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5/20/2025

Tractian Technologies Inc.
201 17th Street NW 2nd Floor – Tractian
Atlanta, GA 30363
USA

Dear Jorge Sousa,

Enclosed is the EMC Wireless test report for compliance testing of the Tractian Technologies Inc. Omni Receiver as tested to the requirements of FCC Part 15.247 for Intentional Radiators. This test report pertains specifically to the 915MHz ISM transmitter onboard which operates in the 902MHz – 928MHz band.

Thank you for using the services of Eurofins MET Labs. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
EUROFINS MET LABS

Nancy LaBrecque
Documentation Department

Reference: WIRA135063 - FCC15.247_R1

915MHz ISM Test Report

for the

Tractian Technologies Inc.
Omni Receiver

Tested under
FCC Part 15.247
For Intentional Radiators

Bryan Taylor, Wireless Team Lead
Electromagnetic Compatibility Lab

Nancy LaBrecque
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Part 15.247 under normal use and maintenance.

Matthew Hinojosa
EMC Manager, Austin Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	4/8/2025	Initial Issue.
1	5/20/2025	Addressing TCB reviewer comments

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**er**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**er**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**microh**enry
µ	**microf**arad
µs	**micros**econds
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Omni Receiver, with the requirements of FCC Part 15.247. Tractian Technologies Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Omni Receiver, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 15.247, in accordance with Tractian Technologies Inc. purchase order number 1009. All tests were conducted using measurement procedures ANSI C63.4-2014 and ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.247:2005	Description	Compliance
Title 47 of the CFR, Part 15 §15.203	Antenna Requirement	**Compliant**
Title 47 of the CFR, Part 15 §15.207(a)	Conducted Emission Limits	**Compliant**
Title 47 of the CFR, Part 15 §15.247(a)(2)	6dB Occupied Bandwidth	**Compliant**
Title 47 of the CFR, Part 15 §15.247(a)(2)	99% Occupied Bandwidth	**Compliant**
Title 47 of the CFR, Part 15 §15.247(b)	Peak Power Output	**Compliant**
Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205	Radiated Spurious Emissions Requirements	**Compliant**
Title 47 of the CFR, Part 15 §15.247(d)	RF Conducted Spurious Emissions Requirements	**Compliant**
Title 47 of the CFR, Part 15; §15.247(e)	Peak Power Spectral Density	**Compliant**

Table 1. Executive Summary

II. Equipment Configuration

A. Overview

Eurofins MET Labs was contracted by Tractian Technologies Inc. to perform testing on the Omni Receiver, under Tractian Technologies Inc.'s purchase order number 1009.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Omni Receiver.

The results obtained relate only to the item(s) tested.

Product Name:	Omni Receiver	
Model(s) Tested:	Omni Receiver	
Serial Number or Sample Number:	25296-1, 25296-2	
FCCID:	2BCIS-OMNIREC	
EUT Specifications:	Primary Power: 10 – 30VDC	
	Type of Modulations:	O-QPSK
	Equipment Code:	DTS
	Peak RF Output Power:	19.63dBm
	EUT Frequency Ranges:	905MHz – 923MHz
	Antenna Gain[1]:	2.1dBi
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35° C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Bryan Taylor	
Report Date(s):	5/20/2025	

Table 2. EUT Summary Table

[1] The antenna gain information was provided by Tractian Technologies Inc. and may affect compliance.

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

Table 3. References

C. Test Site

All testing was performed at Eurofins MET Labs, 13501 McCallen Pass, Austin, TX 78753. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

FCC Lab Info:
Designation Number: US1127

D. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
Occupied Bandwidth Measurements	±4.52 Hz	2	95%
Conducted Power Measurements	±2.74 dB	2	95%
Power Spectral Density Measurements	±2.74 dB	2	95%
Conducted Spurious Emissions	±2.80 dB	2	95%
Conducted Emissions (Mains)	±2.97 dB	2	95%
Radiated Spurious Emissions (9kHz – 1GHz)	±2.95 dB	2	95%
Radiated Spurious Emissions (1GHz - 40GHz)	±3.54 dB	2	95%

Table 4. Uncertainty Calculations Summary

E. Description of Test Sample

The Omni Receiver is a Gateway that collects data from Tractian's IOT sensors and sent to the Tractian platform using LTE networks or Wi-Fi. The LTE and WiFi radios are preapproved modules (FCCID: 2AJYU-8PYA008, ICID: 23761-8PYA009 and FCCID: 2AC7Z-ESP32WROVERE, ICID: 21098-ESPWROVERE).

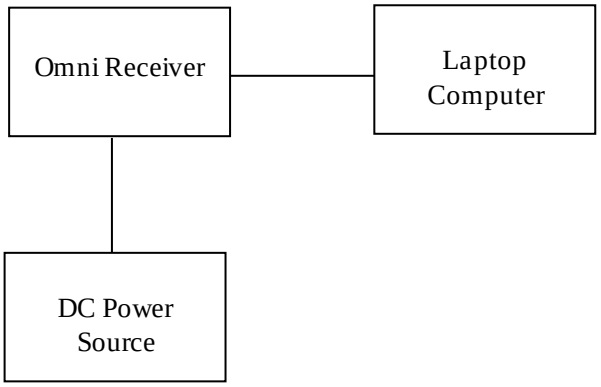


Figure 1. Block Diagram of Test Configuration

F. Equipment Configuration

The EUT was set up as outlined in Figure 1 above. The laptop computer was used to send test commands to force the transmitters to operate in the appropriate test mode.

G. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number	Customer Supplied Calibration Data
None	Laptop Computer	Lenovo	ThinkPad	None

Table 5. Support Equipment

H. Ports and Cabling Information

Port Name on EUT	Qty	Length as tested (m)	Shielded? (Y/N)	Termination Box ID & Port Name
DC Power Cable	1	2m	None	DC Power Source

Table 6. Ports and Cabling Information

I. Mode of Operation

User controlled Software (CoolTerm Version 2.1.1) is provided to enable the EUT to achieve 100% duty cycle during EMC testing on low, mid, and high channels. The support laptop provided a direct means of controlling transmitter parameters. Unless otherwise stated or shown, all tests were performed at worst-case modulation and data rates on the following channels.

Transmit Band	Modulation	Channel Frequencies Tested	Test Tool Power Setting[2]
902 – 928MHz	O-QPSK	905MHz / 915MHz / 923MHz	Product Default (20dBm)

Table 7. Test Channels Utilized

J. Method of Monitoring EUT Operation

A spectrum analyzer was used to confirm proper transmitter operation.

K. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

L. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Tractian Technologies Inc. upon completion of testing.

[2] Note, the test tool power setting does not necessarily correspond to a power in dBm or Watts.

III. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results: The EUT as tested is compliant the criteria of §15.203. The TX antenna is permanently attached to the unit.

Test Engineer(s): Bryan Taylor

Test Date(s): 2/27/2025

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted Emissions Limits

Test Requirement(s): **§ 15.207 (a):** For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (dBμV)	
	Quasi-Peak	Average
0.15-0.5	66 - 56	56 - 46
0.5-5	56	46
5-30	60	50

Table 8. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

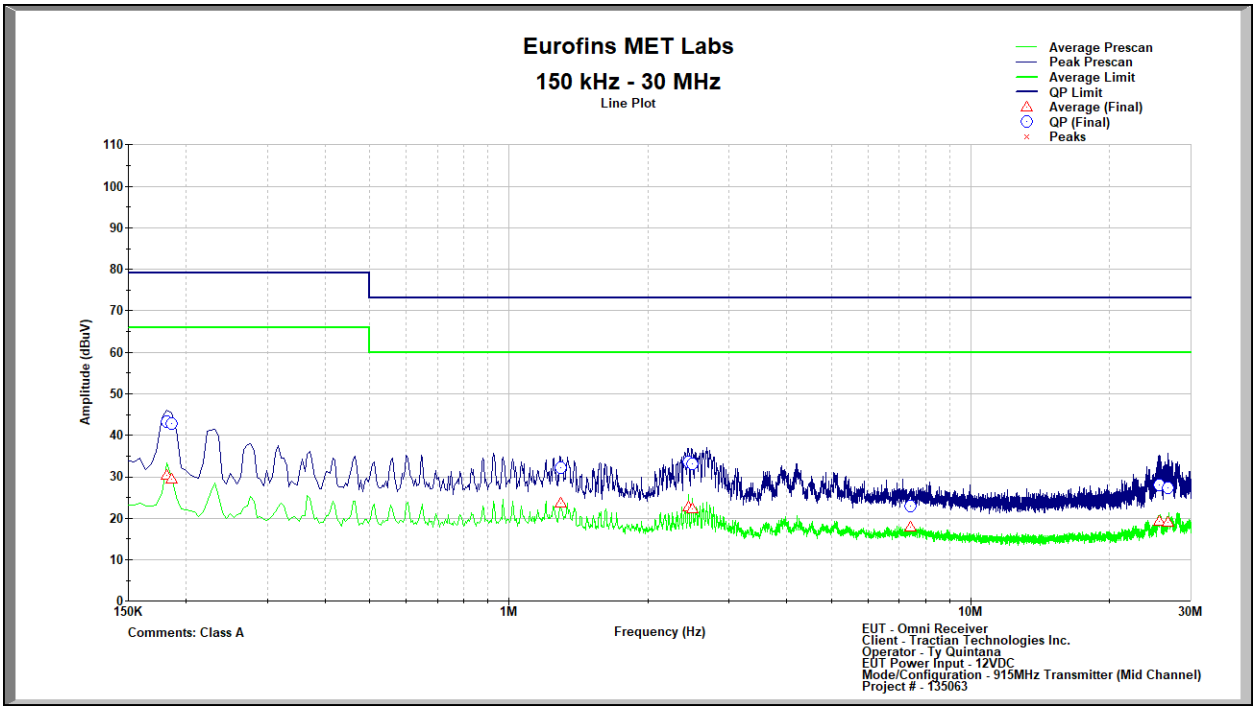
Test Procedure: The EUT was placed on a 0.8 m-high wooden table. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-2014 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed using a 50 Ω/50 μH LISN as the input transducer to an EMI receiver. For the purpose of this testing, the transmitter was turned on.

