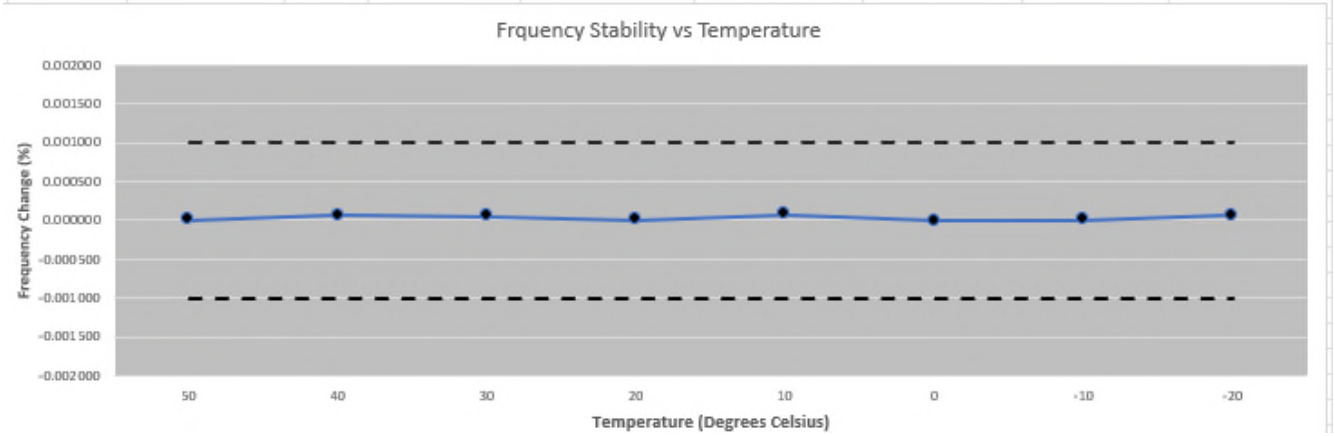


**Figure 2.6.6-5: Frequency Stability at Various Temperatures – High Channel**

| Voltage | Vdc | Degrees C | Frequency (MHz) | ppm | Percentage (%) | ppm upper limit | ppm lower limit | Percentage Upper Limit (%) | Percentage Lower Limit (%) | Reference Frequency (MHz) |
|---|---|---|---|---|---|---|---|---|---|---|
| nominal | 12.00 | 20 | 1660.500655000 | 0.000 | 0.000000 | 10 | -10 | 0.001 | -0.001 | 1660.500655000 |
| 85% | 10.20 | 20 | 1660.500667000 | 0.007 | -0.000001 | 10 | -10 | 0.001 | -0.001 | 1660.500655000 |
| 115% | 13.80 | 20 | 1660.499278000 | -0.829 | 0.000083 | 10 | -10 | 0.001 | -0.001 | 1660.500655000 |

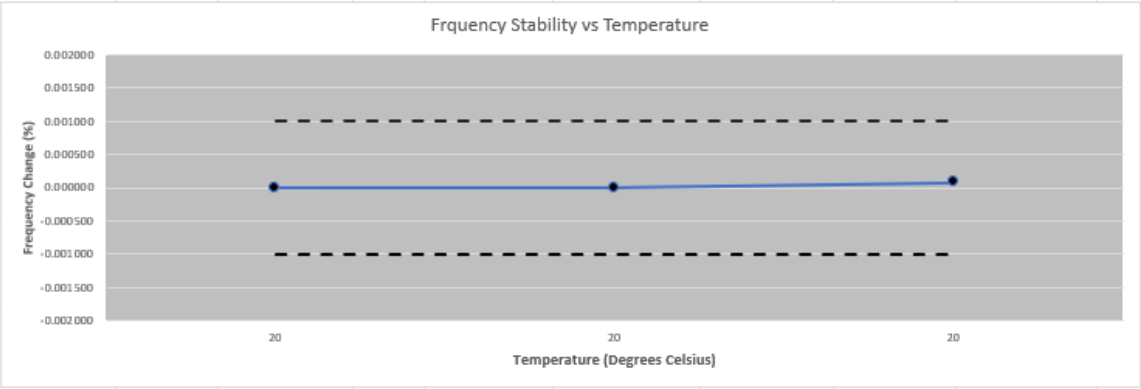


**Figure 2.6.6-6: Frequency Stability at Extreme Voltages – High Channel**

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### 2.5.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: 3mSAC

**Table 2.5-1 – Conducted Emissions Test Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| NBLE02238 | Envirotronics | Chamber, 27 Cu Ft Temp/Humidity | SH27 | 09963482-S | G | 07/29/2024 | 07/29/2025 |
| WRLE11119 | RF Precision Cables | Attenuator, 30 dB | ATX3396-30 | 11119 | B | 01/02/2024 | 01/02/2025 |
| NBLE11555 | Rohde & Schwarz | Receiver, 2 Hz-44 GHz | ESW44 (SAP 21006053) | 101537 | G | 01/26/2024 | 01/26/2025 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

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## 2.6 Protection of Aeronautical Radio Navigation Satellite Service

### 2.6.1 Specification Reference

FCC 47 CFR Part 25.216(c)(h)(i)

### 2.6.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.6.3 Date of Test

15 October 2024

### 2.6.4 Test Method

The maximum peak conducted output power was measured in accordance with the ANSI C63.26. The RF output of the EUT was directly connected to the input of the spectrum analyzer along with a suitable external attenuator. The RBW of the spectrum analyzer was set to 1MHz and the VBW was set to ≥ 3 times the RBW. The spectrum analyzer span was set to cover the entire frequency range per the applicable section of the standard and the trace was set to max hold using the average detector to provide the mean output power.

