Report on the Testing of the

Cobham Satcom

Model: Yahsat T-TAC Vehicular
Part Number: 408064A-41000

FCC ID:ROJ-8064A

In accordance with:
FCC 47 CFR Part 25

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

COMMERCIAL-IN-CONFIDENCE

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Sean Sellergren	Sr. EMC Engineer	**Authorized Signatory**	03 December 2024

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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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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 - Updated verbiage in all test section's Environmental Conditions description - 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 - Testing was redone for Frequency Stability and this section was updated with those results.	06 December 2024
3	- Updated data in Section 2.5 - 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 - Updated data in section 2.3 conducted spurious emissions - 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 Vehicular
Part Number(s)	408064A-41000
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 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-8064A
Transceiver Model #	408064A-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	36.72	1	70	Pass
1643.5	37	1	70	Pass
1660.5	36.88	1	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.

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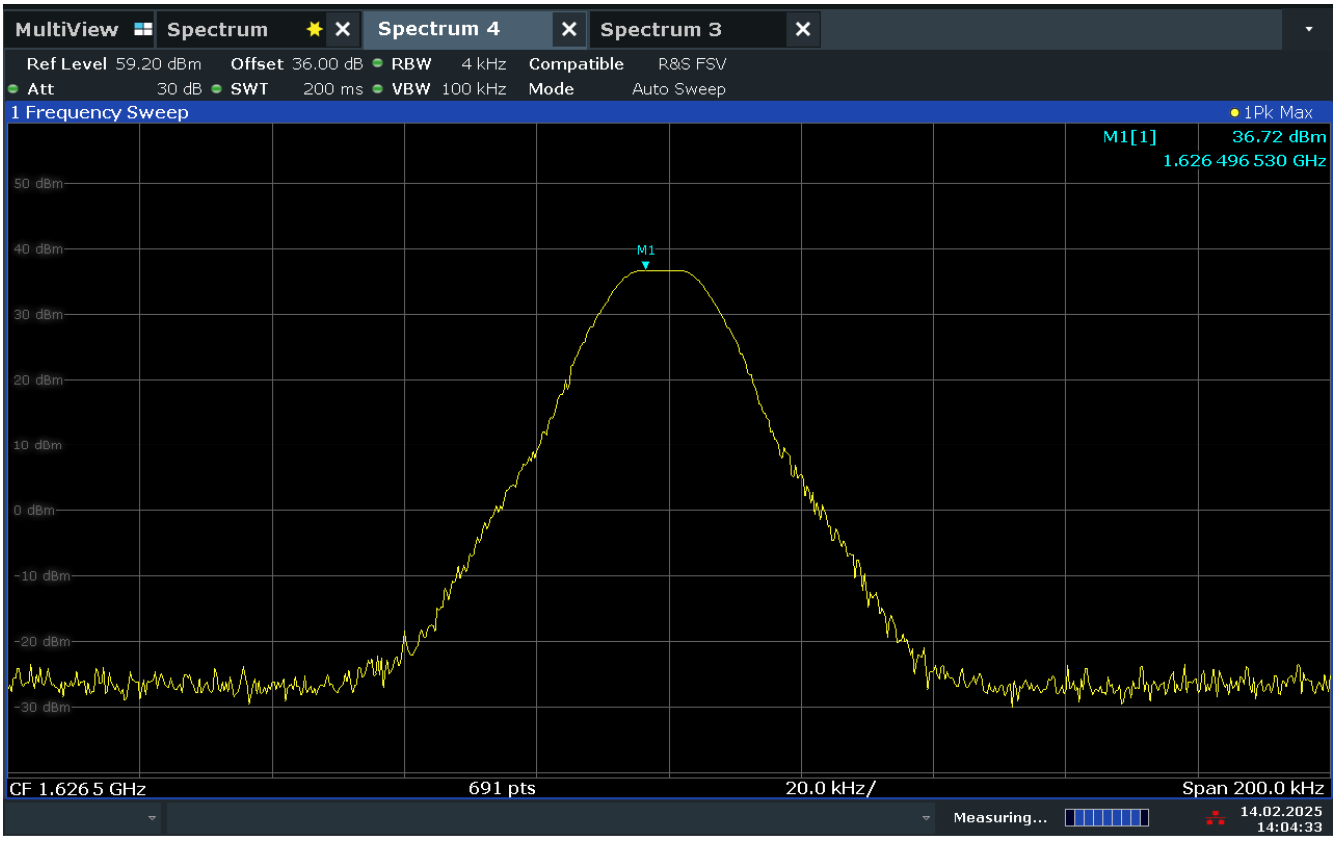

14:04:34 14.02.2025

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

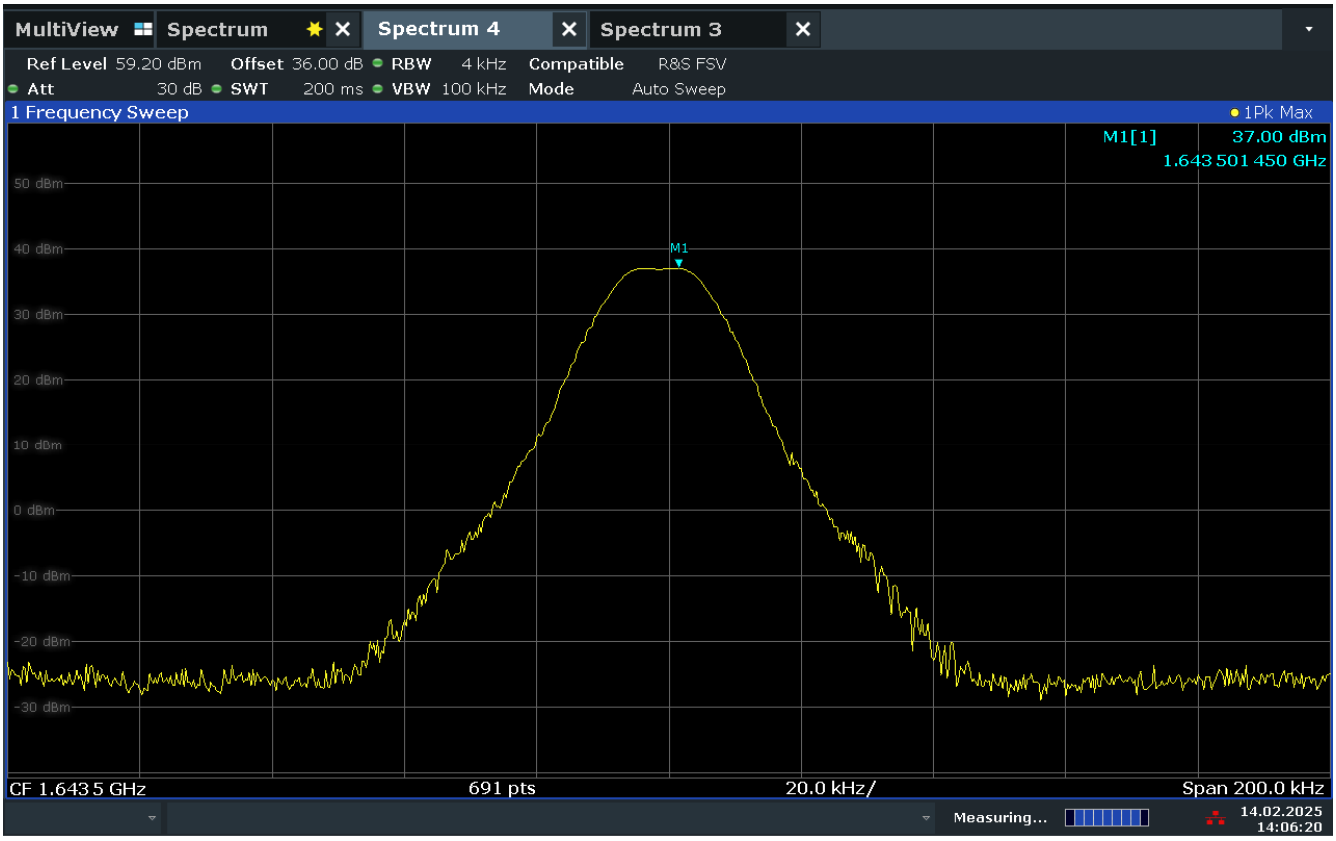

Figure 2-2 – Peak Conducted Output Power – Middle Channel

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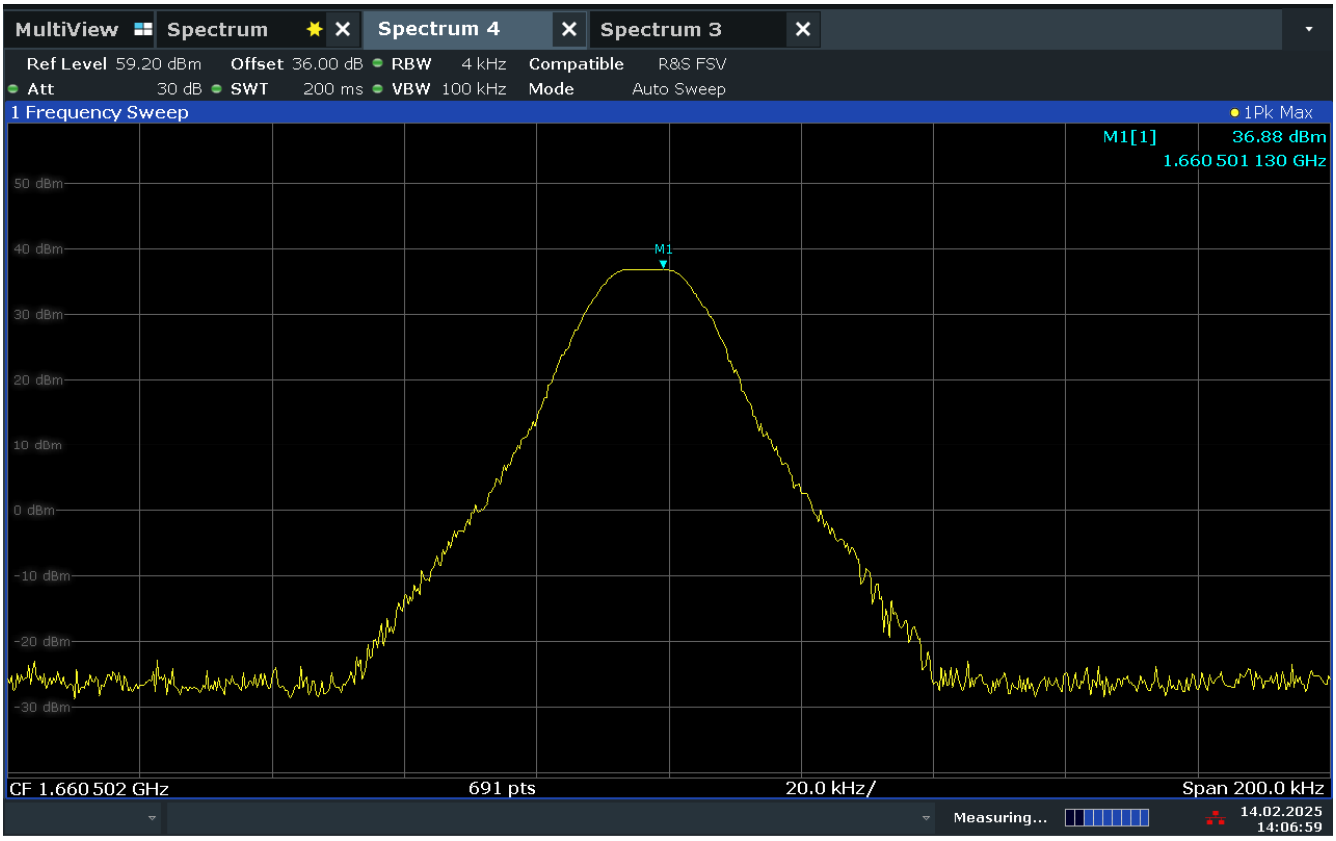

Figure 2-3 – Peak Conducted Output Power – High Channel

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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.