Test Results: The EUT was compliant with this requirement. During these tests the Omni Receiver was connected to a D2-PS-120 AC/DC power adapter.

Test Engineer(s): Ty Quintana

Test Date(s): 3/4/2025

15.207(a) Conducted Emissions Test Results

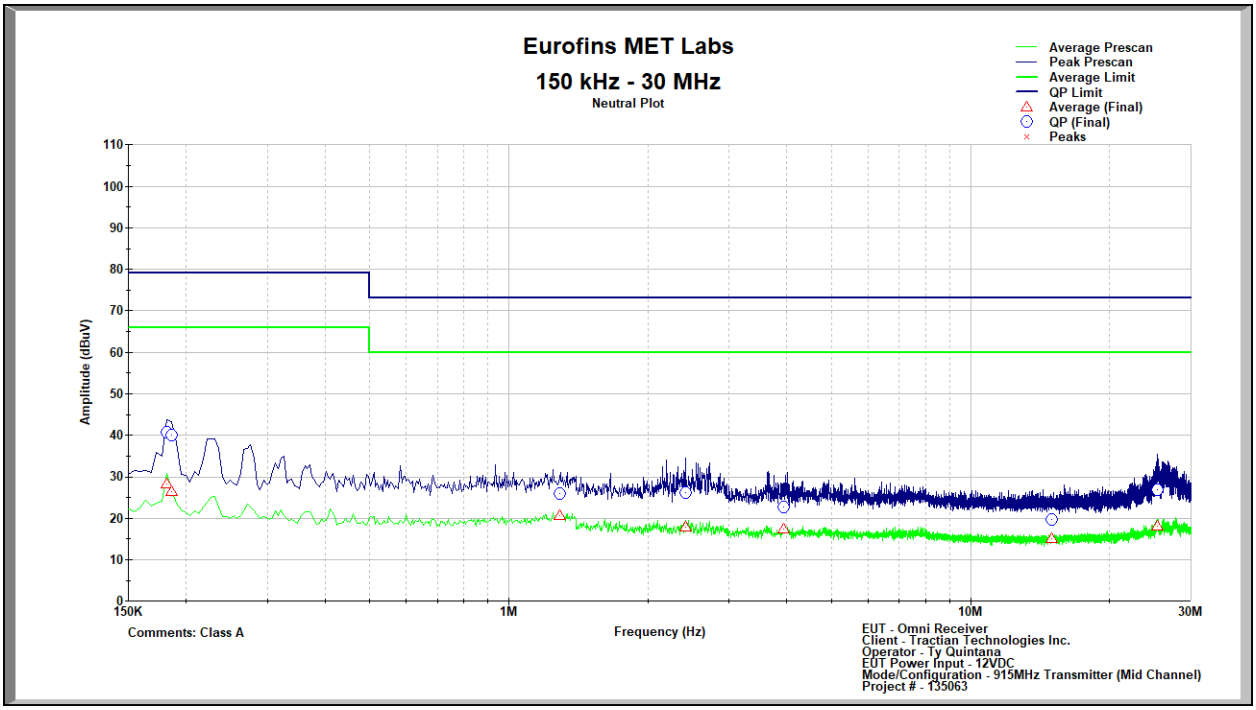


Conducted Emissions, 15.207(a), Phase

Frequency (MHz)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Margin (dB)	Average (dBµV/m)	Average Limit (dBµV/m)	Average Margin (dB)
0.181	43.277	79.000	35.723	30.413	66.000	35.587
0.186	42.764	79.000	36.236	29.343	66.000	36.657
1.293	32.222	73.000	40.778	23.725	60.000	36.275
2.445	33.634	73.000	39.366	22.626	60.000	37.374
2.499	33.008	73.000	39.992	22.201	60.000	37.799
7.407	22.832	73.000	50.168	17.840	60.000	42.160
25.632	28.083	73.000	44.917	19.136	60.000	40.864
26.775	27.220	73.000	45.780	18.958	60.000	41.042

Table 9. Conducted Emissions, 15.207(a), Phase, Test Results

15.207(a) Conducted Emissions Test Results



Conducted Emissions, 15.207(a), Neutral

Frequency (MHz)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Margin (dB)	Average (dBµV/m)	Average Limit (dBµV/m)	Average Margin (dB)
0.181	40.689	79.000	38.311	28.141	66.000	37.859
0.186	40.106	79.000	38.894	26.408	66.000	39.592
1.288	25.919	73.000	47.081	20.730	60.000	39.270
2.413	26.114	73.000	46.886	17.909	60.000	42.091
3.936	22.626	73.000	50.374	17.293	60.000	42.707
14.952	19.634	73.000	53.366	15.020	60.000	44.980
25.398	26.841	73.000	46.159	17.976	60.000	42.024

Table 10. Conducted Emissions, 15.207(a), Neutral, Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(2) 6 dB Bandwidth

Test Requirements: **§ 15.247(a)(2):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Test Procedure: The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% of the total emission bandwidth, and the VBW > RBW. The 6 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

Test Results The EUT was compliant with § 15.247 (a)(2).

The 6 dB Bandwidth was determined from the plots on the following pages. The 99% bandwidth is also reported.

Test Engineer(s): Bryan Taylor, Veer Patel

Test Date(s): 2/25/2025, 4/7/2025

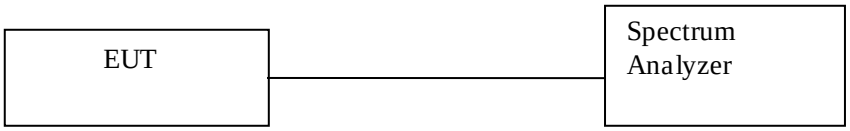
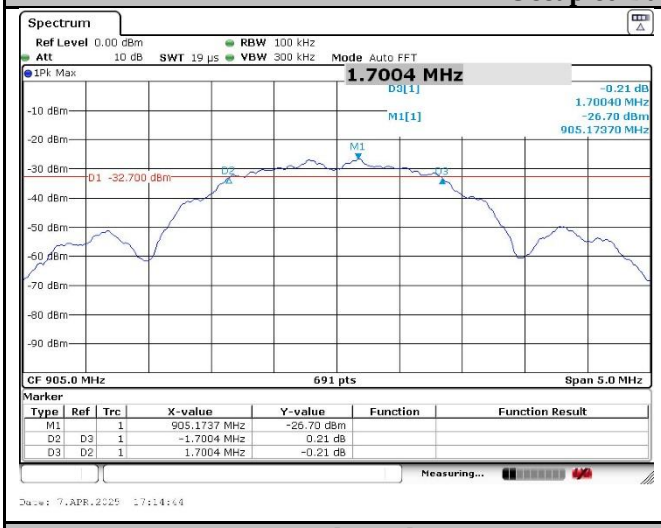