The limit used for the entire frequency range is in dBW/MHz and was converted to dBm on the receiver using the formula: dBm = dBW + 30

### 2.6.5 Environmental Conditions

All tests are performed within the ambient climatic conditions of the laboratory.

### 2.6.6 Test Results

**Test Summary**: An RF attenuator was used between the EUT output and the measurement receiver during testing. All measurement correction factors were entered into the receiver as an offset to provide corrected measurement results. EUT operated as intended before, during, and after testing.

.

**Test Result: Pass**

See data below for detailed results.

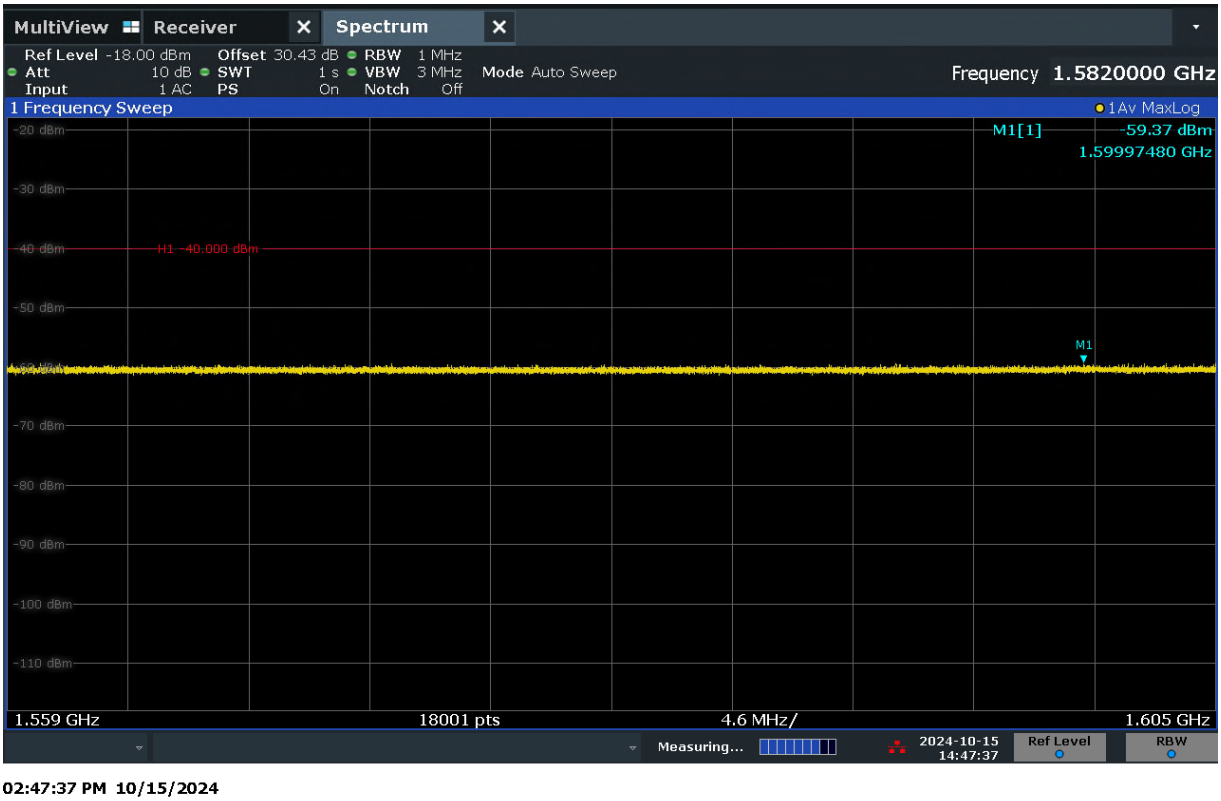


**Figure 2-19 – FCC 25.216(c) – Low Channel**

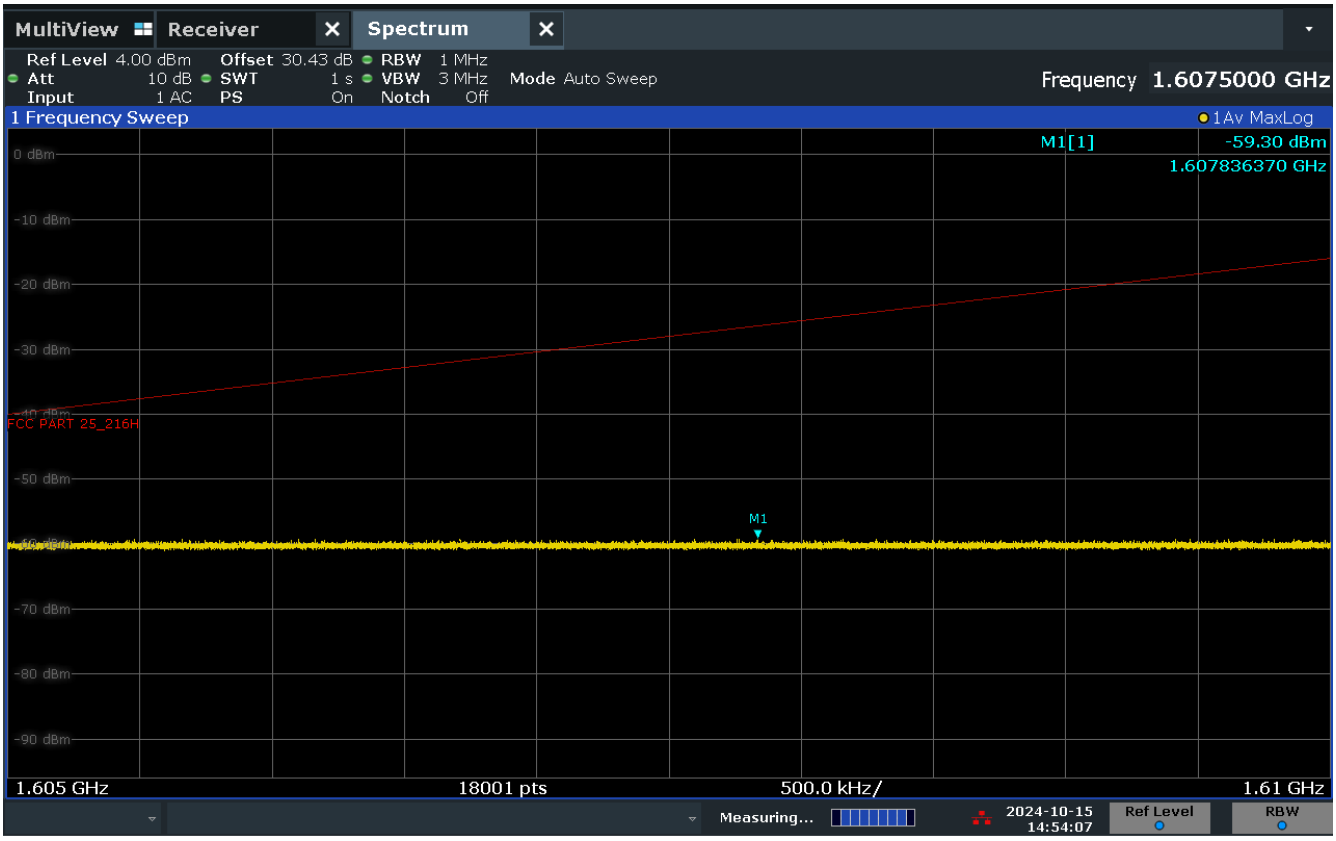


**Figure 2-20 – FCC 25.216(h) – Low Channel**

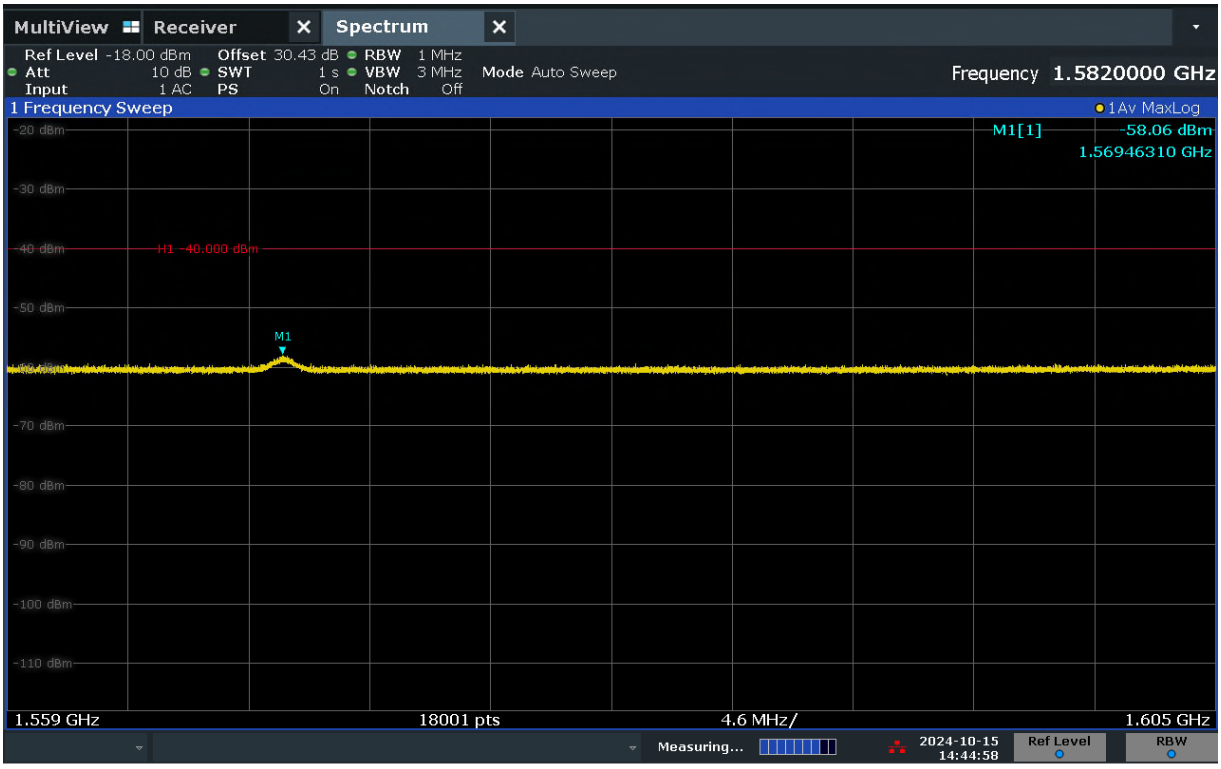


**Figure 2-21 – FCC 25.216(c) – Mid Channel**

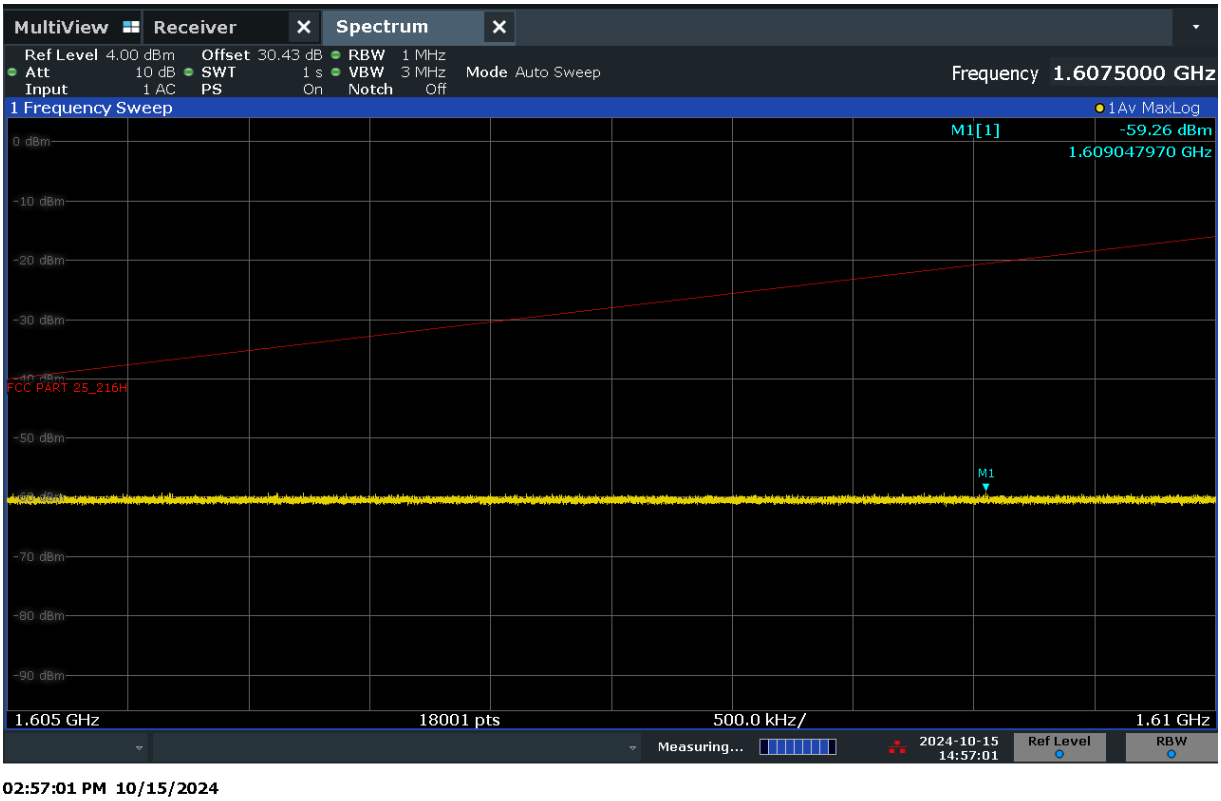