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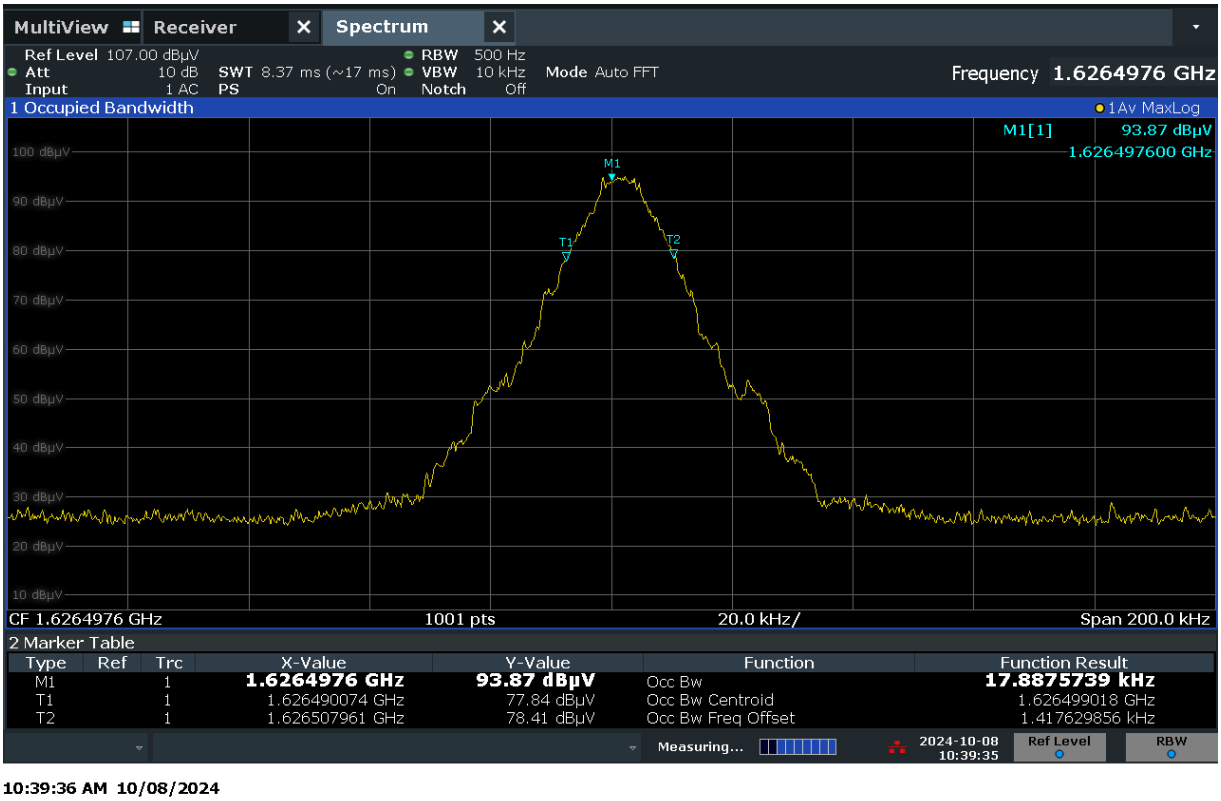

Figure 2-4 – Occupied Bandwidth – Low Channel

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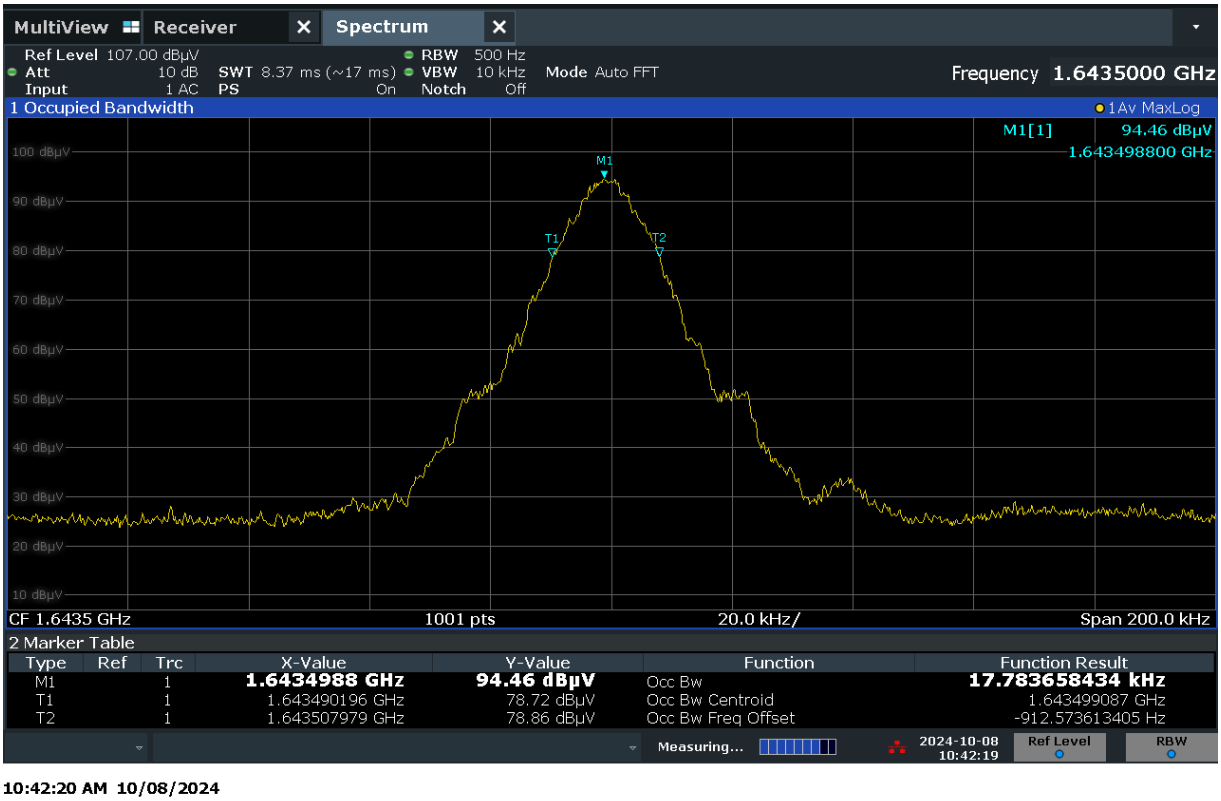

Figure 2-5 – Occupied Bandwidth – Middle Channel

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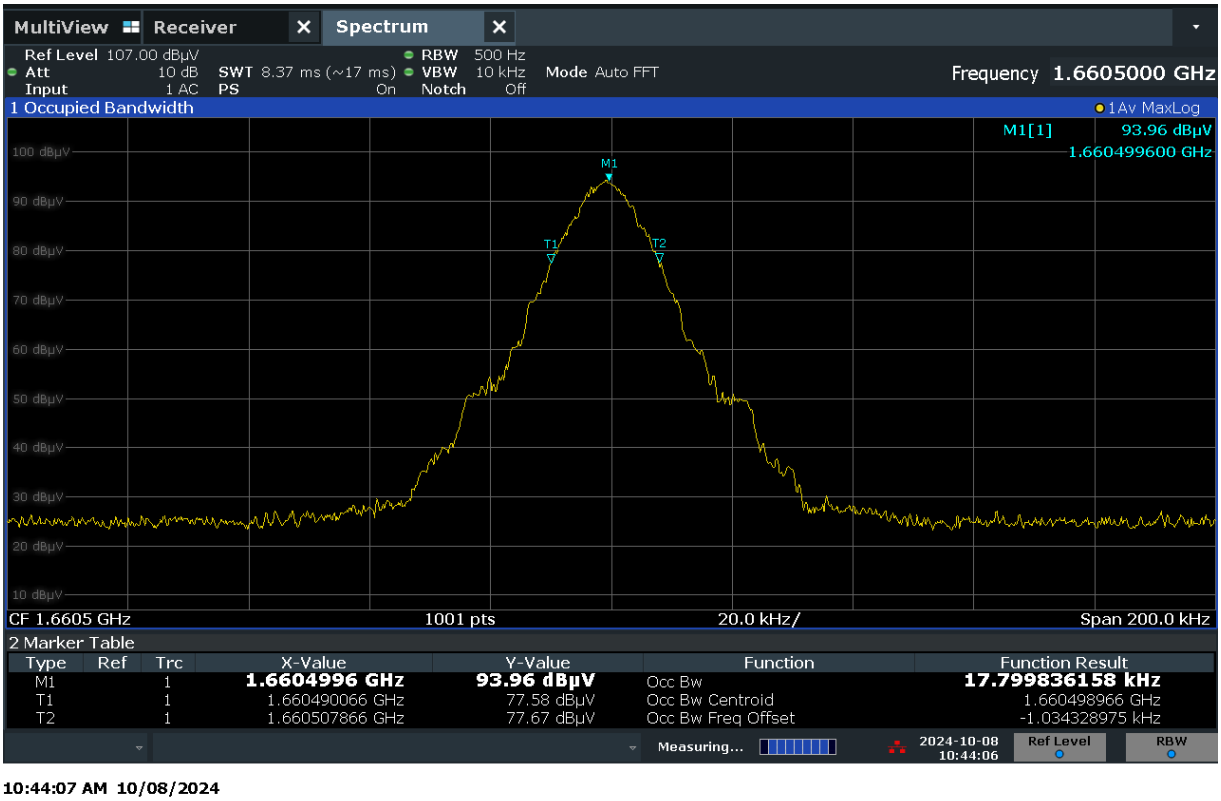

Figure 2-6 – Occupied Bandwidth – High Channel

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.

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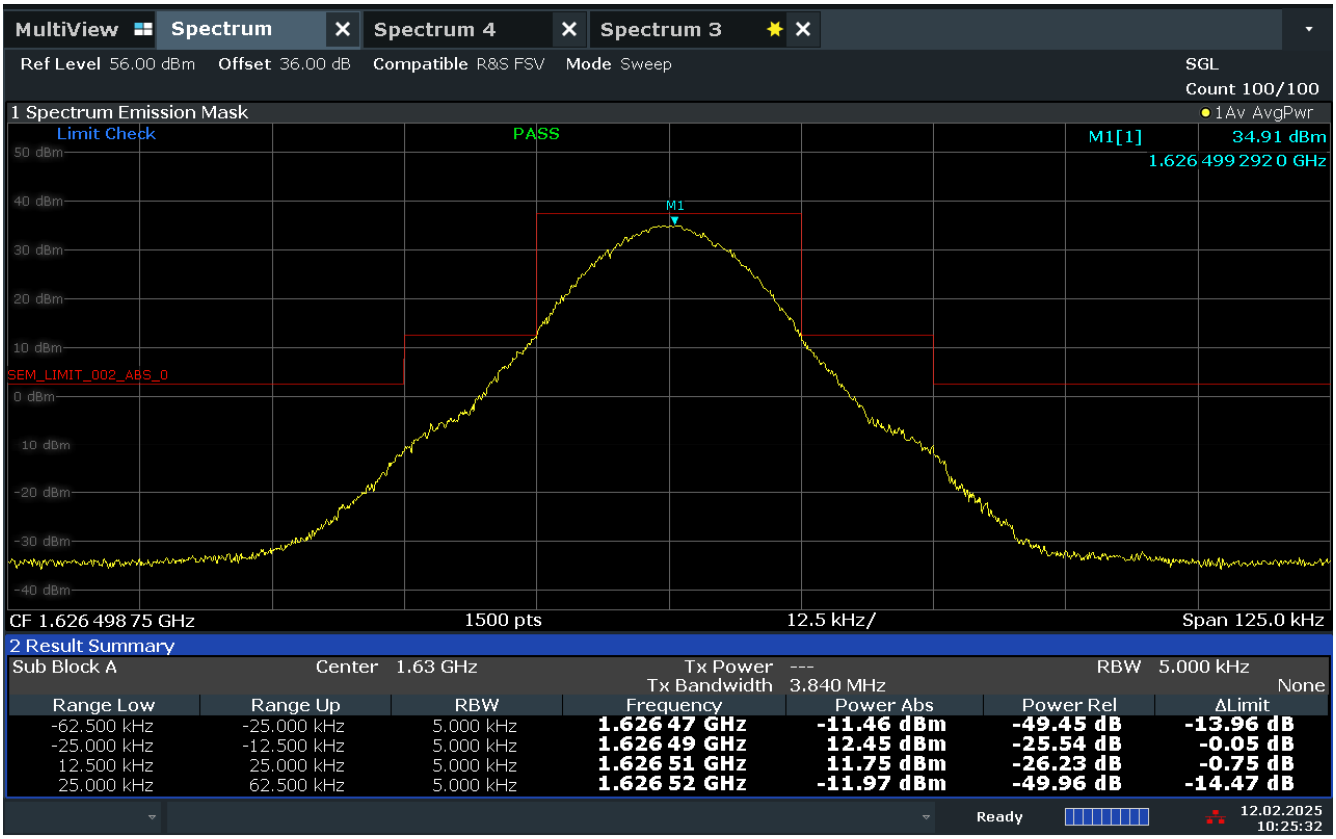
Test Result: Pass

See data below for detailed results.



10:25:33 12.02.2025

Figure 2-7 – Emission Mask – Low Channel

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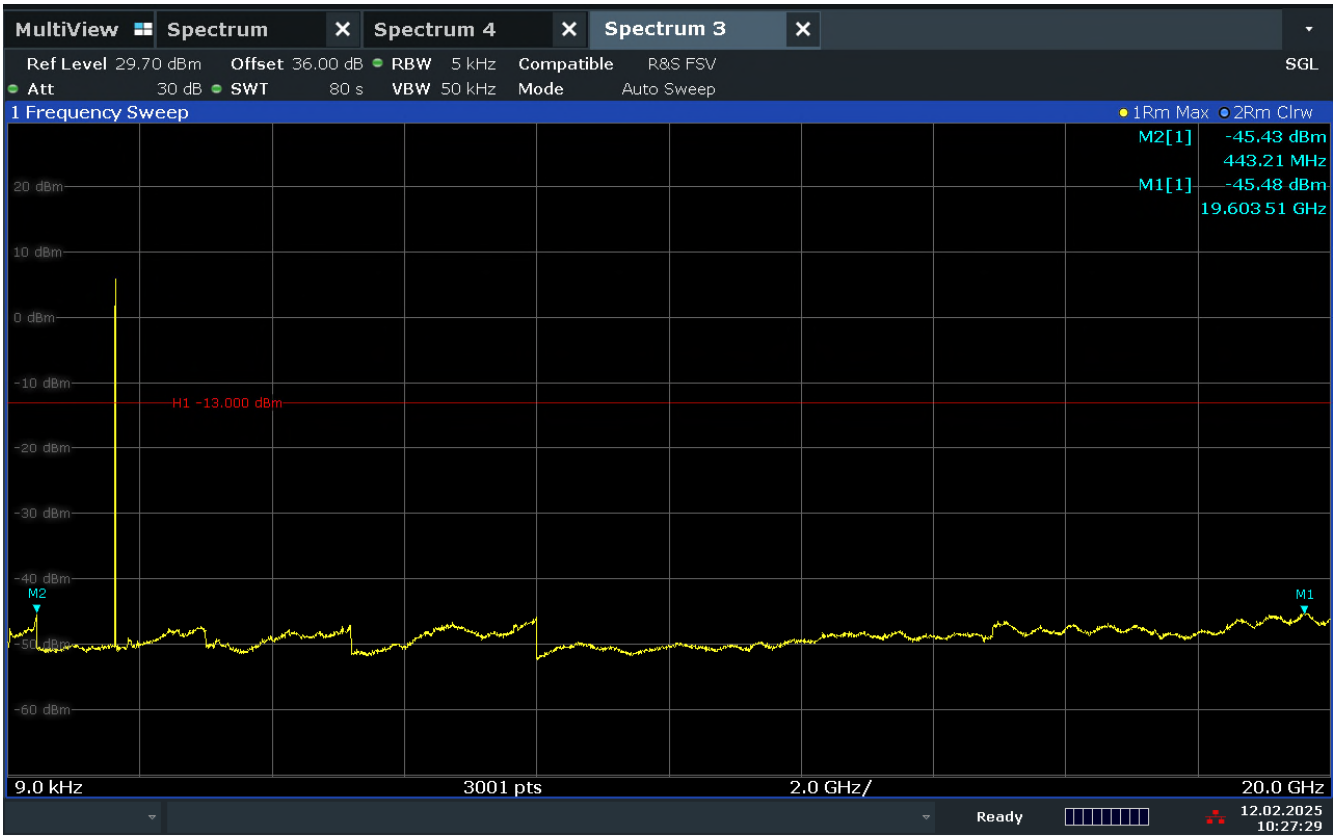