Figure 2. Block Diagram, Occupied Bandwidth Test Setup

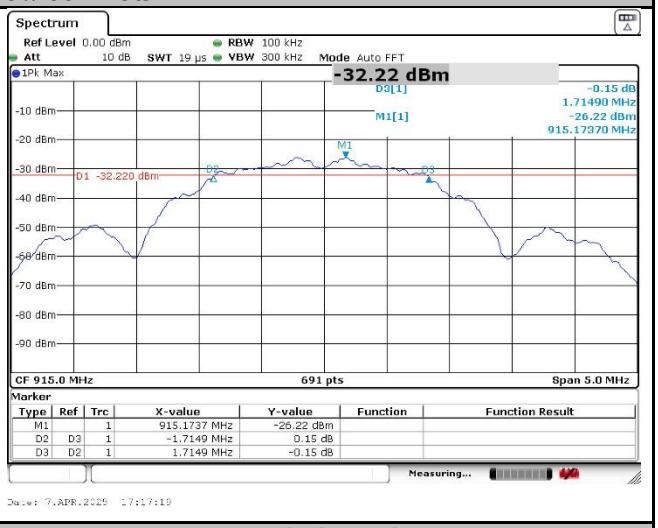
Channel	Frequency (MHz)	6dB Bandwidth (MHz)	6dB Bandwidth Limit (MHz)	99% Bandwidth (MHz)	Result
Low	905MHz	1.700MHz	0.5MHz	2.362MHz	Pass
Middle	915MHz	1.715MHz	0.5MHz	2.361MHz	Pass
High	923MHz	1.664MHz	0.5MHz	2.363MHz	Pass

Table 11. 99% and 6 dB Occupied Bandwidth, Test Results

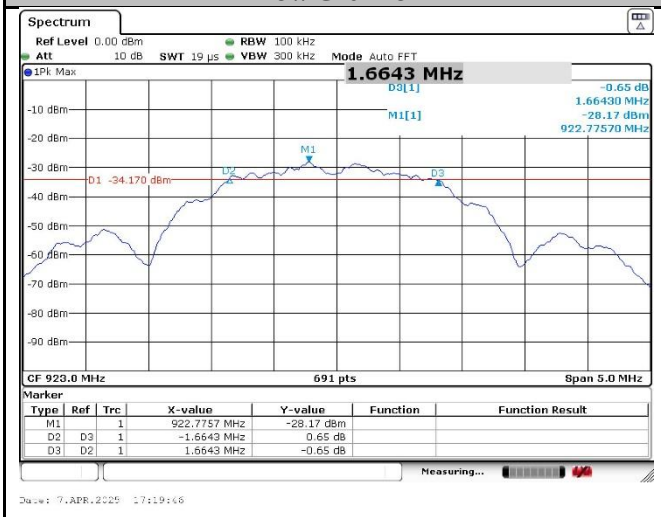
Occupied Bandwidth Plots



Low Channel



Mid Channel



High Channel

Intentionally Blank

Figure 3. 6dB Bandwidth Plots

Occupied Bandwidth Plots

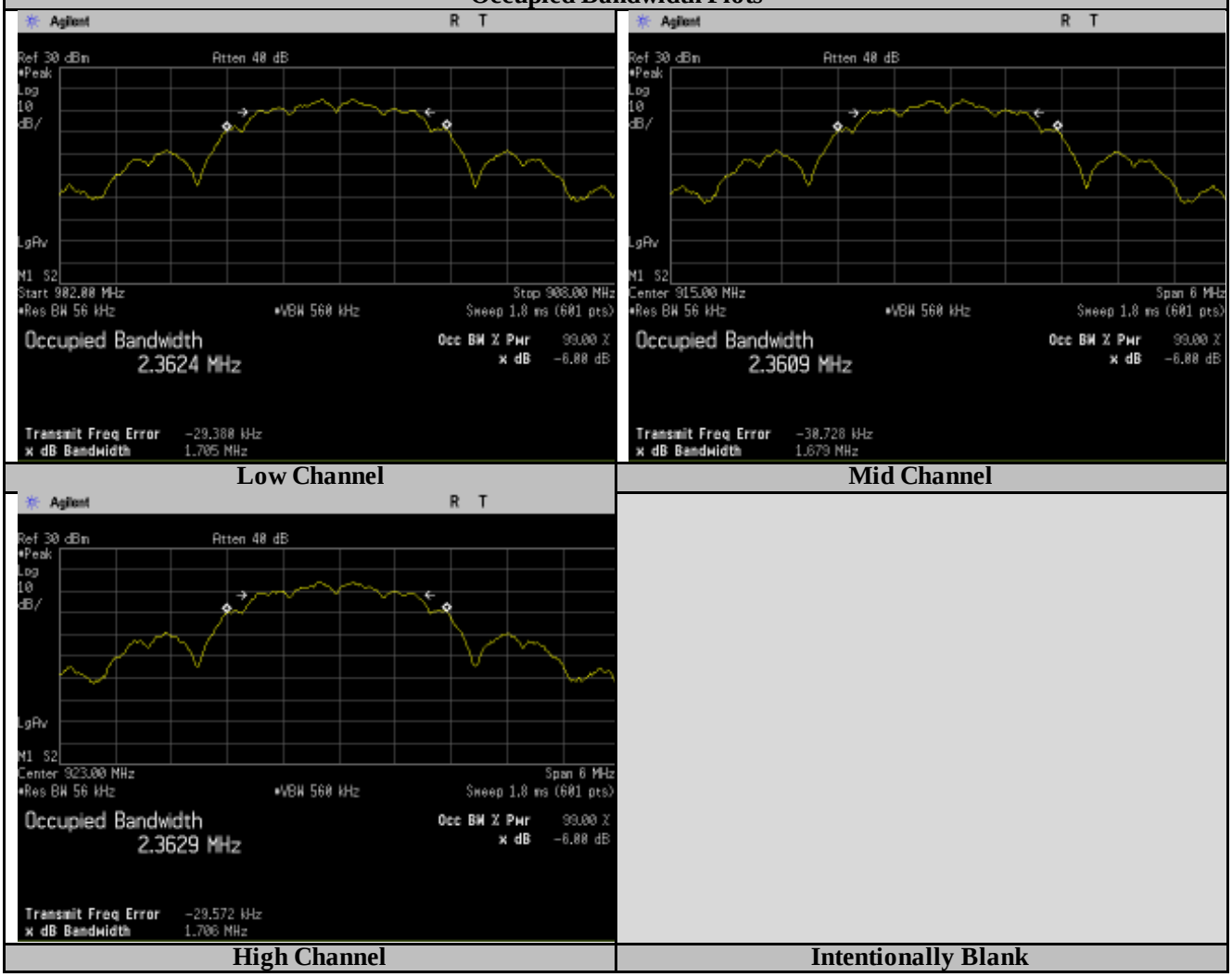


Figure 4. 99% Bandwidth Plots

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

Test Requirements: **§15.247(b):** The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit (Watts)
902-928	1.000
2400–2483.5	1.000
5725– 5850	1.000

Table 12. Output Power Requirements from §15.247(b)

§15.247(c): if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Table 12, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400 – 2483.5 MHz band and using a point to point application may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Fixed, point-to-point operation excludes the use of point-to-multipoint systems, Omni-directional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

Test Procedure: The transmitter was connected to a calibrated spectrum analyzer. The analyzer reference level was offset by cable loss connecting to the test sample. The peak power was measured at the low, mid and high channels of each band at the maximum power level. The antenna gain provided by the manufacturer was added to the measured conducted power to arrive at the EIRP.

The analyzer settings are shown in the following table:

RBW:	3MHz	Detector:	Peak	Reference Level:	30dBm
VBW:	10MHz	Sweep Time:	Auto	Internal Attenuation:	30dB

Figure 5. Analyzer Settings During Measurement

Test Software: TILE Version 7.4.2.5 (Manufactured by ETS Lindgren) was utilized to perform these measurements.

Test Results: The EUT was compliant with the Peak Power Output limits of §15.247(b).

Test Engineer(s): Bryan Taylor

Test Date(s): 2/25/2025

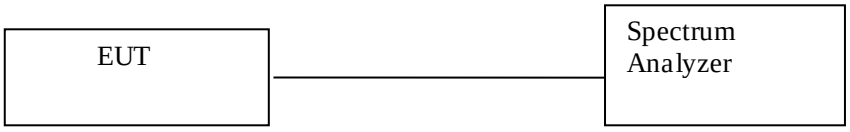


Figure 6. Peak Power Output Test Setup

Peak Power Output Test Results

Channel	Frequency (MHz)	Peak Conducted Power (dBm)	Peak Power Limit (dBm)	Result
Low	905MHz	19.63dBm	30	Pass
Middle	915MHz	19.26dBm	30	Pass
High	923MHz	18.97dBm	30	Pass

Table 13. Peak Power Output, Test Results

Channel	Frequency (MHz)	Peak Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Peak Power Limit (dBm)	Result
Low	905MHz	19.63dBm	2.1	21.73dBm	36	Pass
Middle	915MHz	19.26dBm	2.1	21.36dBm	36	Pass
High	923MHz	18.97dBm	2.1	21.07dBm	36	Pass

Table 14. EIRP, Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Peak Power Spectral Density

Test Requirements: **§15.247(e):** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level. The RBW was set between 3kHz and 100 kHz. The VBW was set to 3x the RBW. The spectrum analyzer was set to an auto sweep time and a peak detector was used. Measurements were carried out at the low, mid and high channels. Measurements were carried out at the low, mid and high channels.