**Figure 2-22 – FCC 25.216(h) – Mid Channel**

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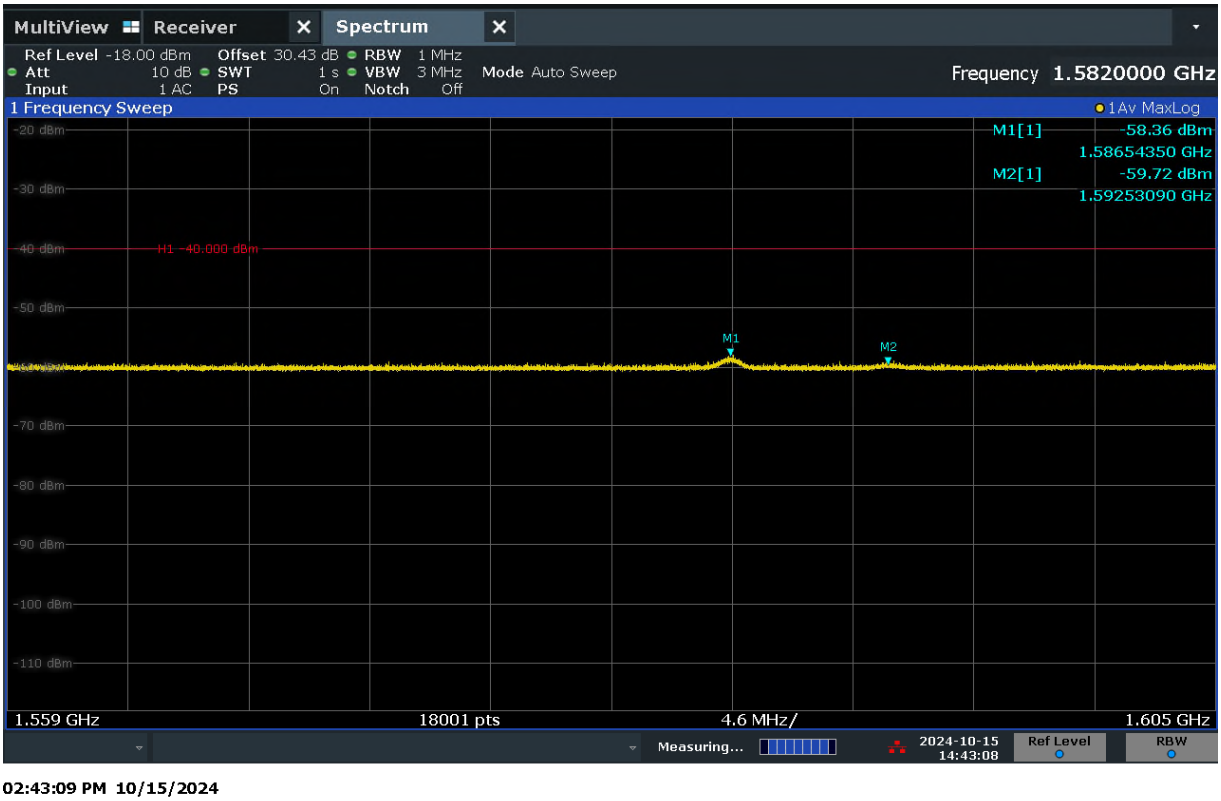


**Figure 2-23 – FCC 25.216(c) – High Channel**

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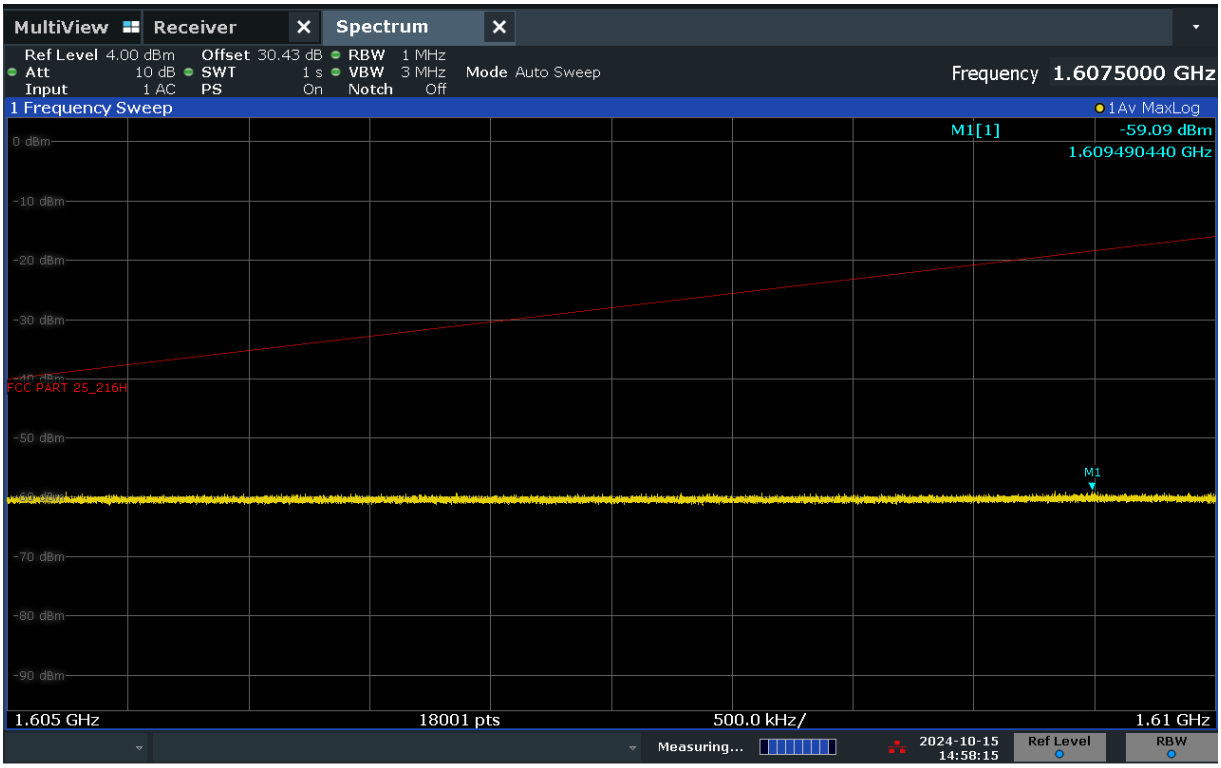