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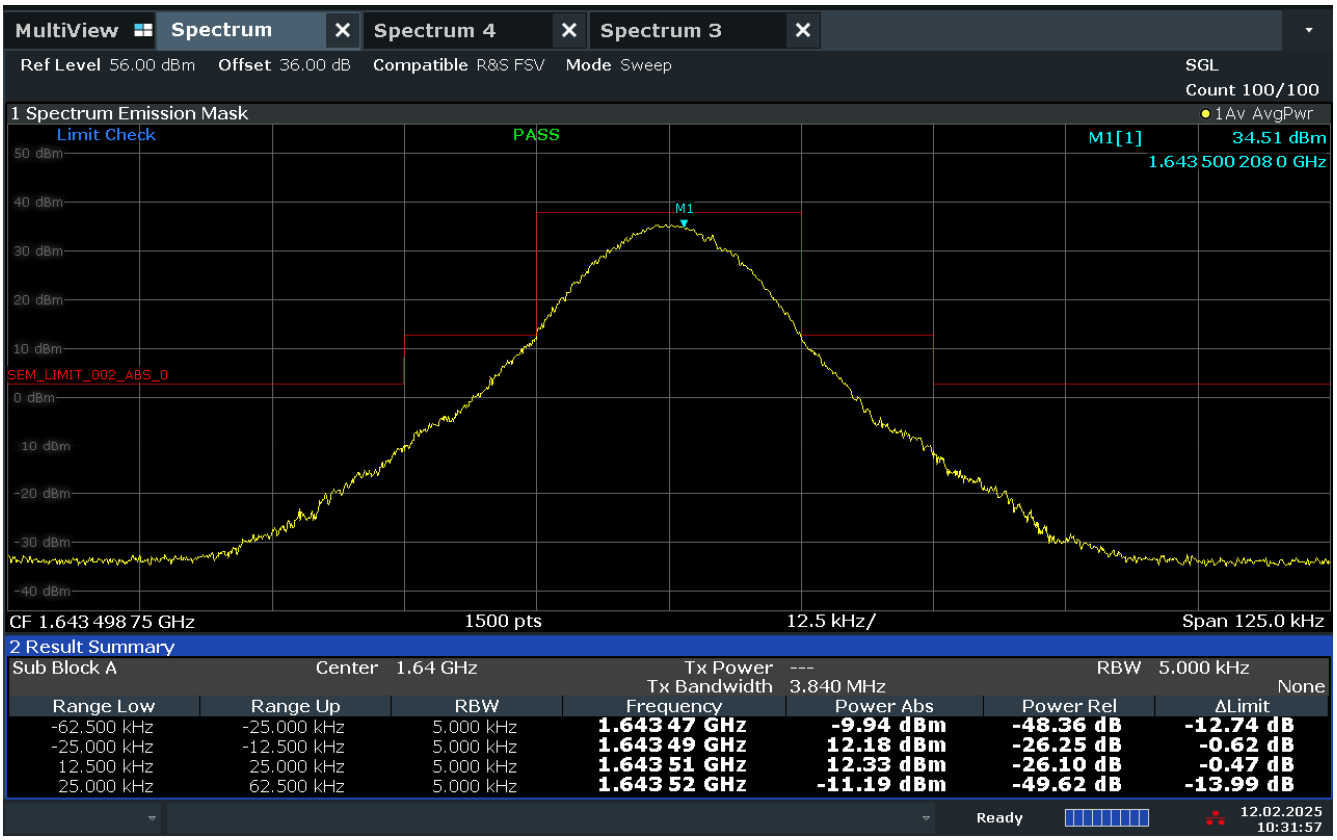
Figure 2-8 – Conducted Spurious Emissions 9 kHz – 20GHz – Low Channel



10:31:58 12.02.2025

Figure 2-9 – Emission Mask – Mid Channel

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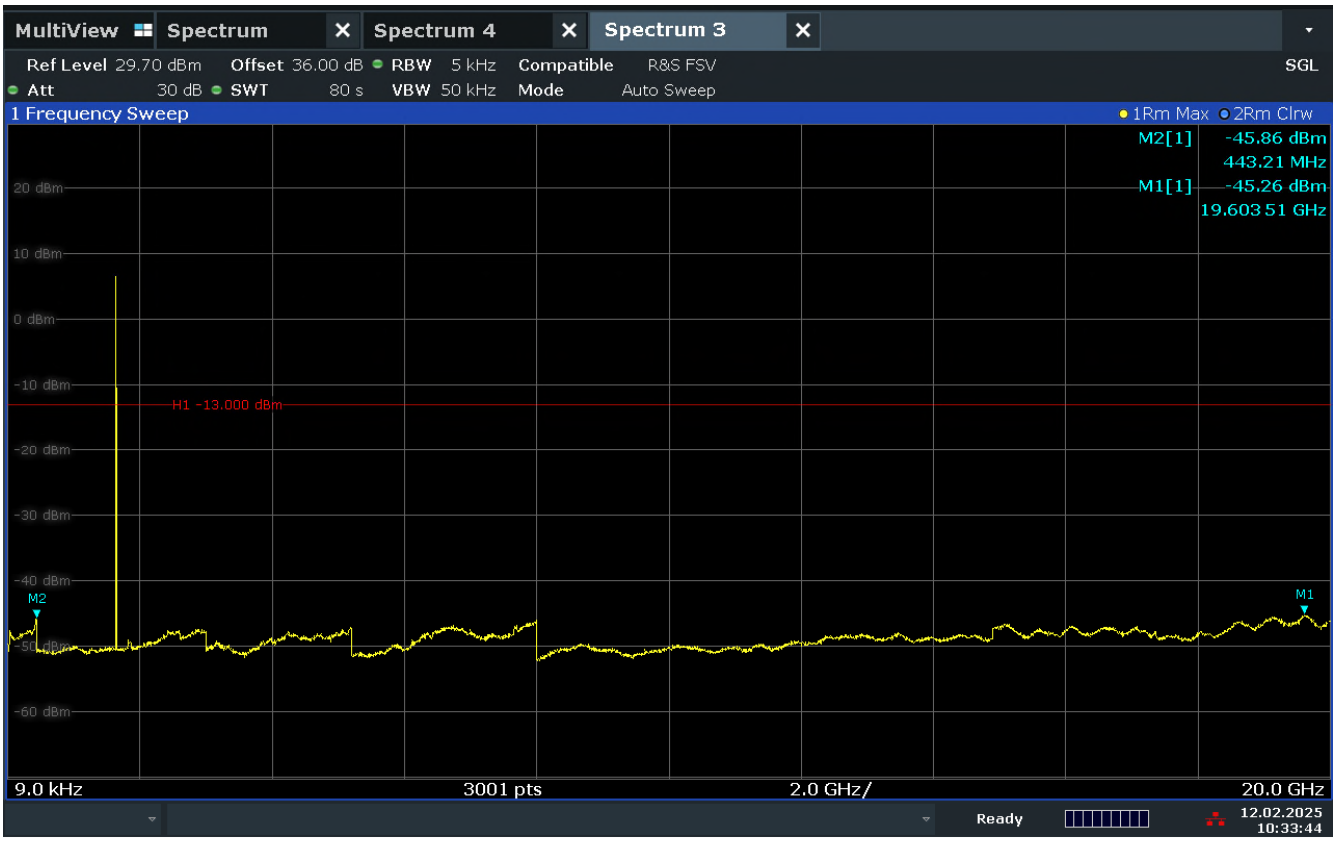

Figure 2-10 – Conducted Spurious Emissions 9 kHz – 20GHz – Mid Channel

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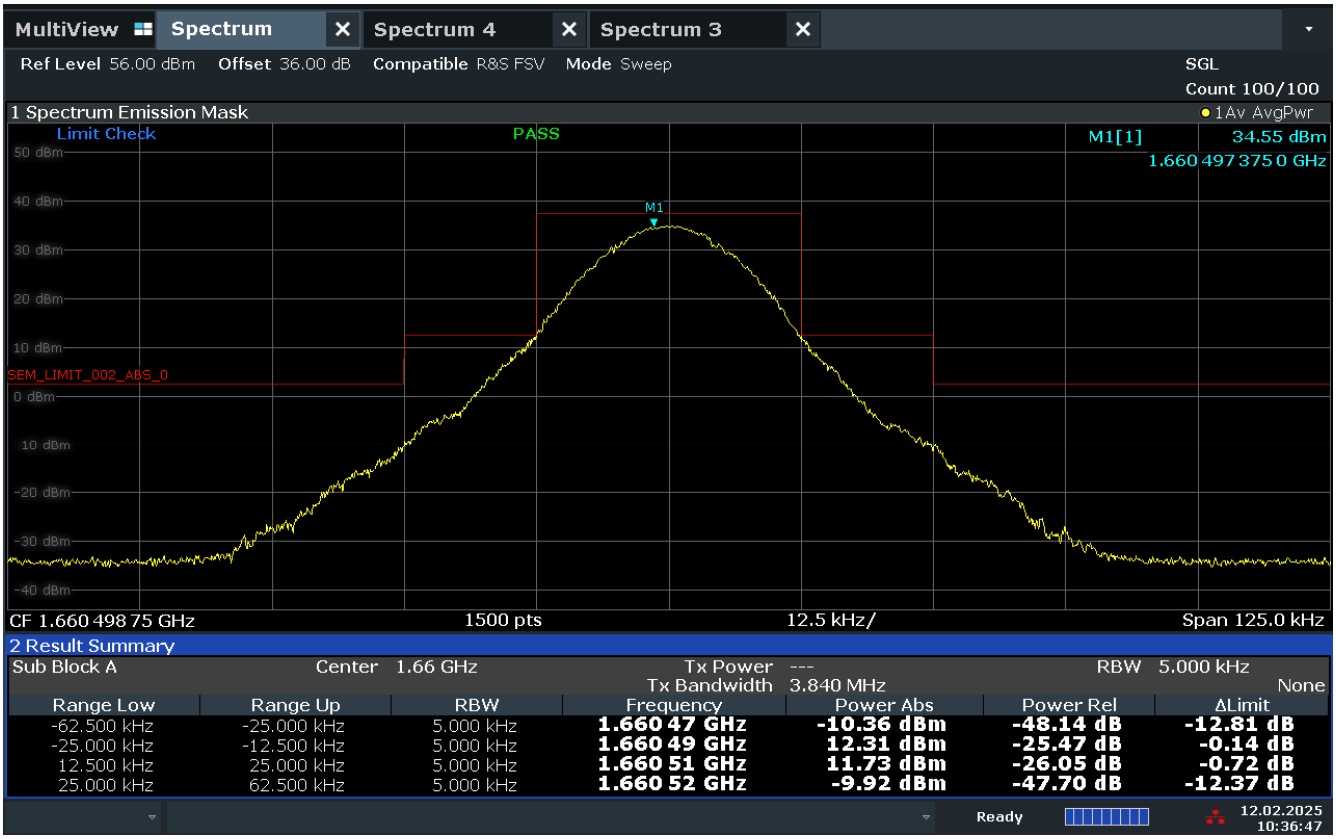