The analyzer settings are shown in the following table:

RBW:	3kHz	Detector:	Peak	Reference Level:	10dBm
VBW:	10kHz	Sweep Time:	Auto	Internal Attenuation:	20dB

Figure 7. Analyzer Settings During Measurement

Test Software: TILE Version 7.4.2.5 (Manufactured by ETS Lindgren) was utilized to perform these measurements.

Test Results: The EUT was compliant with the peak power spectral density limits of § 15.247 (e).

The peak power spectral density was determined from plots on the following page(s).

Test Engineer: Bryan Taylor

Test Date: 2/25/2025

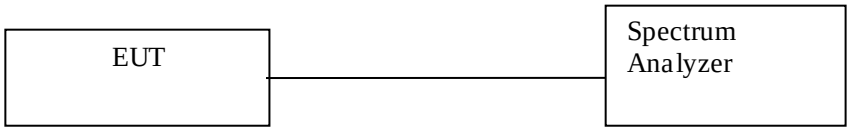


Figure 8. Block Diagram, Peak Power Spectral Density Test Setup

Channel	Frequency (MHz)	Peak Power Spectral Density (dBm / 3kHz)	Peak Power Spectral Density Limit (dBm / 3kHz)	Result
Low	905MHz	2.43dBm	8	Pass
Middle	915MHz	1.60dBm	8	Pass
High	923MHz	1.89dBm	8	Pass

Table 15. Peak Power Spectral Density, Test Results

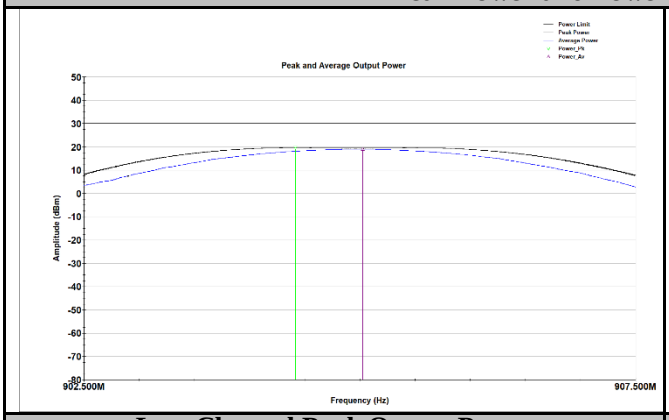
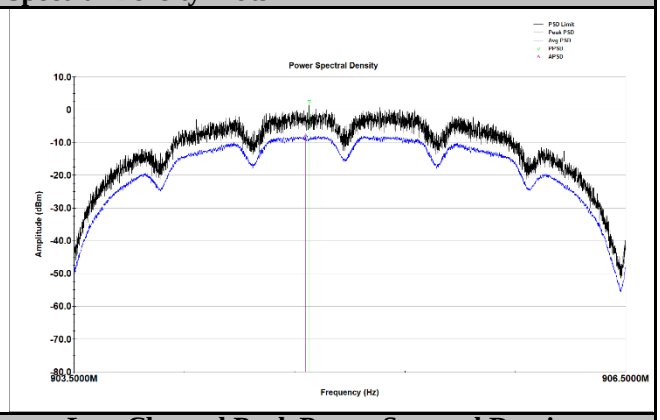
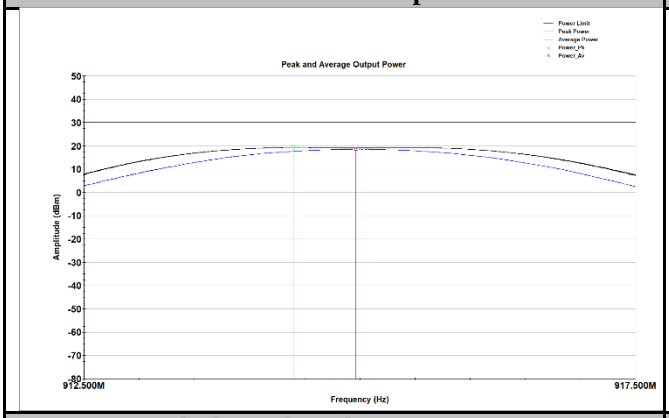
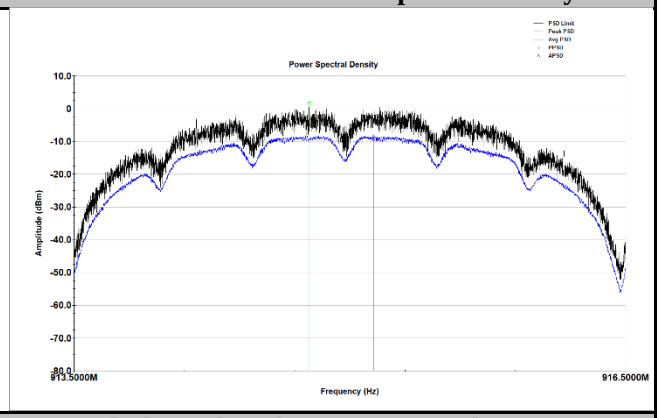
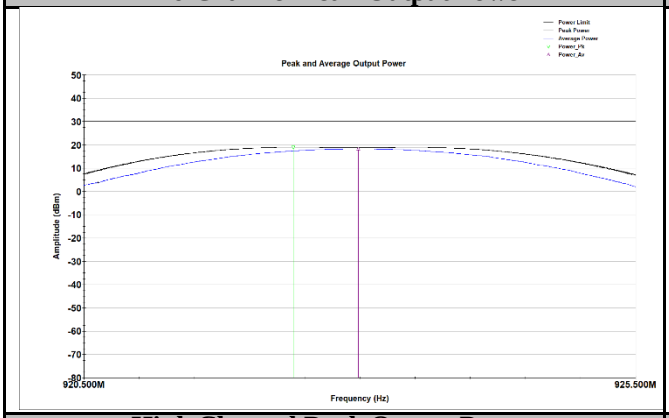
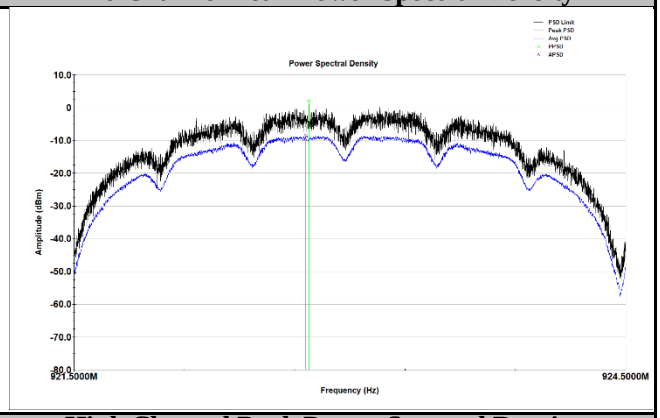
Peak Power and Power Spectral Density Plots	
	
Low Channel Peak Output Power	**Low Channel Peak Power Spectral Density**
	
Mid Channel Peak Output Power	**Mid Channel Peak Power Spectral Density**
	
High Channel Peak Output Power	**High Channel Peak Power Spectral Density**

Figure 9. Peak Power and Power Spectral Density Plots

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) RF Conducted Spurious Emissions Requirements

Test Requirement: **15.247(d)** 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.

Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level. The RBW was set to 100 kHz. The VBW was set to 3x the RBW. The spectrum analyzer was set to an auto sweep time and a peak detector was used. Measurements were carried out at the low, mid and high channels.

See following pages for detailed test results with RF Conducted Spurious Emissions.

The analyzer settings are shown in the following table:

RBW:	100kHz	Detector:	Peak	Reference Level:	30dBm
VBW:	300kHz	Sweep Time:	Auto	Internal Attenuation:	30dB

Figure 10. Analyzer Settings During Measurement

Test Software: TILE Version 7.4.2.5 (Manufactured by ETS Lindgren) was utilized to perform these measurements.

Test Results: The EUT was compliant with the Conducted Spurious Emission limits of §15.247(d).