**Figure 2-24 – FCC 25.216(h) – High Channel**

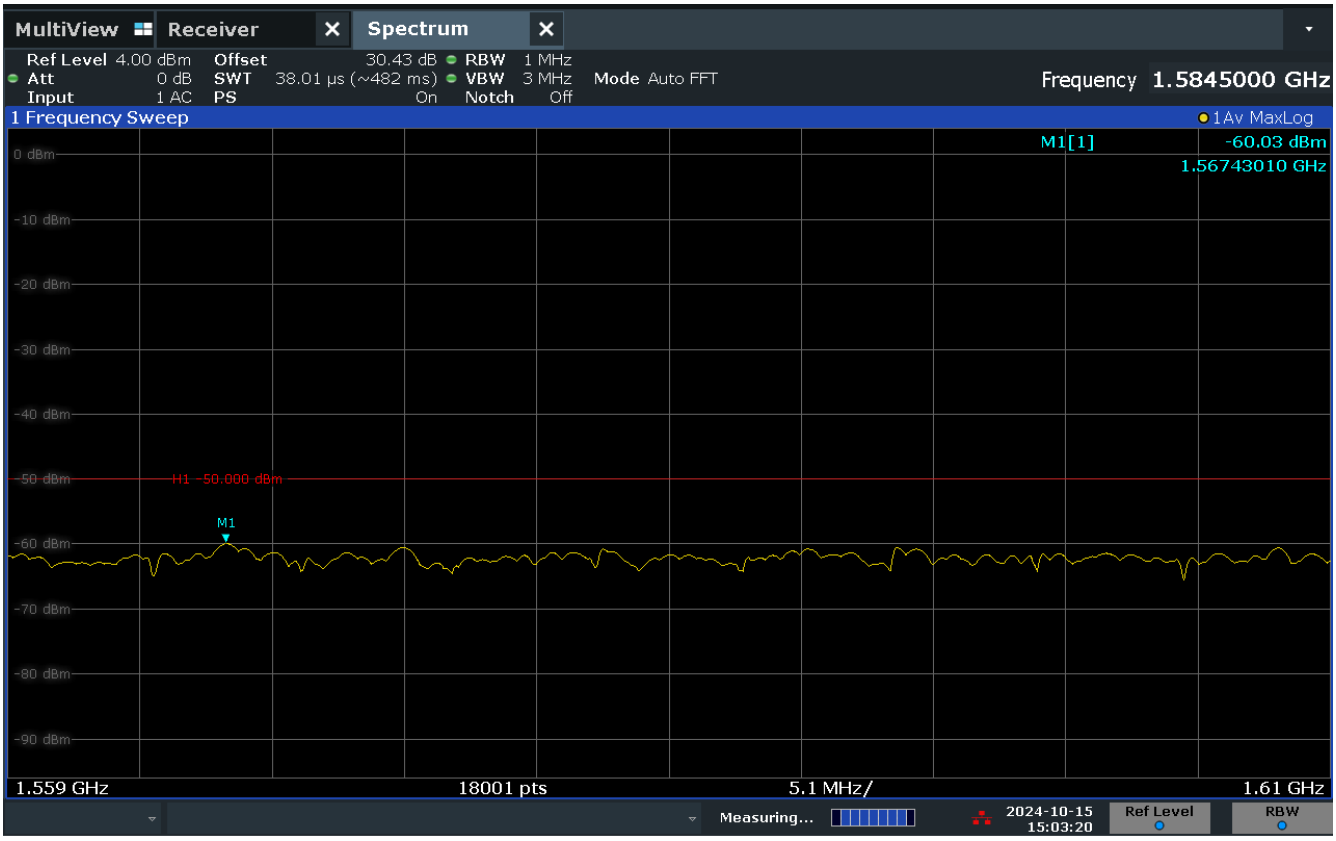


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**Figure 2-25 – FCC 25.216(i)**

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### 2.6.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: 3mSAC

**Table 2.6-1 – Conducted Emissions Test Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| WRLE11119 | RF Precision Cables | Attenuator, 30 dB | ATX3396-30 | 11119 | B | 01/02/2024 | 01/02/2025 |
| NBLE11555 | Rohde & Schwarz | Receiver, 2 Hz-44 GHz | ESW44 (SAP 21006053) | 101537 | G | 01/26/2024 | 01/26/2025 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