10:36:48 12.02.2025

Figure 2-11 – Emission Mask – High Channel

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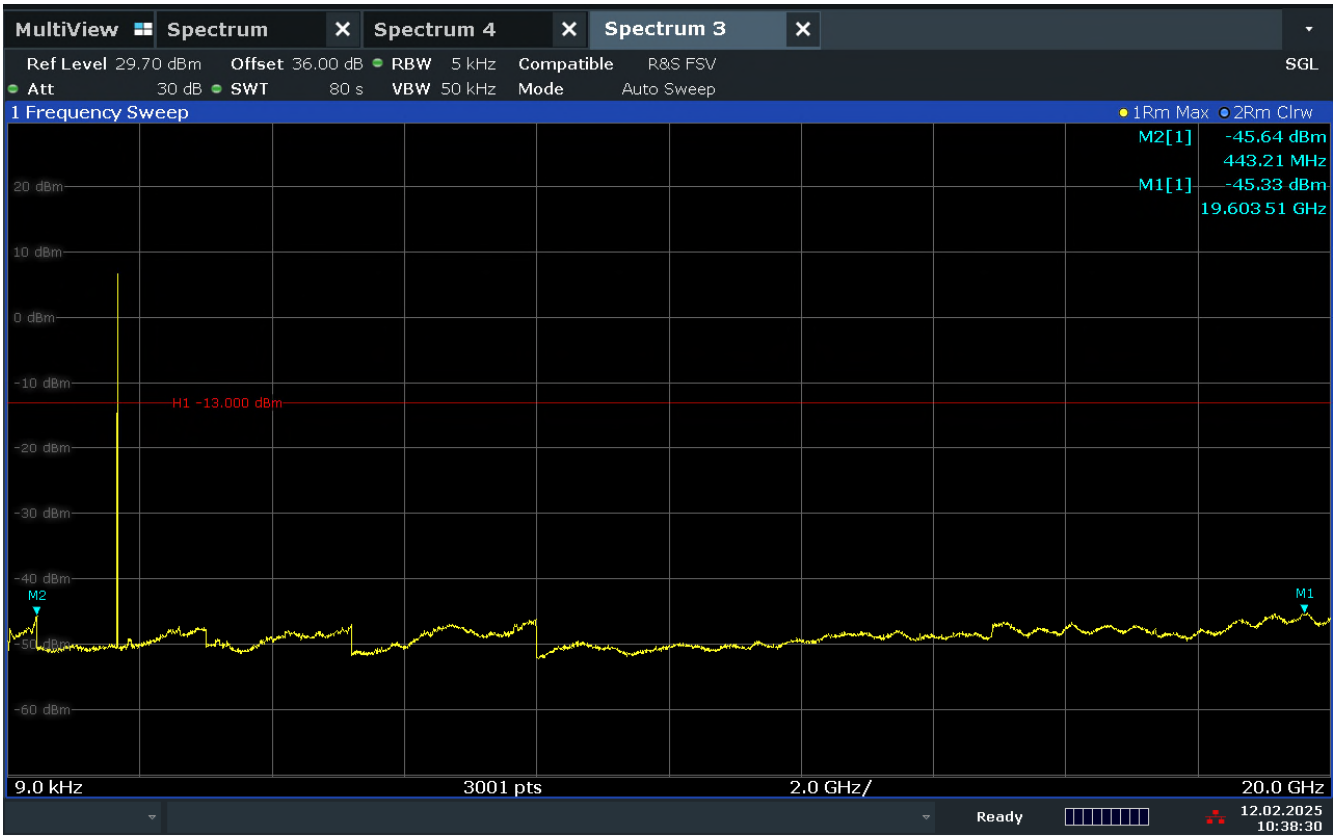


10:38:30 12.02.2025

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

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

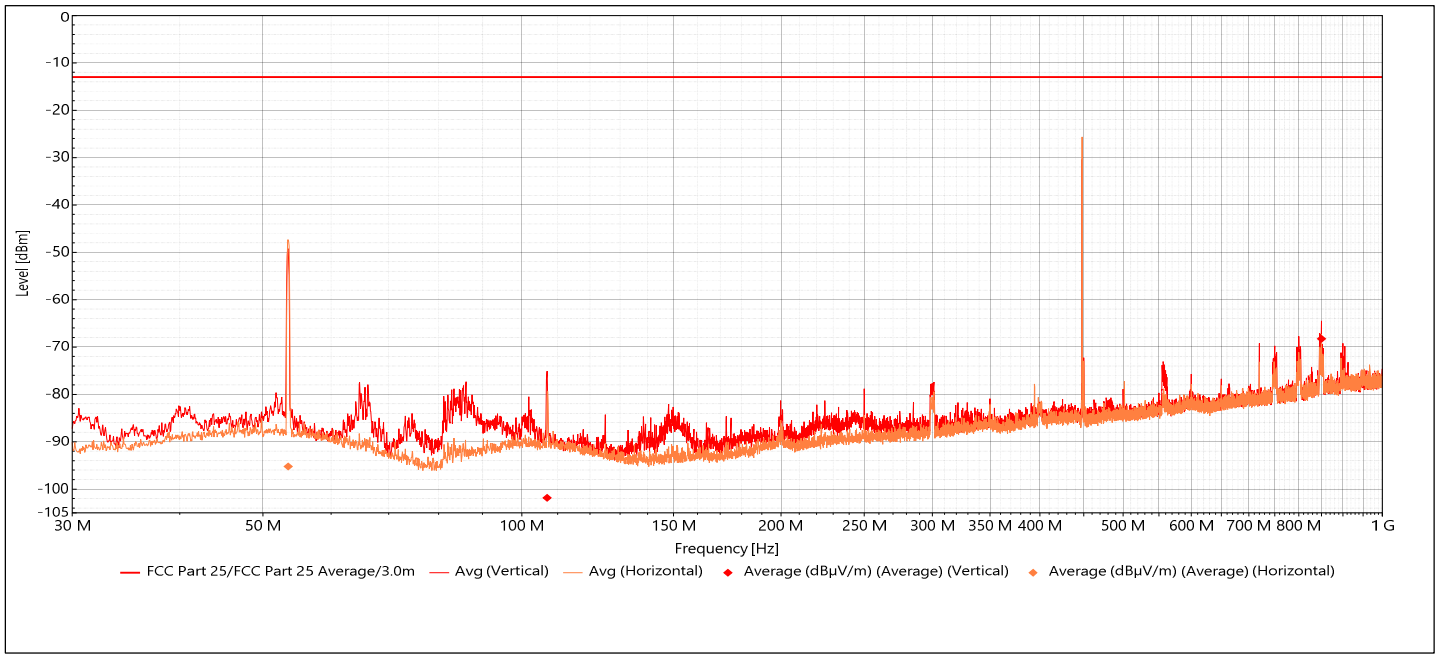
Test Summary: An RF attenuator was used at the input to the RF pre-amp during testing. EUT operated as intended before, during, and after testing.

Test Result: Pass

See data below for detailed results.

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

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
106.953	-101.85	-13.00	-88.85	248.00	1.97	Vertical	Pass
849.973	-68.26	-13.00	-55.26	43.00	1.12	Vertical	Pass
53.496	-95.25	-13.00	-82.25	137.00	2.19	Horizontal	Pass

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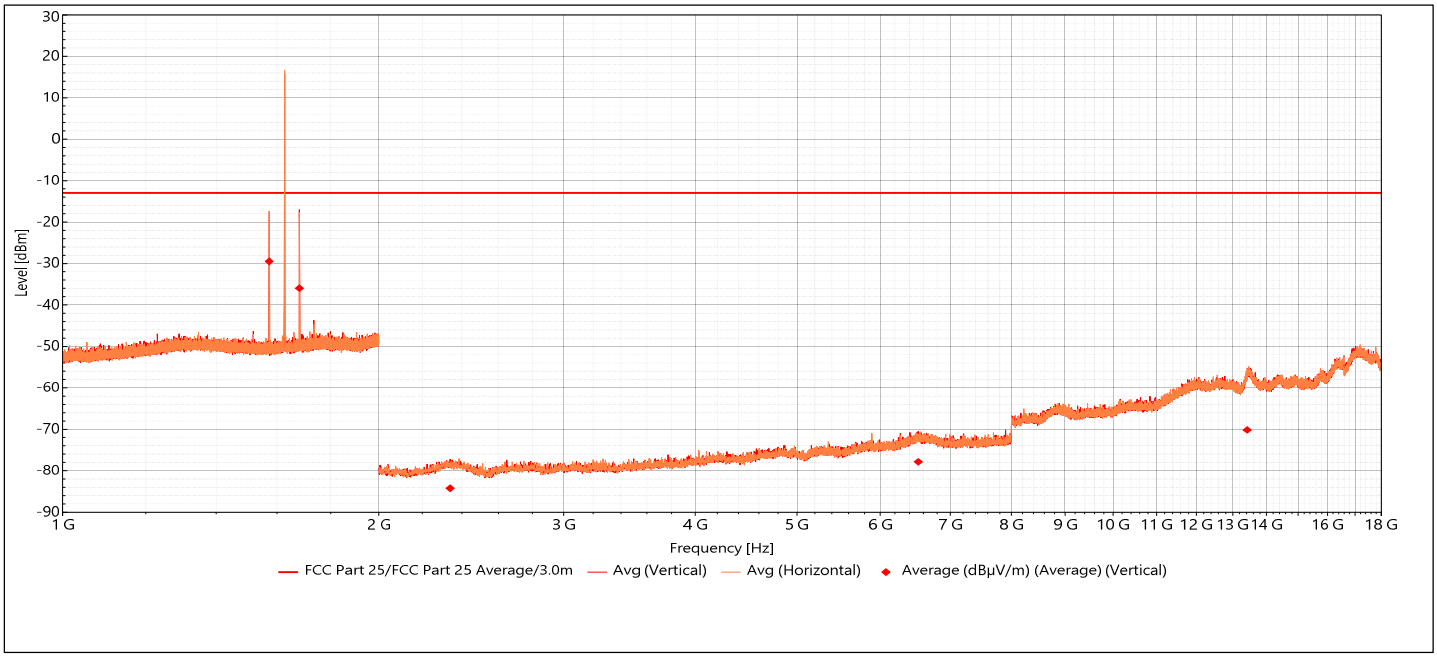
Spurious Emissions 1 - 18GHz - Low Channel 1626.5MHz

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	10/21/2024	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

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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
1572.444	-29.49	-13.00	-16.49	182.00	3.77	Vertical	Pass
1680.556	-35.95	-13.00	-22.95	179.00	3.55	Vertical	Pass
2337.778	-84.25	-13.00	-71.25	0.00	1.00	Vertical	Pass
6523.556	-77.86	-13.00	-64.86	0.00	3.94	Vertical	Pass
13420.444	-70.16	-13.00	-57.16	360.00	3.94	Vertical	Pass

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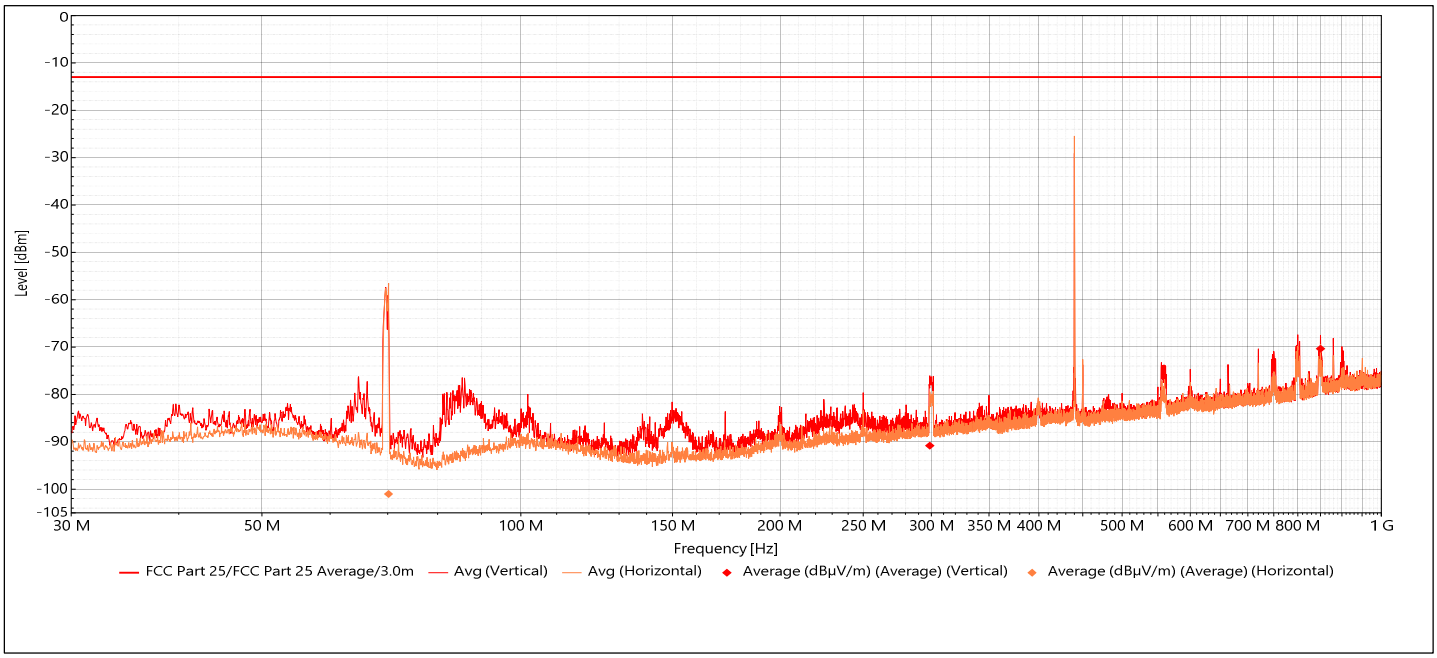
Spurious Emissions 30M-1GHz - Mid Channel 1643.5MHz

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
298.690	-90.85	-13.00	-77.85	123.00	1.00	Vertical	Pass
849.973	-70.37	-13.00	-57.37	54.00	1.12	Vertical	Pass
70.147	-101.06	-13.00	-88.06	12.00	1.98	Horizontal	Pass