Test Engineer(s): Bryan Taylor

Test Date(s): 2/26/2025

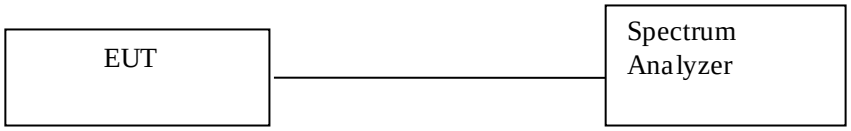


Figure 11. Block Diagram, Conducted Spurious Emissions Test Setup

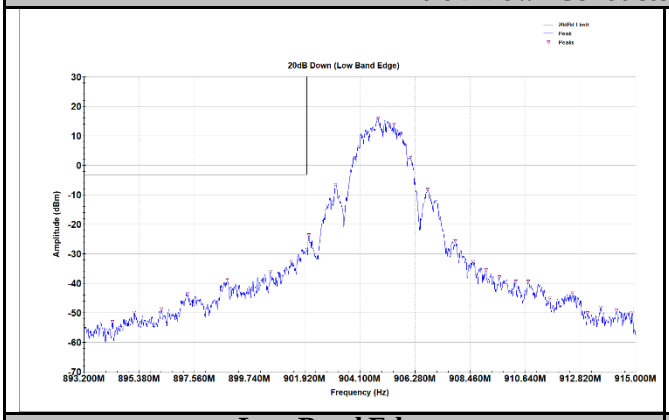
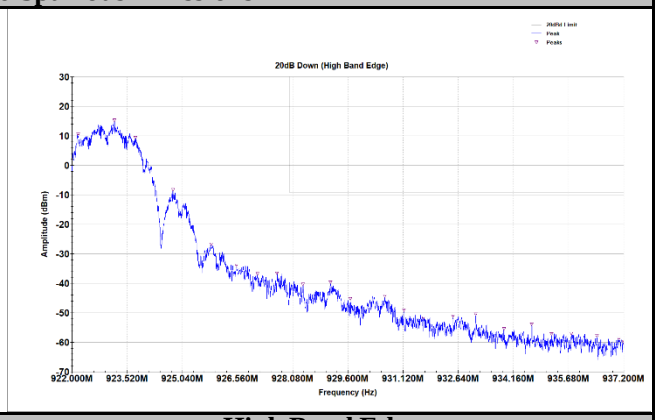
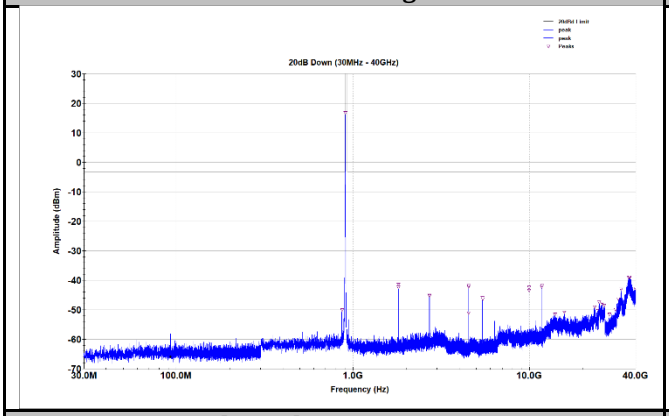
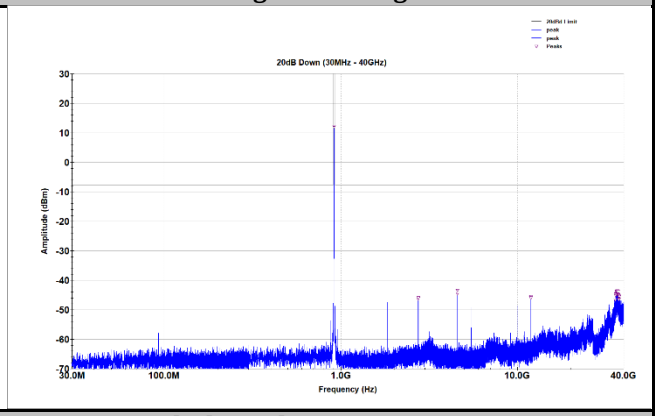
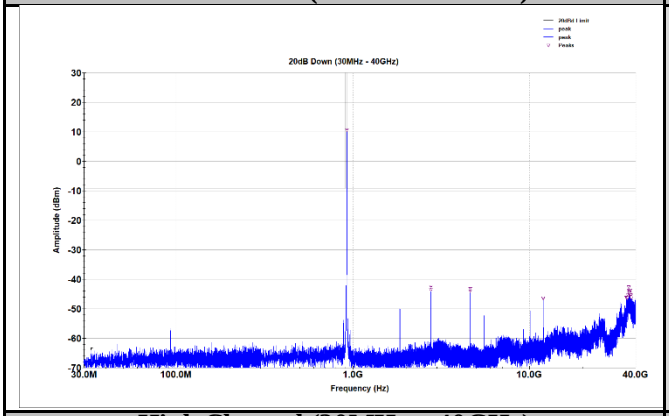
20 dB Down Conducted Spurious Emissions	
	
Low Band Edge	High Band Edge
	
Low Channel (30MHz – 40GHz)	Mid Channel (30MHz – 40GHz)
	
High Channel (30MHz – 40GHz)	Intentionally Blank

Figure 12. 20dB Down Conducted Spurious Emissions

Spurious Frequency (MHz)	Peak Amplitude (dBm)	-20dBd Limit (dBm)	Margin (dB)	Result
894.32	-53.05	-3.21	49.84	Pass
895.187	-49.82	-3.21	46.61	Pass
896.266	-48.59	-3.21	45.38	Pass
897.29	-43.5	-3.21	40.29	Pass
898.857	-38.69	-3.21	35.48	Pass
900.582	-35.9	-3.21	32.69	Pass
901.394	-32.58	-3.21	29.37	Pass

Figure 13. Low Channel 20dB Down Emissions, Low Band Edge

Spurious Frequency (MHz)	Peak Amplitude (dBm)	-20dBd Limit (dBm)	Margin (dB)	Result
928.365	-40.34	-9.36	30.98	Pass
929.123	-39.63	-9.36	30.27	Pass
929.668	-45.15	-9.36	35.79	Pass
930.615	-44.32	-9.36	34.96	Pass
931.143	-49.01	-9.36	39.65	Pass
931.681	-51.63	-9.36	42.27	Pass
932.496	-51.12	-9.36	41.76	Pass
933.126	-50.46	-9.36	41.1	Pass
933.9	-55.38	-9.36	46.02	Pass
934.663	-53.78	-9.36	44.42	Pass
935.207	-57.07	-9.36	47.71	Pass
935.758	-56.92	-9.36	47.56	Pass
936.465	-57.85	-9.36	48.49	Pass
937.061	-58.74	-9.36	49.38	Pass
937.189	-59.71	-9.36	50.35	Pass

Figure 14. High Channel 20dB Down Emissions, High Band Edge

Spurious Frequency (MHz)	Peak Amplitude (dBm)	-20dBd Limit (dBm)	Margin (dB)	Result
1808.963	-41.35	-3.21	38.14	Pass
1810.987	-42.28	-3.21	39.07	Pass
2713.8	-45.08	-3.21	41.87	Pass
2716.162	-45.24	-3.21	42.03	Pass
4521.965	-42.26	-3.21	39.05	Pass
4525.036	-51.16	-3.21	47.95	Pass
4527.449	-41.76	-3.21	38.55	Pass
5426.981	-45.93	-3.21	42.72	Pass
5432.891	-46.35	-3.21	43.14	Pass
9948.796	-42.36	-3.21	39.15	Pass
9960.366	-43.39	-3.21	40.18	Pass
11757.55	-42.19	-3.21	38.98	Pass
11771.32	-41.75	-3.21	38.54	Pass
13940.2	-51.48	-3.21	48.27	Pass
15771.27	-50.85	-3.21	47.64	Pass
23440.27	-49.1	-3.21	45.89	Pass
24295.52	-49.91	-3.21	46.7	Pass
24887.84	-47.39	-3.21	44.18	Pass
25768	-47.84	-3.21	44.63	Pass
26471.03	-48.43	-3.21	45.22	Pass
28375.29	-51.47	-3.21	48.26	Pass
30636.25	-49.92	-3.21	46.71	Pass
31835	-46.35	-3.21	43.14	Pass
33145	-43.01	-3.21	39.8	Pass
36350	-38.94	-3.21	35.73	Pass
36983.75	-39.08	-3.21	35.87	Pass
37048.75	-38.94	-3.21	35.73	Pass
39825	-42.71	-3.21	39.5	Pass