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# 3 Diagram of Test Setups

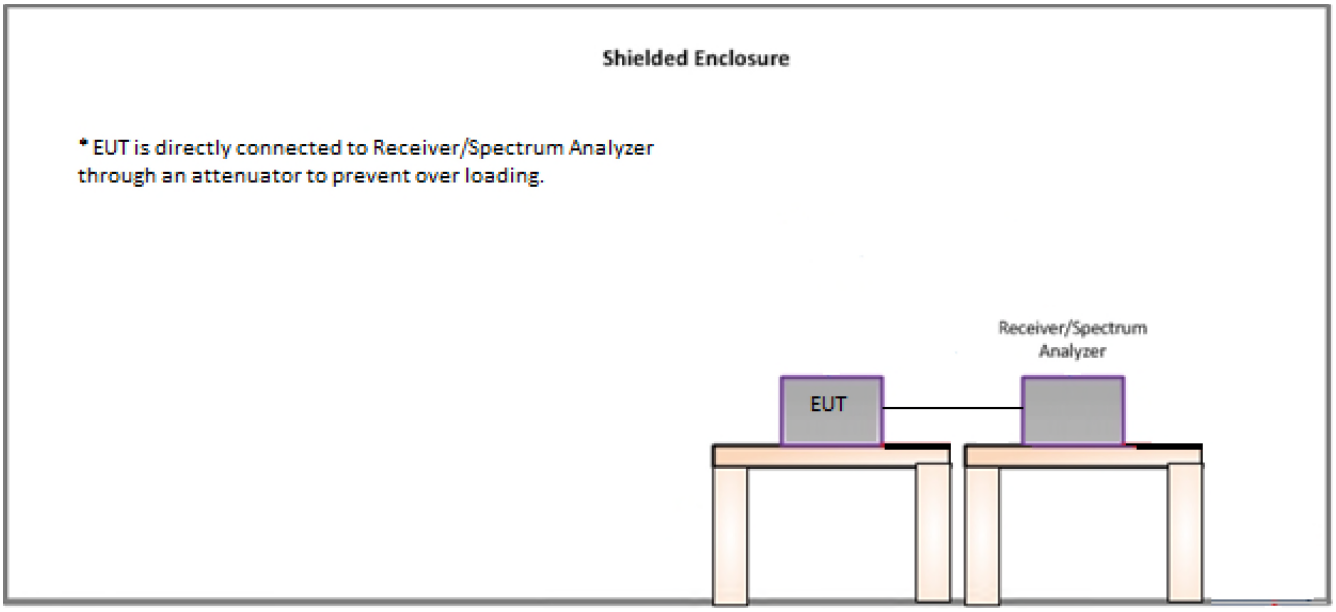


**Figure 3-1 – Conducted Test Setup**

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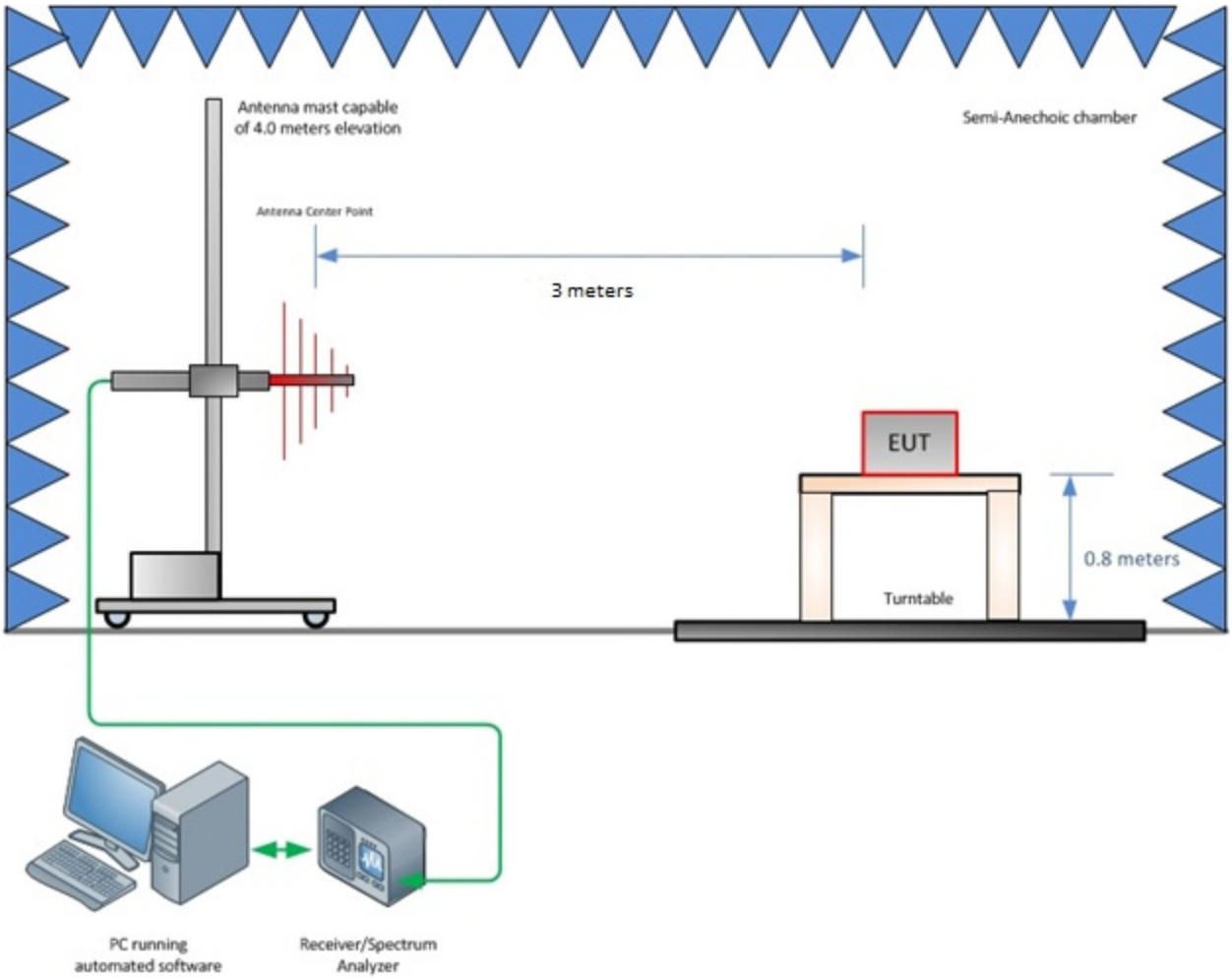