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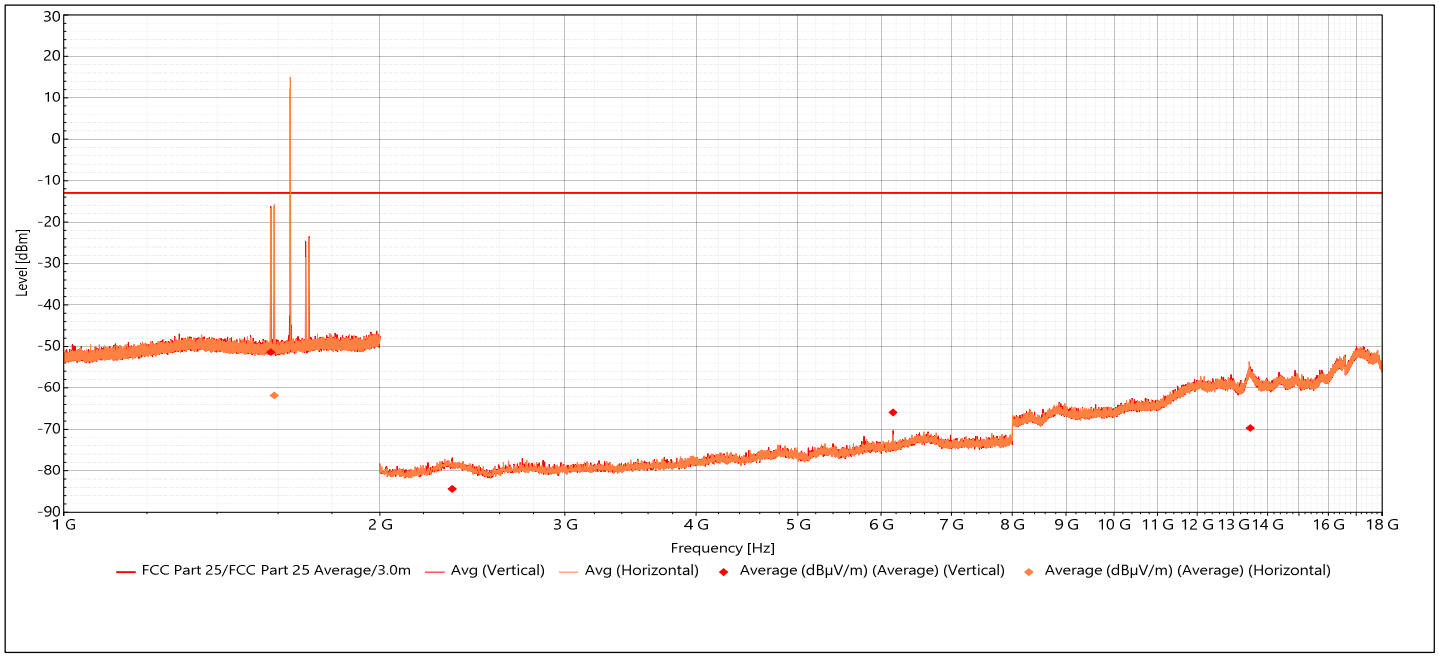
Spurious Emissions 1 - 18GHz - Mid Channel 1643.5MHz

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	10/21/2024	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 (°)	Height (m)	Polarity	Result
1574.944	-51.40	-13.00	-38.40	182.00	2.45	Vertical	Pass
1586.667	-61.82	-13.00	-48.82	108.00	1.78	Horizontal	Pass
2344.000	-84.38	-13.00	-71.38	235.00	3.94	Vertical	Pass
6160.000	-65.95	-13.00	-52.95	0.00	1.00	Vertical	Pass
13480.000	-69.69	-13.00	-56.69	360.00	4.00	Vertical	Pass

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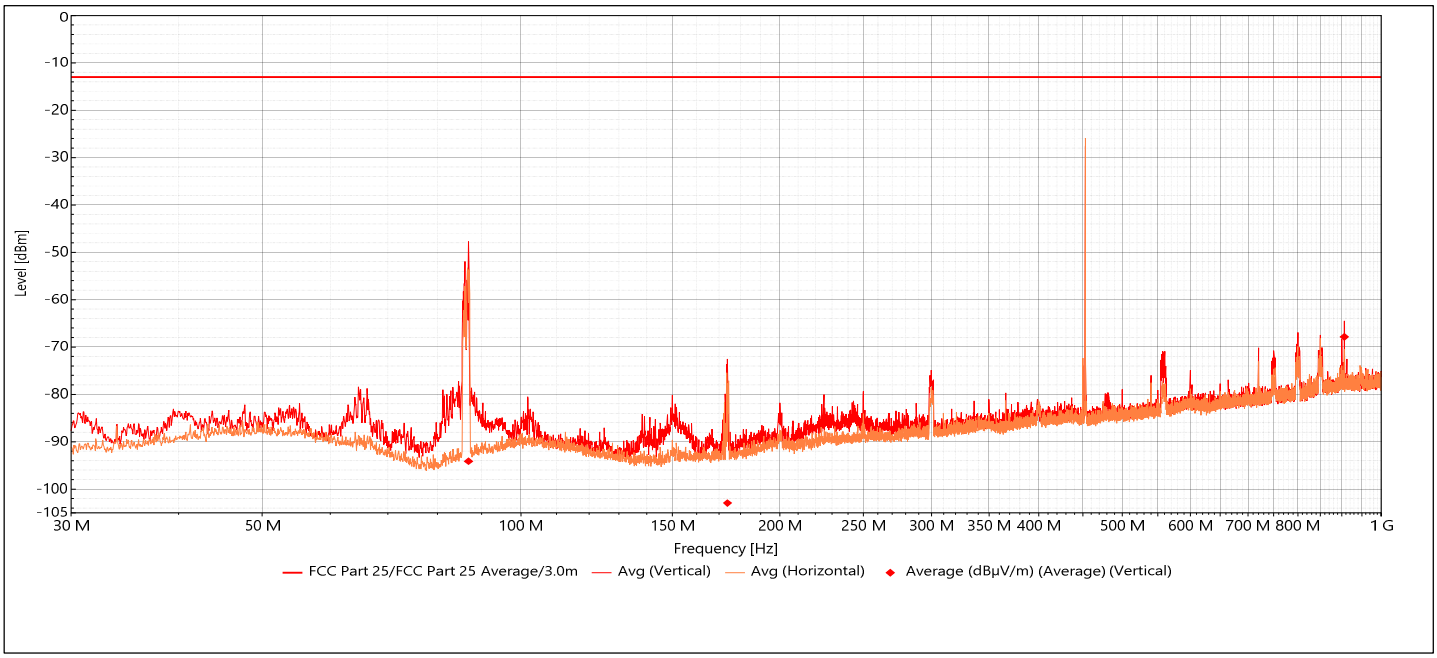
Spurious Emissions 30M-1GHz - High Channel 1660.5MHz

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
86.907	-94.13	-13.00	-81.13	165.00	1.33	Vertical	Pass
173.829	-102.97	-13.00	-89.97	289.00	1.00	Vertical	Pass
906.018	-67.87	-13.00	-54.87	209.00	1.00	Vertical	Pass

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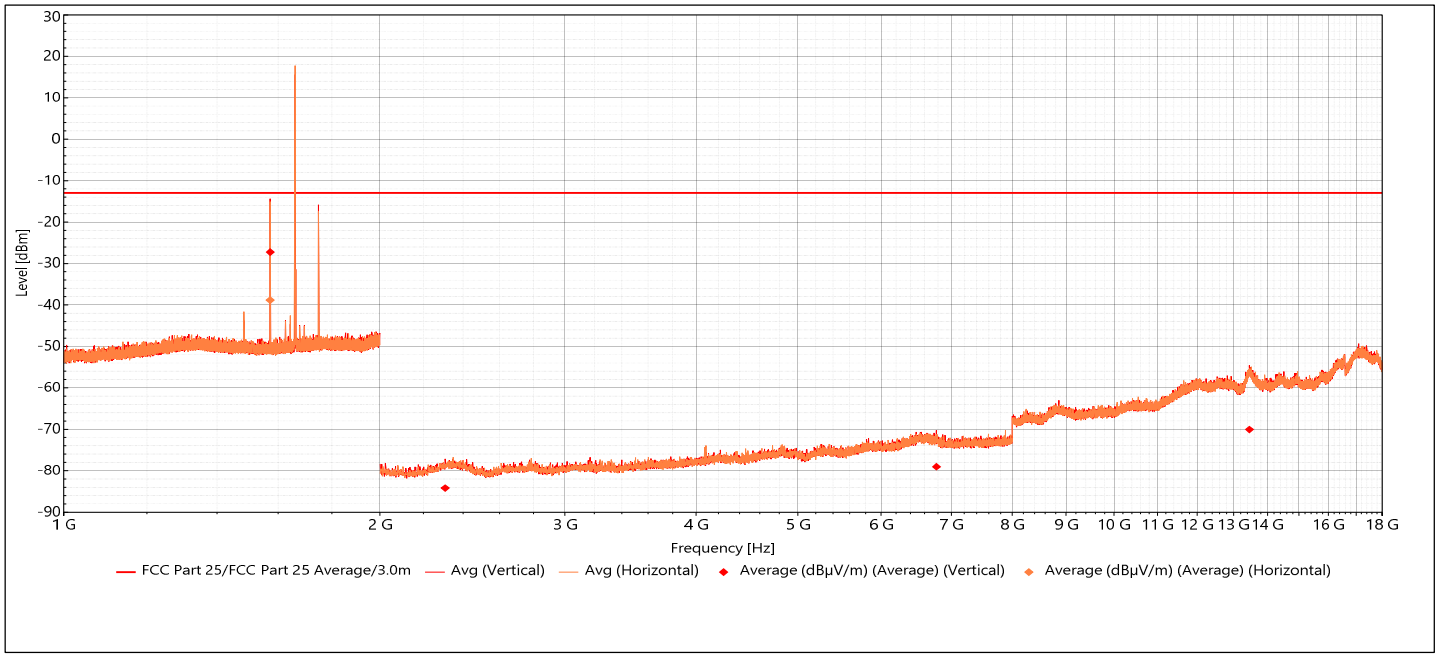
Spurious Emissions 1 - 18GHz - High Channel 1660.5MHz

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	10/21/2024	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
1313.722	-60.53	-13.00	-47.53	69.00	2.21	Horizontal	Pass
3241.778	-84.46	-13.00	-71.46	0.00	1.00	Horizontal	Pass
4981.333	-81.82	-13.00	-68.82	0.00	3.94	Horizontal	Pass
8302.222	-77.09	-13.00	-64.09	0.00	3.94	Horizontal	Pass
11623.111	-72.21	-13.00	-59.21	360.00	4.00	Horizontal	Pass
17183.111	-62.24	-13.00	-49.24	235.00	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

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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

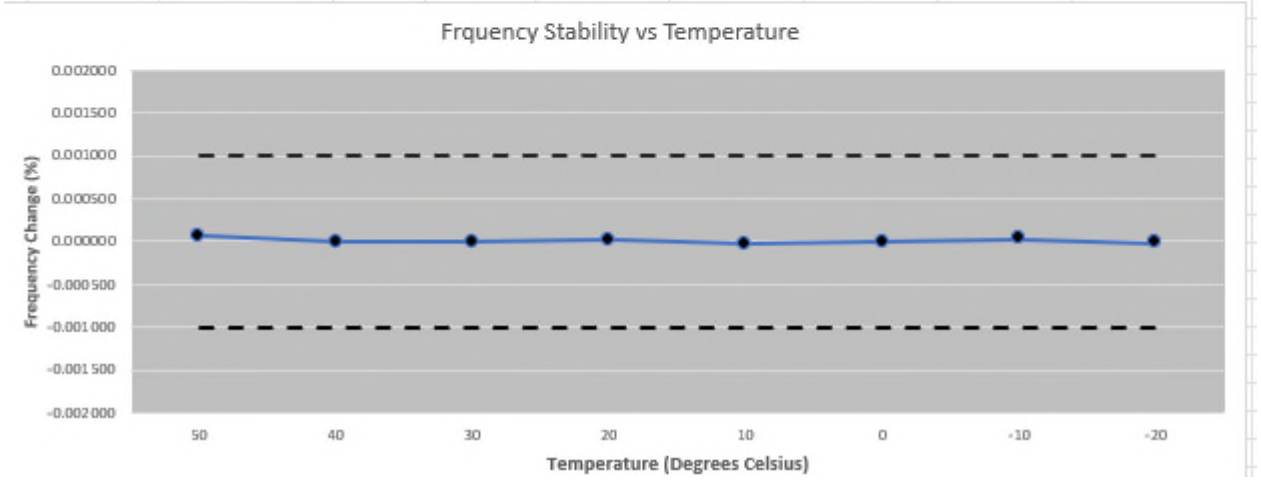
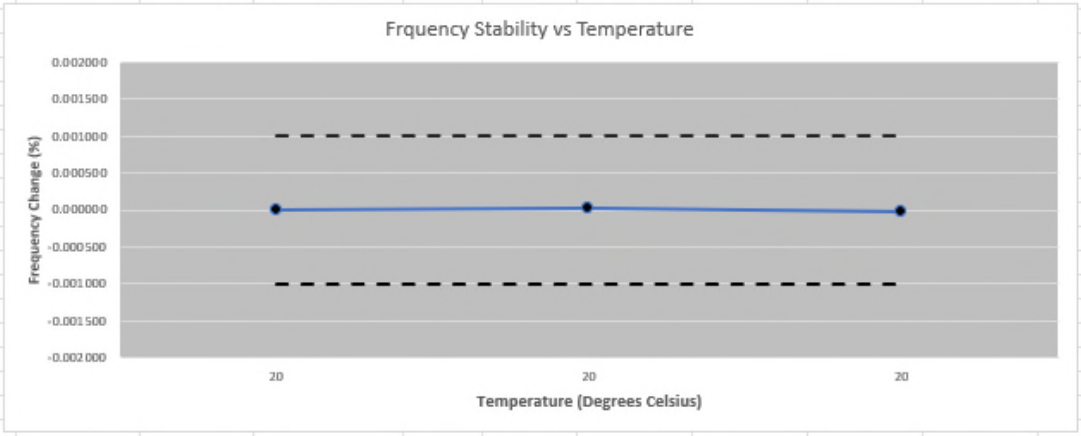