Figure 15. Low Channel 20 dB Down Emissions

Spurious Frequency (MHz)	Peak Amplitude (dBm)	-20dBd Limit (dBm)	Margin (dB)	Result
2743.5	-46.35	-7.86	38.48	Pass
2746.2	-45.86	-7.86	38	Pass
4572.193	-44.52	-7.86	36.66	Pass
4577.457	-43.4	-7.86	35.53	Pass
11888.12	-45.54	-7.86	37.67	Pass
11901.34	-45.83	-7.86	37.97	Pass
35840	-46.54	-7.86	38.67	Pass
36071.25	-45.05	-7.86	37.19	Pass
36157.5	-44.68	-7.86	36.82	Pass
36286.25	-44.39	-7.86	36.53	Pass
36350	-43.66	-7.86	35.8	Pass
36376.25	-44.43	-7.86	36.57	Pass
36386.25	-44.53	-7.86	36.67	Pass
36568.75	-43.71	-7.86	35.85	Pass
36660	-43.52	-7.86	35.65	Pass
36667.5	-44.09	-7.86	36.23	Pass
36745	-43.96	-7.86	36.1	Pass
36782.5	-44.51	-7.86	36.64	Pass
36901.25	-44.85	-7.86	36.98	Pass
36975	-44.83	-7.86	36.96	Pass
37056.25	-44.68	-7.86	36.82	Pass
37125	-44.83	-7.86	36.97	Pass
37150	-43.86	-7.86	35.99	Pass
37192.5	-44.3	-7.86	36.44	Pass
37426.25	-44.98	-7.86	37.12	Pass
37471.25	-45.18	-7.86	37.31	Pass
37585	-45.46	-7.86	37.6	Pass
37642.5	-46.45	-7.86	38.59	Pass
37720	-45.44	-7.86	37.57	Pass

Figure 16. Mid Channel 20 dB Down Emissions

Spurious Frequency (MHz)	Peak Amplitude (dBm)	-20dBd Limit (dBm)	Margin (dB)	Result
2767.8	-43.6	-9.36	34.24	Pass
2770.5	-42.48	-9.36	33.12	Pass
4612.112	-44	-9.36	34.64	Pass
4617.595	-43.11	-9.36	33.75	Pass
11992.11	-46.37	-9.36	37.01	Pass
12005.21	-46.27	-9.36	36.91	Pass
35503.75	-46.17	-9.36	36.81	Pass
35670	-46.3	-9.36	36.94	Pass
35857.5	-46.39	-9.36	37.03	Pass
35948.75	-46.34	-9.36	36.98	Pass
36176.25	-45.32	-9.36	35.96	Pass
36480	-42.63	-9.36	33.27	Pass
36526.25	-44.58	-9.36	35.22	Pass
36581.25	-43.92	-9.36	34.56	Pass
36643.75	-43.87	-9.36	34.51	Pass
36660	-43.92	-9.36	34.56	Pass
36831.25	-44.74	-9.36	35.38	Pass
36888.75	-45.31	-9.36	35.95	Pass
36923.75	-45.24	-9.36	35.88	Pass
36967.5	-45.1	-9.36	35.74	Pass
36987.5	-44.45	-9.36	35.09	Pass
37023.75	-45.03	-9.36	35.67	Pass
37077.5	-43.89	-9.36	34.53	Pass
37106.25	-43.72	-9.36	34.36	Pass
37341.25	-45.33	-9.36	35.97	Pass
37462.5	-45.36	-9.36	36	Pass
37470	-45.48	-9.36	36.12	Pass
37543.75	-44.8	-9.36	35.44	Pass
37663.75	-46.36	-9.36	37	Pass

Figure 17. High Channel 20 dB Down Emissions

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Radiated Spurious Emissions Requirements and Band Edge

Test Requirements: **§15.247(d); §15.205:** Emissions outside the frequency band.

§15.247(d): 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. 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).

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

MHz	MHz	MHz	GHz
0.090–0.110----------	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505----------	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905----------	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128----------	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775----------	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775----------	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218----------	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825----------	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225----------	123–138	2200–2300	14.47–14.5
8.291–8.294----------	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366----------	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675----------	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475----------	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293----------	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025----------	240–285	3345.8–3358 36.	43–36.5
12.57675–12.57725----------	322–335.4	3600–4400	([2])

Table 16. Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 17.

Frequency (MHz)	§ 15.209(a),Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

Table 17. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedures: The conducted methodology referenced in ANSI C63.10: 2013 Section 11.12.1 was utilized in order to assess the unwanted emissions in the restricted bands.

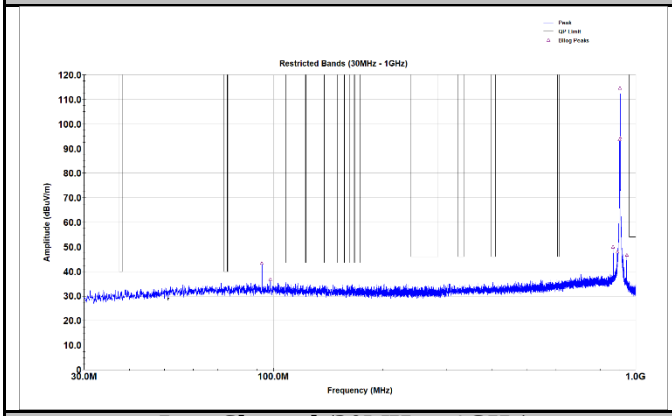
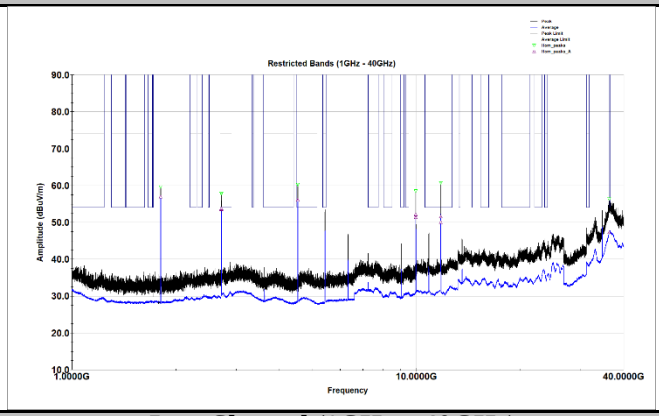
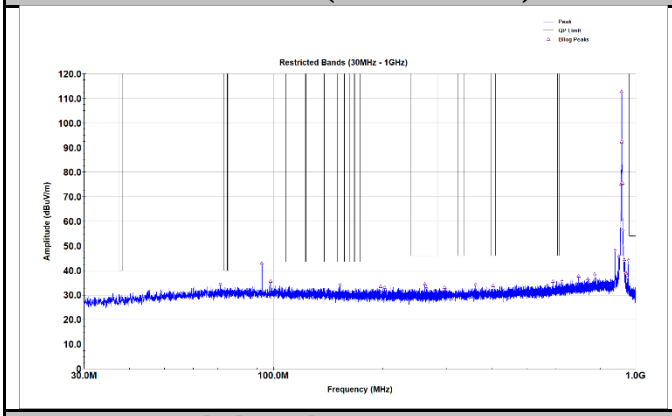
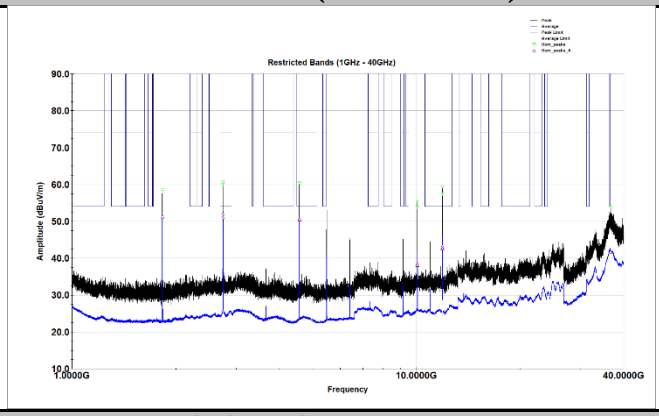
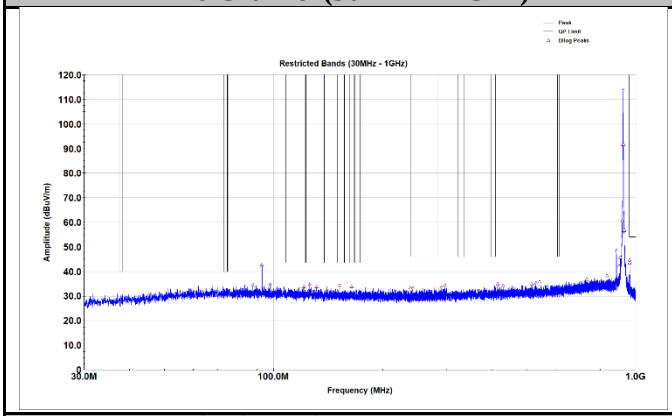
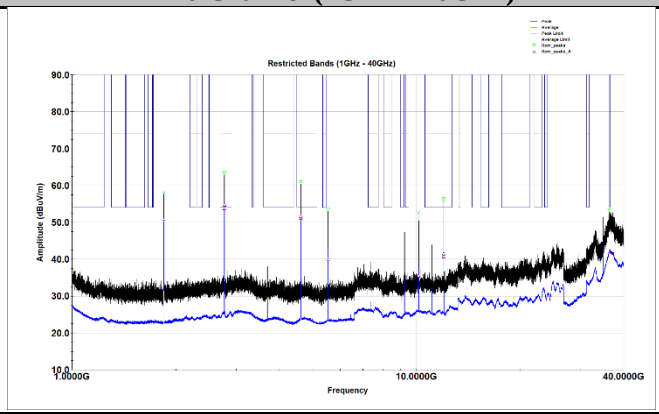
Additionally, in order to assess the emissions emanating from the cabinet, a radiated scan was performed with the antenna of proper impedance installed per ANSI C63.10 Section 11.12.2.7. The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes if multiple mounting orientations are supported. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.