**Figure 3-2 – Radiated Emissions Test Setup up to 1 GHz**

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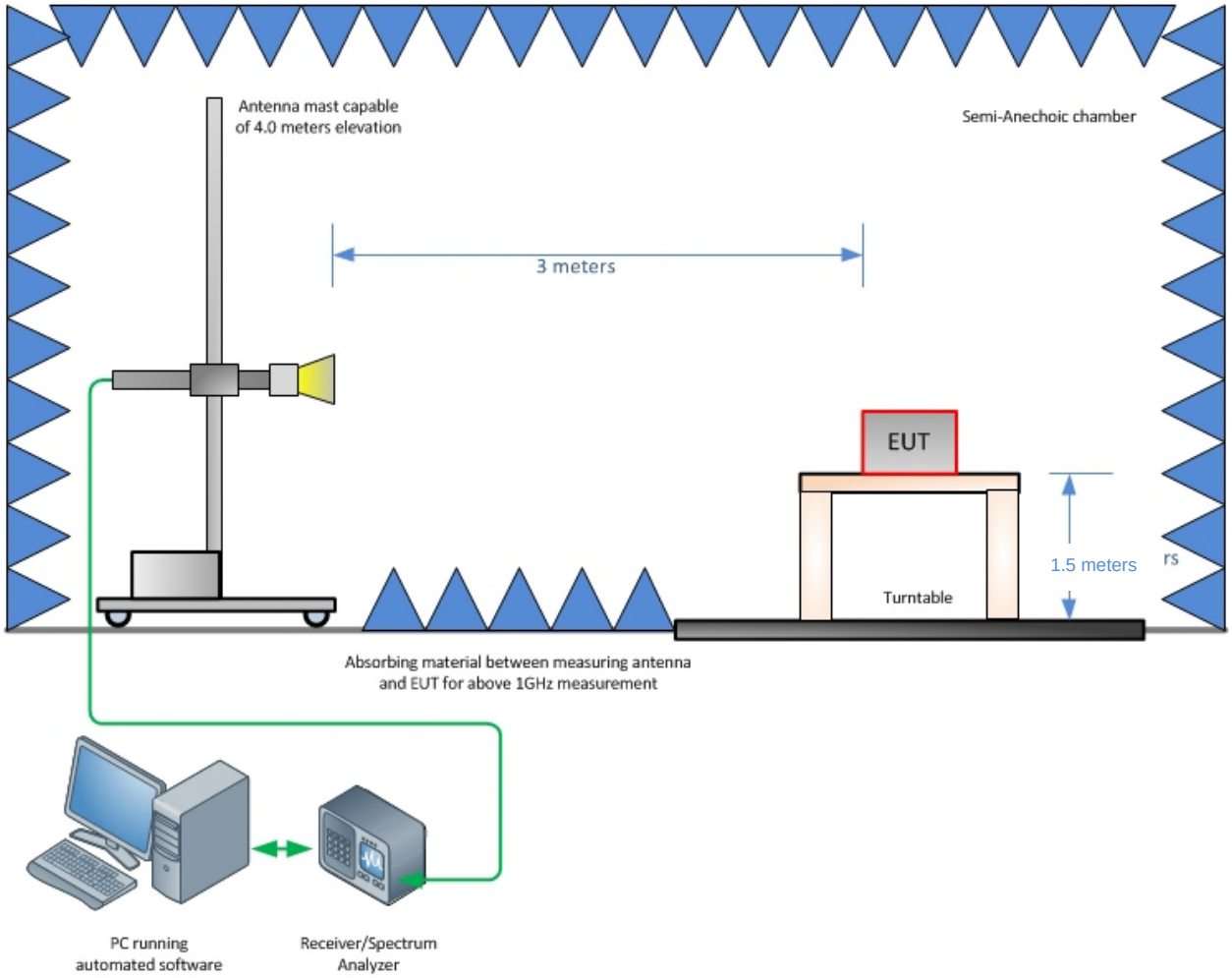


**Figure 3-3 – Radiated Emissions Test Setup above 1 GHz**

# 4 Accreditation, Disclaimers and Copyright

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**STATEMENT OF MEASUREMENT UNCERTAINTY – Emissions**

The test system for conducted emissions is defined as the LISN, tuned receiver or spectrum analyzer, and coaxial cable. This test system has a measurement uncertainty of ±3.30 dB. The test system for radiated emissions is defined as the antenna, the pre-amplifier, the spectrum analyzer and the coaxial cable. This test system for 30 MHz-1000 MHz has a measurement uncertainty of ±5.88 dB and above 1 GHz a measurement uncertainty of ±4.47 dB. The measurement uncertainty values for conducted and radiated emissions meet the requirements as expressed in CISPR 16-4-2. The equipment comprising the test systems is calibrated on an annual basis.

**TEST EQUIPMENT**

All measurement instrumentation is traceable to the National Institute of Standards and Technology and is calibrated to meet test method standard requirements and/or manufacturer's specifications

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