Figure 2.6.6-1: Frequency Stability at Various Temperatures – Low Channel

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

Voltage	Vdc	Degrees C	Frequency (MHz)	ppm	Percentage (%)	ppm upper lim	ppm 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

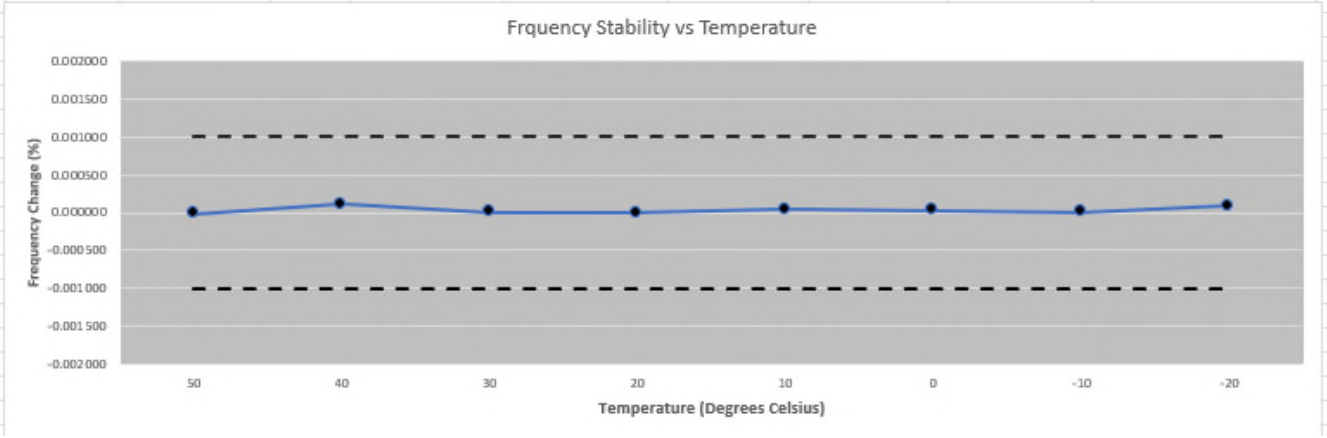

Figure 2.6.6-3: Frequency Stability at Various Temperatures – Mid Channel

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

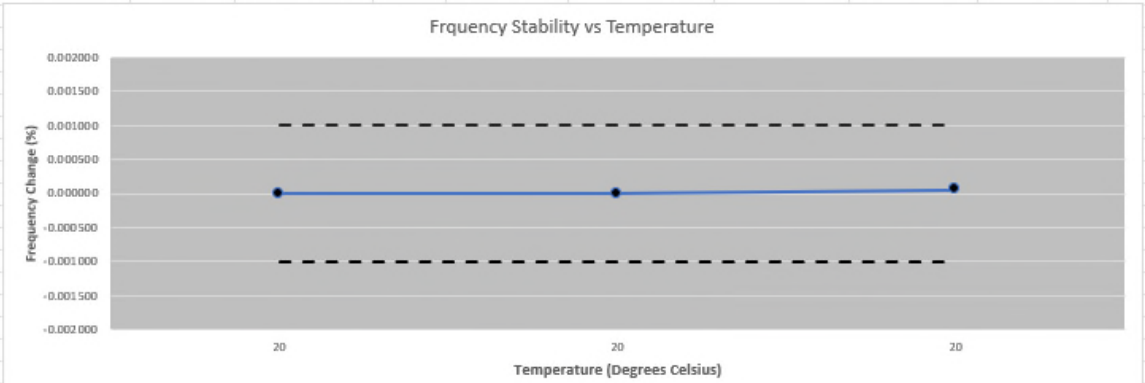

Figure 2.6.6-4: Frequency Stability at Extreme Voltages – Mid Channel

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

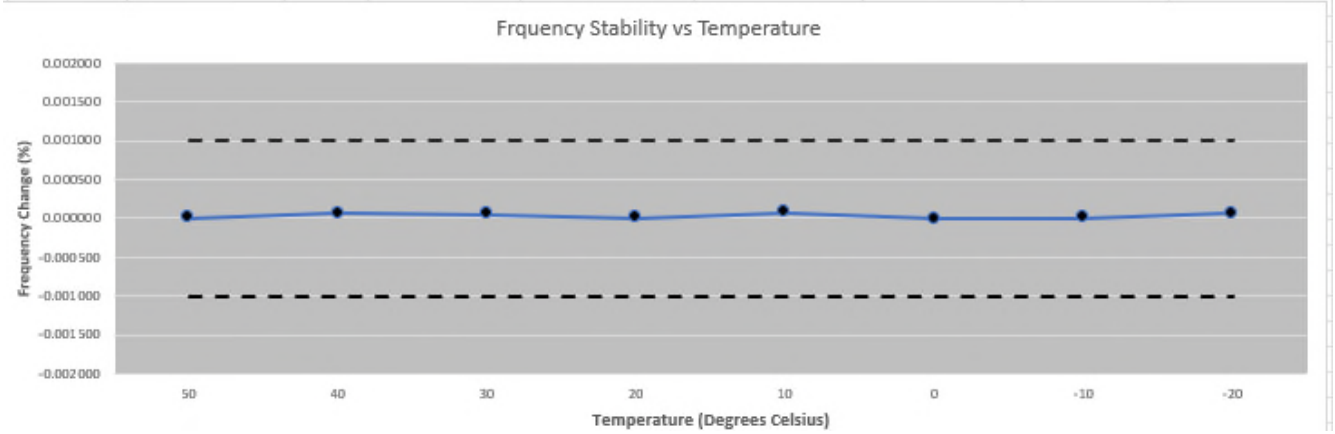

Figure 2.6.6-5: Frequency Stability at Various Temperatures – High Channel

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

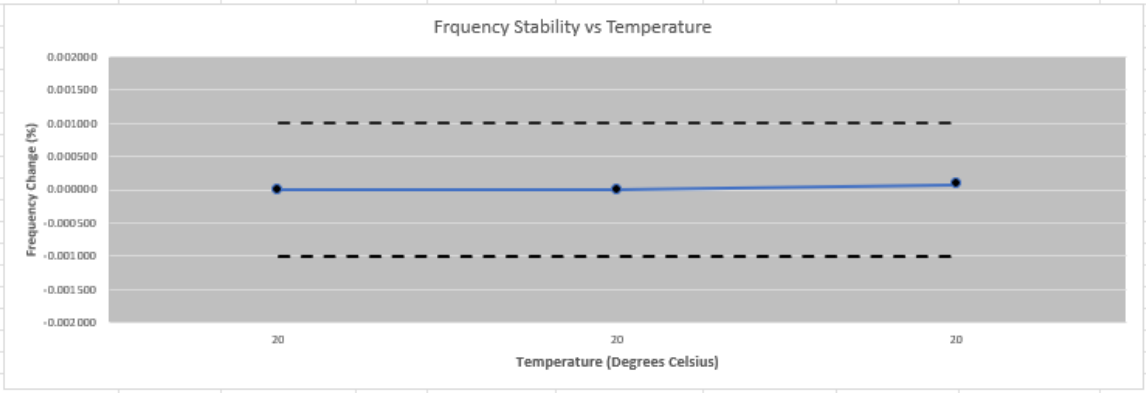

Figure 2.6.6-6: Frequency Stability at Extreme Voltages – High Channel

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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.

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.

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Test Result: Pass

See data below for detailed results.