Radiated measurements below 30MHz were performed in a semi-anechoic chamber that has been correlated to an open area site.

Test Results: The EUT was compliant with the Radiated Spurious Emission limits of § 15.247(d).

Test Engineer(s): Bryan Taylor, Sergio Gutierrez

Test Date(s): 2/25/2025 – 3/3/2025

Restricted Band Spurious Emissions	
	
Low Channel (30MHz – 1GHz)	Low Channel (1GHz – 40GHz)
	
Mid Channel (30MHz – 1GHz)	Mid Channel (1GHz – 40GHz)
	
High Channel (30MHz – 1GHz)	High Channel (1GHz – 40GHz)

* A duty cycle correction factor was applied to the tabular data in order to arrive at an average measurement per ANSI C63.10 Section 7.5. The plots above do not include the duty cycle correction factor.

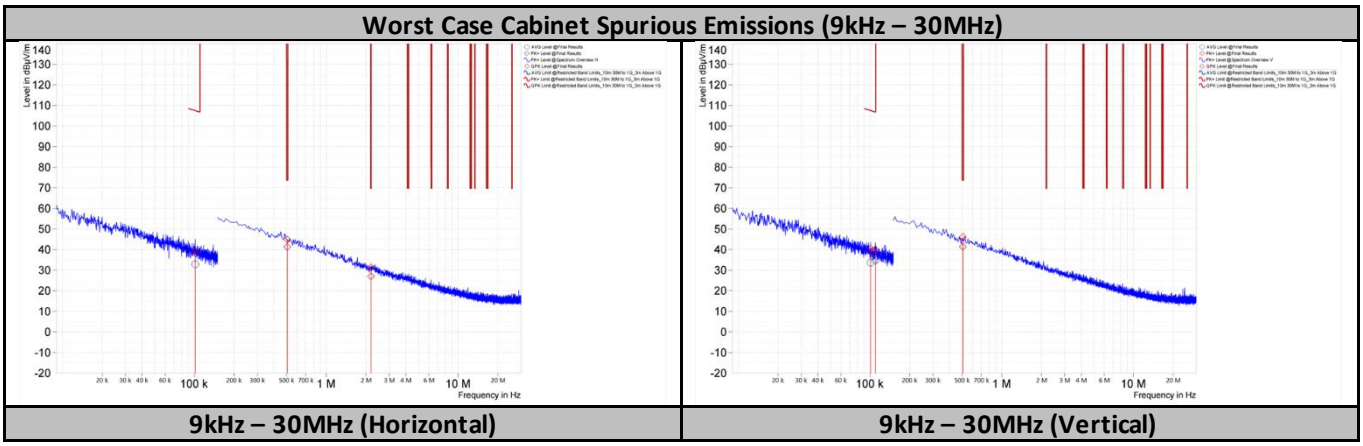
Figure 18. 30MHz – 40GHz Restricted Band Spurious Emissions

Tx Ch.	Frequency (GHz)	Peak Reading (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)	Avg Reading (dBuV/m)	DCF (dB)	Corrected Avg Reading (dBuV/m)	Avg Limit (dBuV/m)	Avg Margin (dBuV/m)	Result
Low	2.713	57.74	74	16.26	53.55	-18.92	34.63	54	19.37	Pass
	2.717	57.87	74	16.13	53.77	-18.92	34.85	54	19.15	Pass
	4.522	60.33	74	13.67	56.03	-18.92	37.11	54	16.89	Pass
	4.527	60.33	74	13.67	56.01	-18.92	37.09	54	16.91	Pass
	11.758	60.76	74	13.24	50.02	-18.92	31.1	54	22.9	Pass
	11.771	60.76	74	13.24	51.49	-18.92	32.57	54	21.43	Pass
Mid	2.743	60.08	74	13.92	50.95	-18.92	32.03	54	21.97	Pass
	2.746	60.66	74	13.34	52.01	-18.92	33.09	54	20.91	Pass
	4.572	60.54	74	13.46	50.53	-18.92	31.61	54	22.39	Pass
	4.578	60.25	74	13.75	50.46	-18.92	31.54	54	22.46	Pass
	11.888	59.4	74	14.6	43.1	-18.92	24.18	54	29.82	Pass
	11.902	57.45	74	16.55	42.52	-18.92	23.6	54	30.4	Pass
High	2.768	63.21	74	10.79	53.7	-18.92	34.78	54	19.22	Pass
	2.77	63.44	74	10.56	54.72	-18.92	35.8	54	18.2	Pass
	4.612	61.27	74	12.73	51.12	-18.92	32.2	54	21.8	Pass
	4.617	60.83	74	13.17	51.68	-18.92	32.76	54	21.24	Pass
	11.991	56.43	74	17.57	41.46	-18.92	22.54	54	31.46	Pass
	12.006	55.78	74	18.22	40.71	-18.92	21.79	54	32.21	Pass

* A duty cycle correction factor was applied to the tabular data in order to arrive at an average measurement per ANSI C63.10 Section 7.5. The plots above do not include the duty cycle correction factor.

Figure 19. Worst Case Restricted Band Spurious Emissions

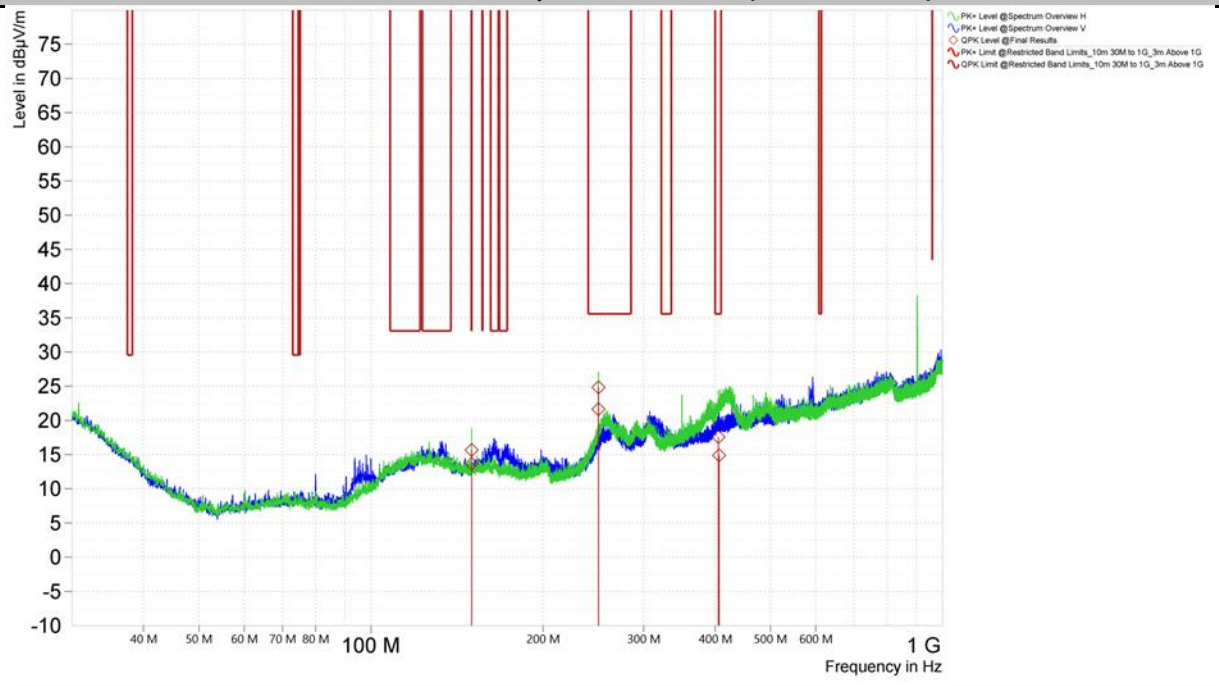
Worst Case Cabinet Spurious Emissions



Fequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Detector	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
0.101	40.49	107.53	67.04	Pk.	11.27	V	131	1	0.200	Pass
0.102	39.23	107.47	68.24	Pk.	11.28	H	310.5	1	0.200	Pass
0.109	40.04	106.83	66.79	Pk.	11.37	V	257.3	1	0.200	Pass
0.506	44.90	73.62	28.72	Pk.	11.31	H	253.7	1	9.000	Pass
0.506	46.14	73.62	27.48	Pk.	11.31	V	138.7	1	9.000	Pass
2.184	31.45	69.54	38.09	Pk.	11.69	H	22.8	1	9.000	Pass