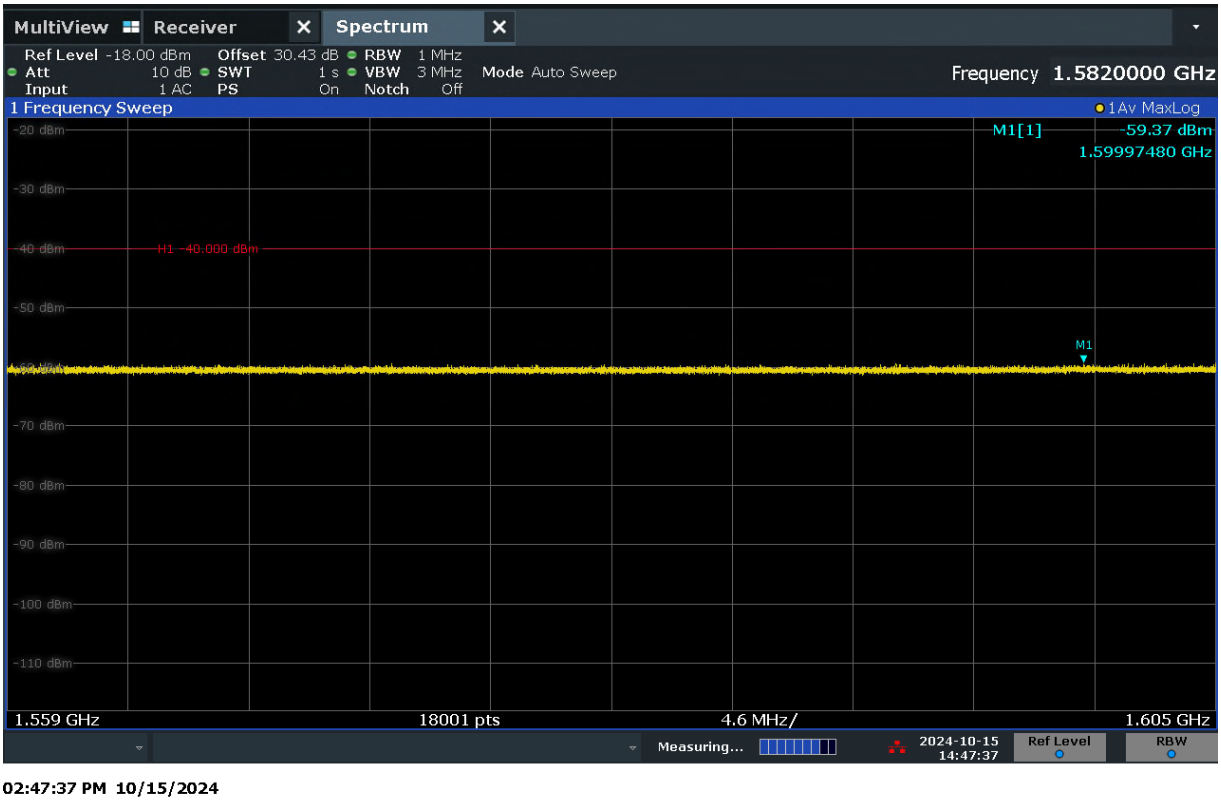

Figure 2-19 – FCC 25.216(c) – Low Channel

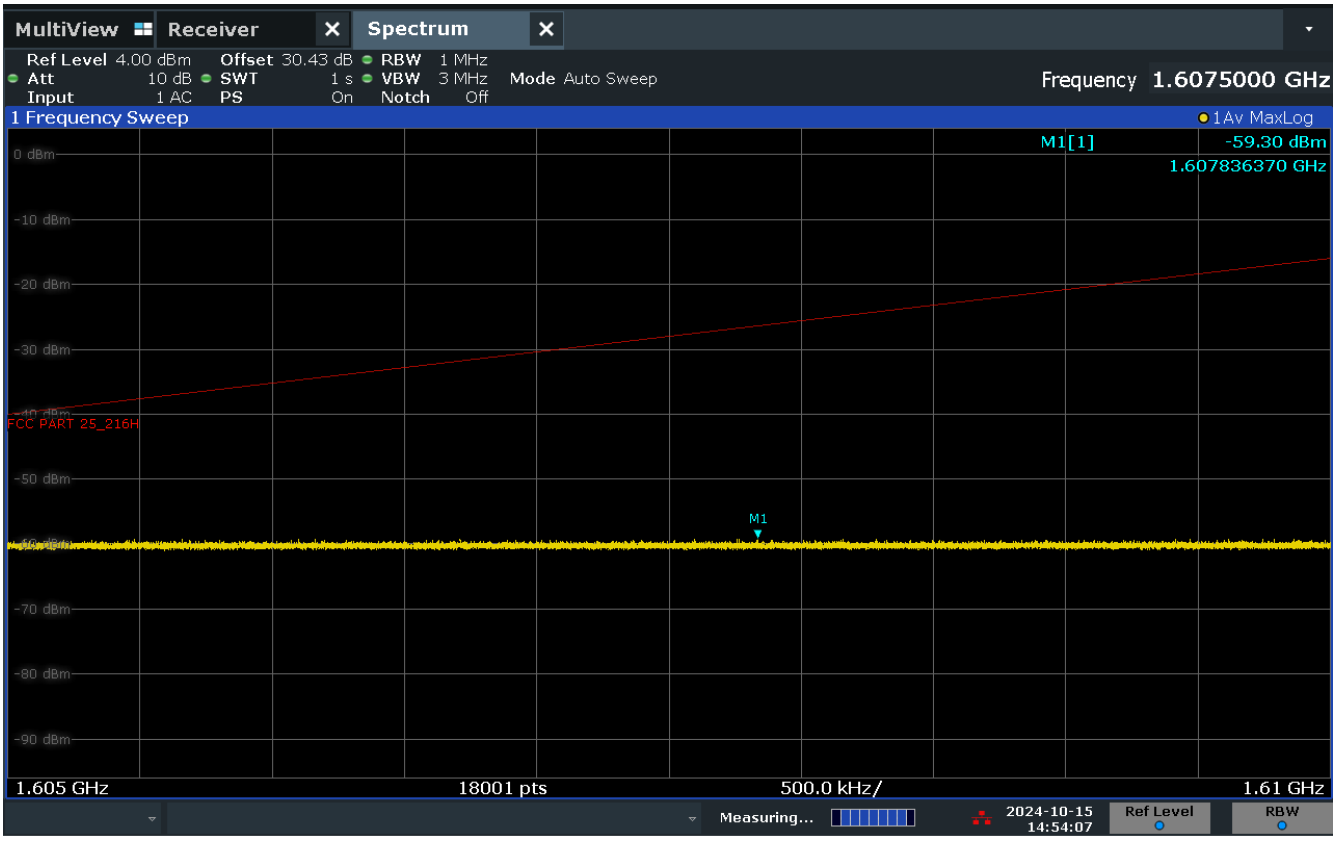

Figure 2-20 – FCC 25.216(h) – Low Channel

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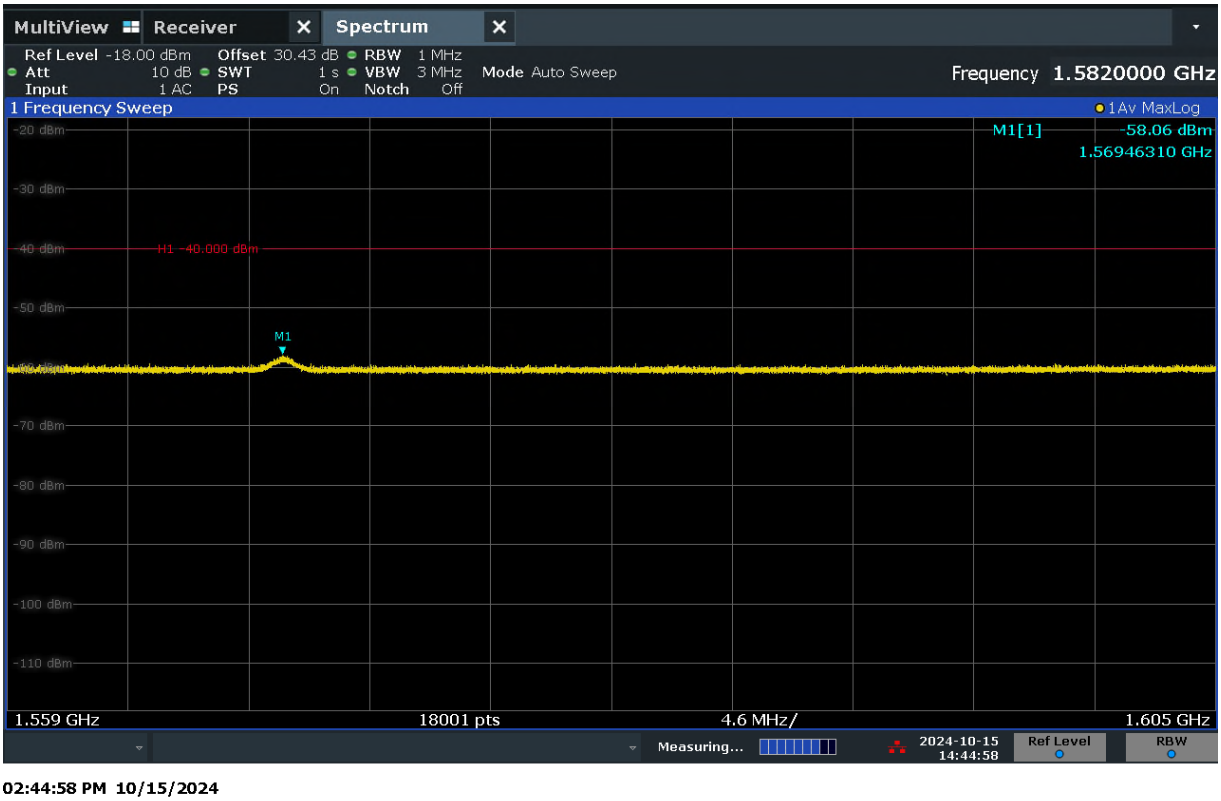


Figure 2-21 – FCC 25.216(c) – Mid Channel

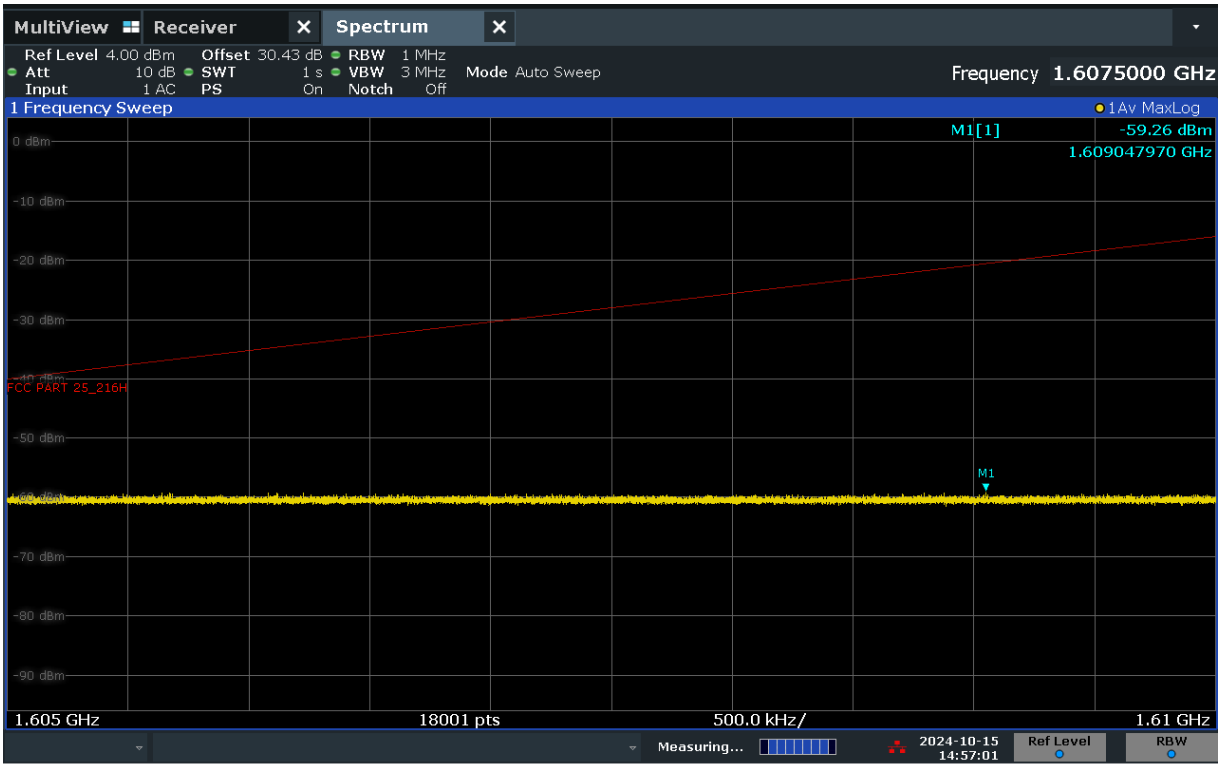


Figure 2-22 – FCC 25.216(h) – Mid Channel

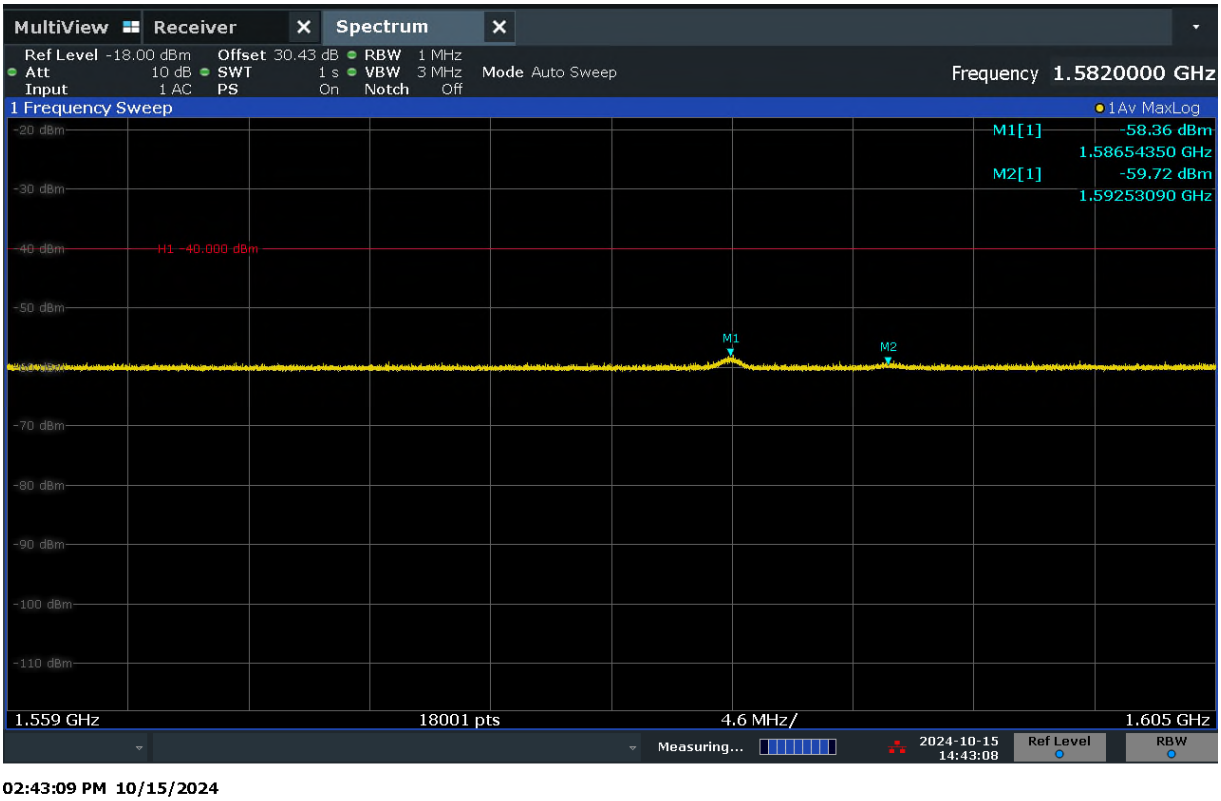


Figure 2-23 – FCC 25.216(c) – High Channel

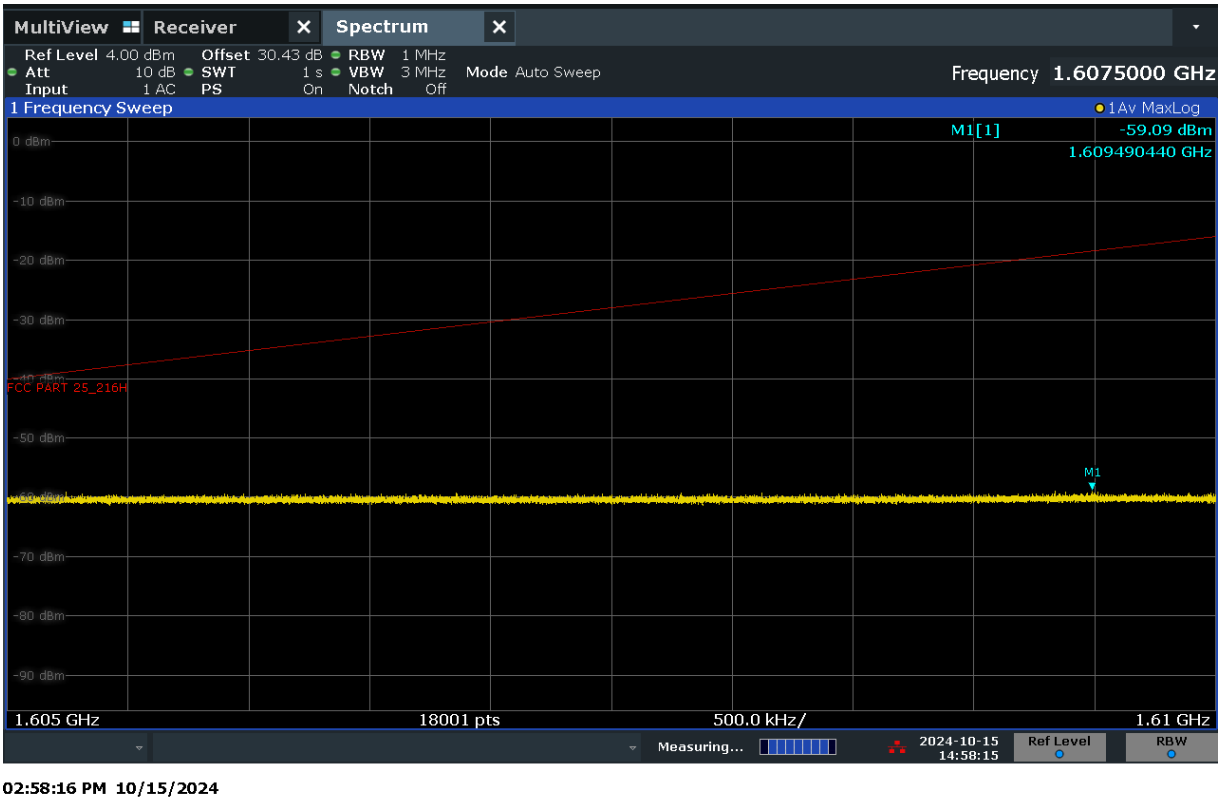
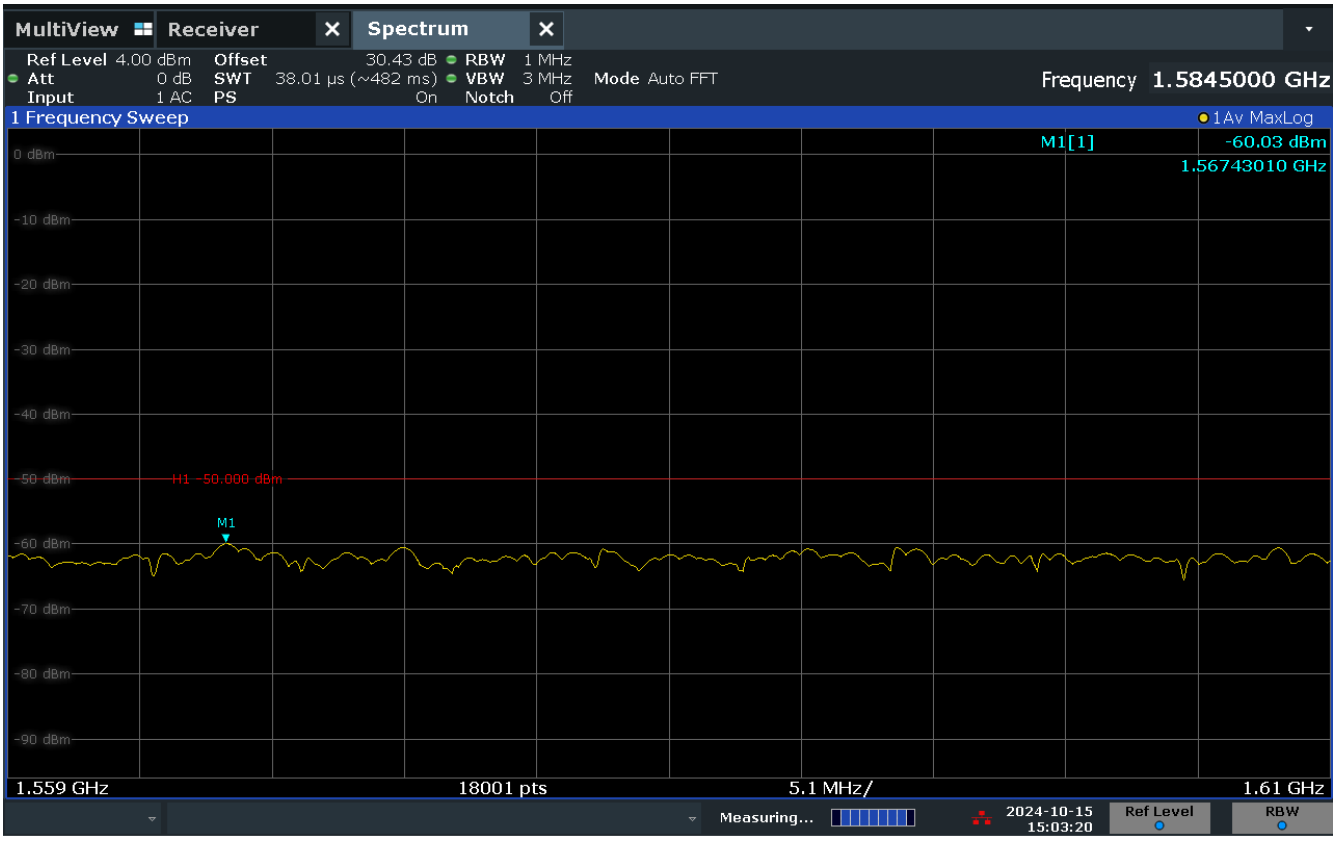


Figure 2-24 – FCC 25.216(h) – High Channel



03:03:21 PM 10/15/2024

Figure 2-25 – FCC 25.216(i)

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

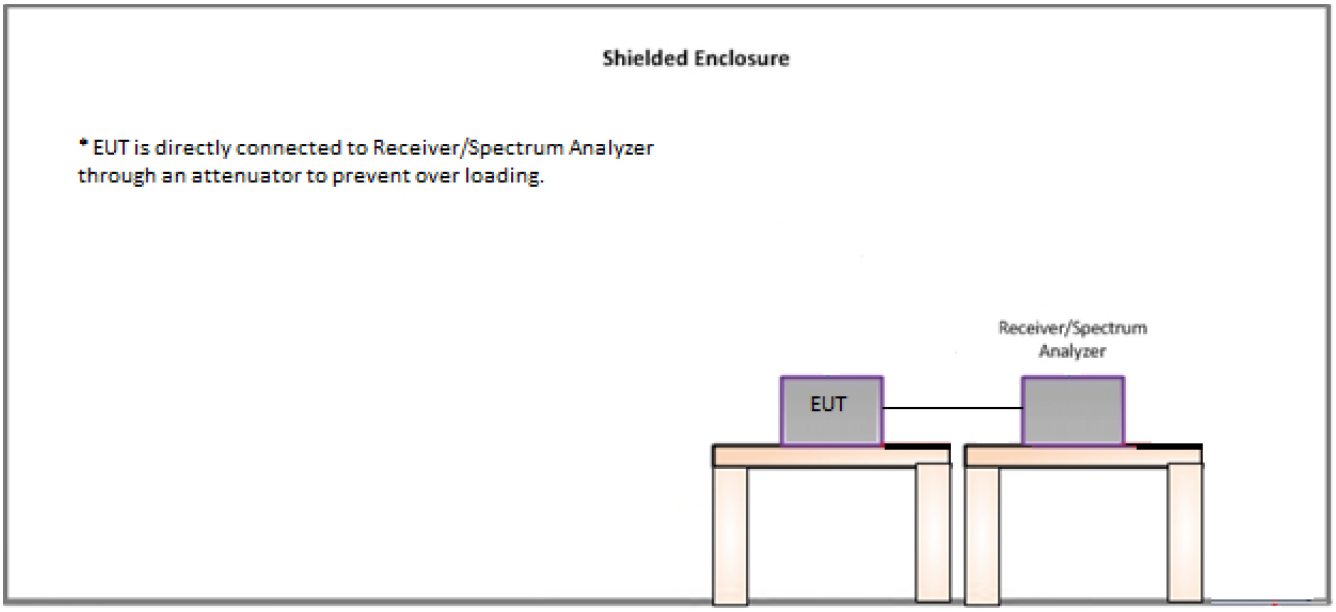

Figure 3-1 – Conducted Test Setup

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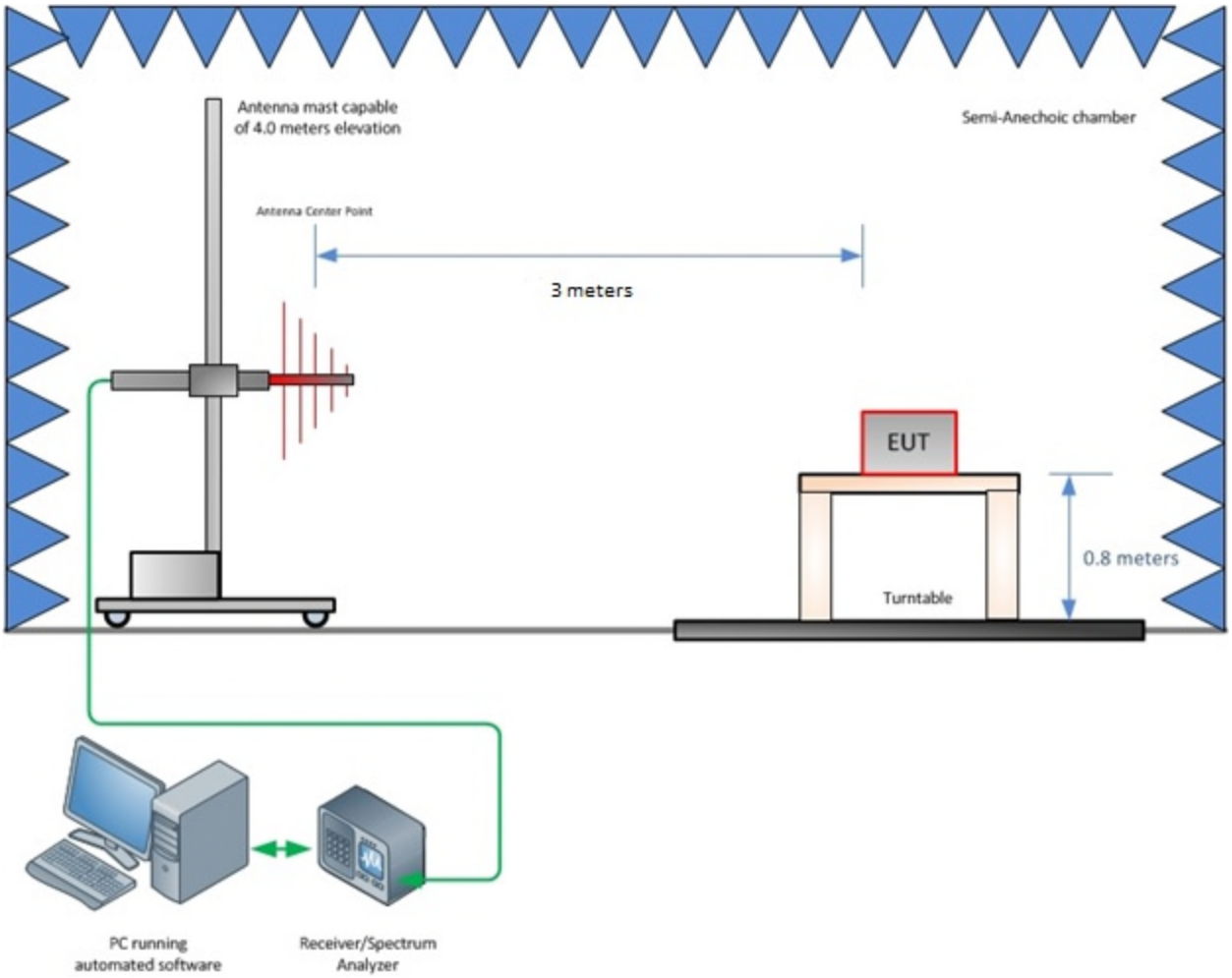

Figure 3-2 – Radiated Emissions Test Setup up to 1 GHz

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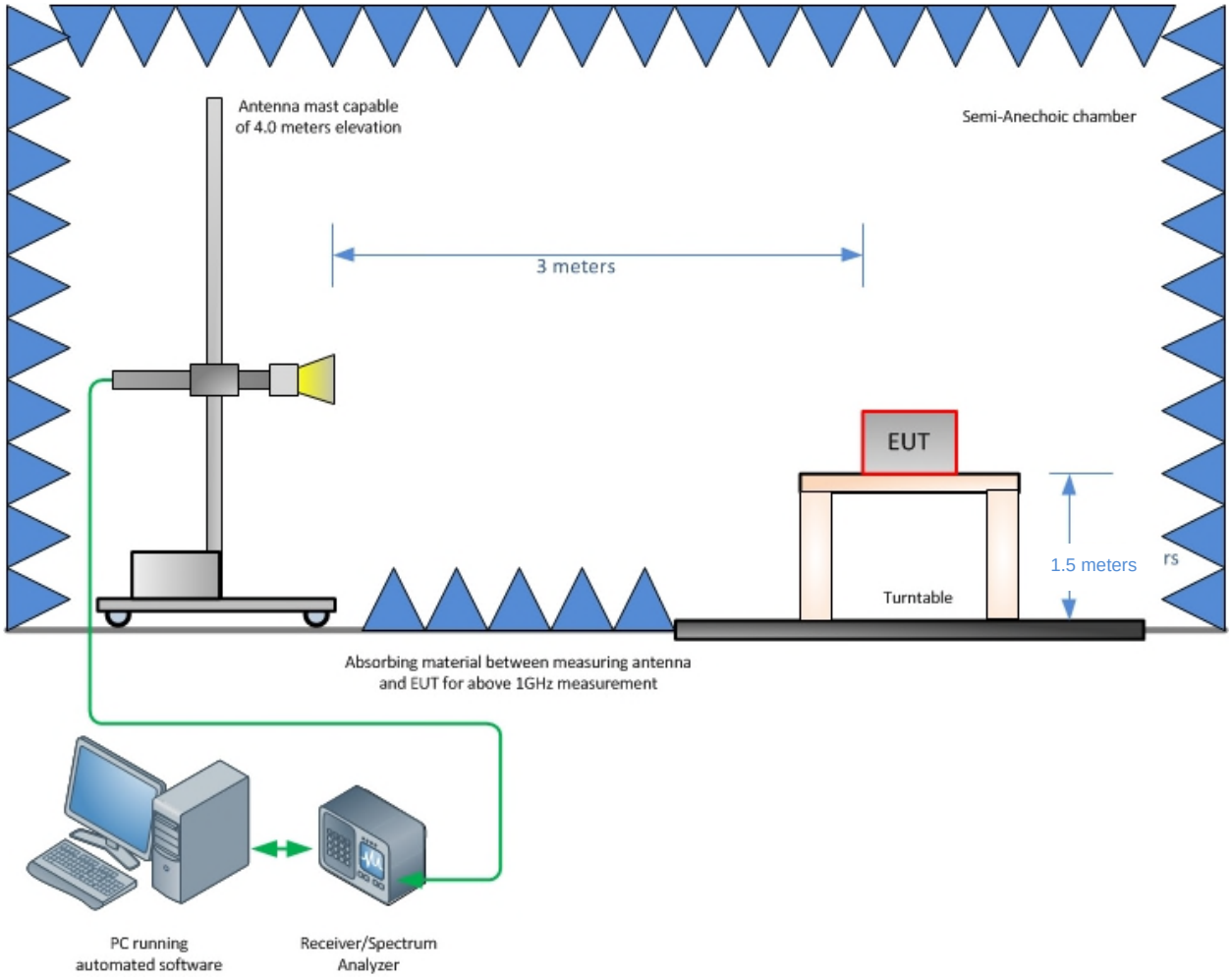

Figure 3-3 – Radiated Emissions Test Setup above 1 GHz

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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