Figure 20. Worst Case Cabinet Radiation, Below 30MHz (representative of low, mid, and high channels)

Worst Case Cabinet Spurious Emissions (30MHz – 1GHz)

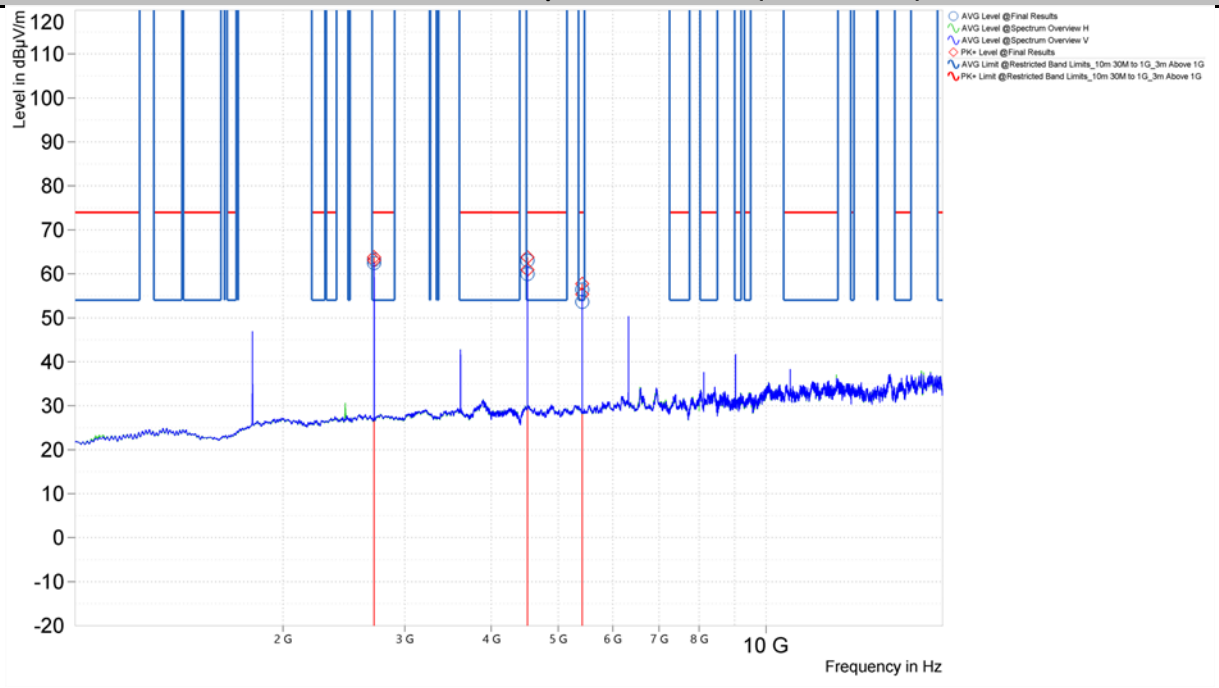


30MHz – 1GHz (Horizontal and Vertical)

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Detector	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
150.000	15.67	33.07	17.40	QPK	-7.61	H	25	4	120.000	Pass
150.000	13.63	33.07	19.44	QPK	-7.71	V	44.7	1.48	120.000	Pass
250.020	24.83	35.57	10.74	QPK	-7.68	H	53.3	3.61	120.000	Pass
250.020	21.66	35.57	13.91	QPK	-7.48	V	204	1.01	120.000	Pass
405.270	17.57	35.57	18.00	QPK	-2.68	H	34.1	2.63	120.000	Pass
406.350	14.91	35.57	20.66	QPK	-2.49	V	199.8	1.05	120.000	Pass

Figure 21. Worst Case Cabinet Radiation, 30MHz – 1GHz (representative of low, mid, and high channels)

Worst Case Cabinet Spurious Emissions (1GHz -18GHz)



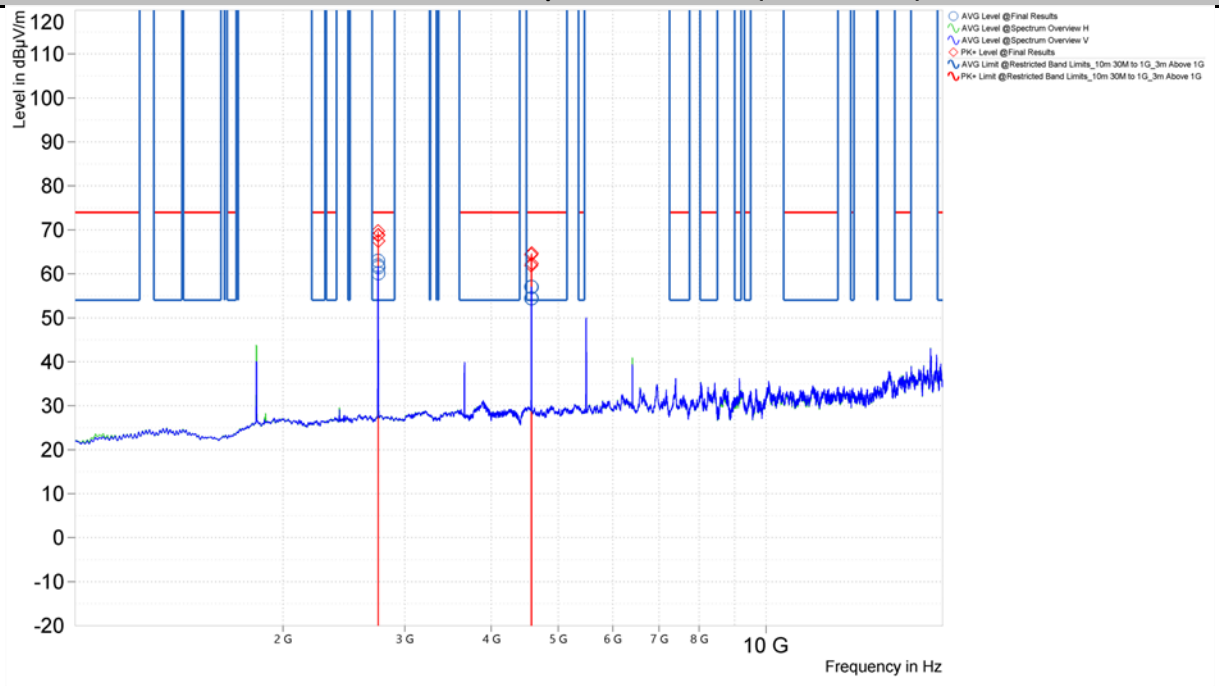
1GHz – 18GHz (Horizontal and Vertical)

Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	DCF [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Result
2,709.000	63.08	74.00	10.92	43.53*	54.00	10.47	-2.70	-18.92	H	191.1	3.27	Pass
2,709.000	63.75	74.00	10.25	44.3*	54.00	9.7	-2.70	-18.92	V	303.6	2.15	Pass
4,515.000	60.89	74.00	13.11	41.01*	54.00	12.99	-3.16	-18.92	H	109.7	3.33	Pass
4,515.000	63.77	74.00	10.23	44.1*	54.00	9.9	-3.16	-18.92	V	198.4	2.16	Pass
5,418.000	55.31	74.00	18.69	34.69*	54.00	19.31	-4.26	-18.92	H	171.9	2.83	Pass
5,418.000	57.74	74.00	16.26	37.5*	54.00	16.5	-4.26	-18.92	V	80.6	2.48	Pass

* A duty cycle correction factor was applied to the tabular data in order to arrive at an average measurement per ANSI C63.10 Section 7.5. The plots above do not include the duty cycle correction factor.

Figure 22. Worst Case Cabinet Radiation, Above 1GHz (Low Channel)

Worst Case Cabinet Spurious Emissions (1GHz -18GHz)



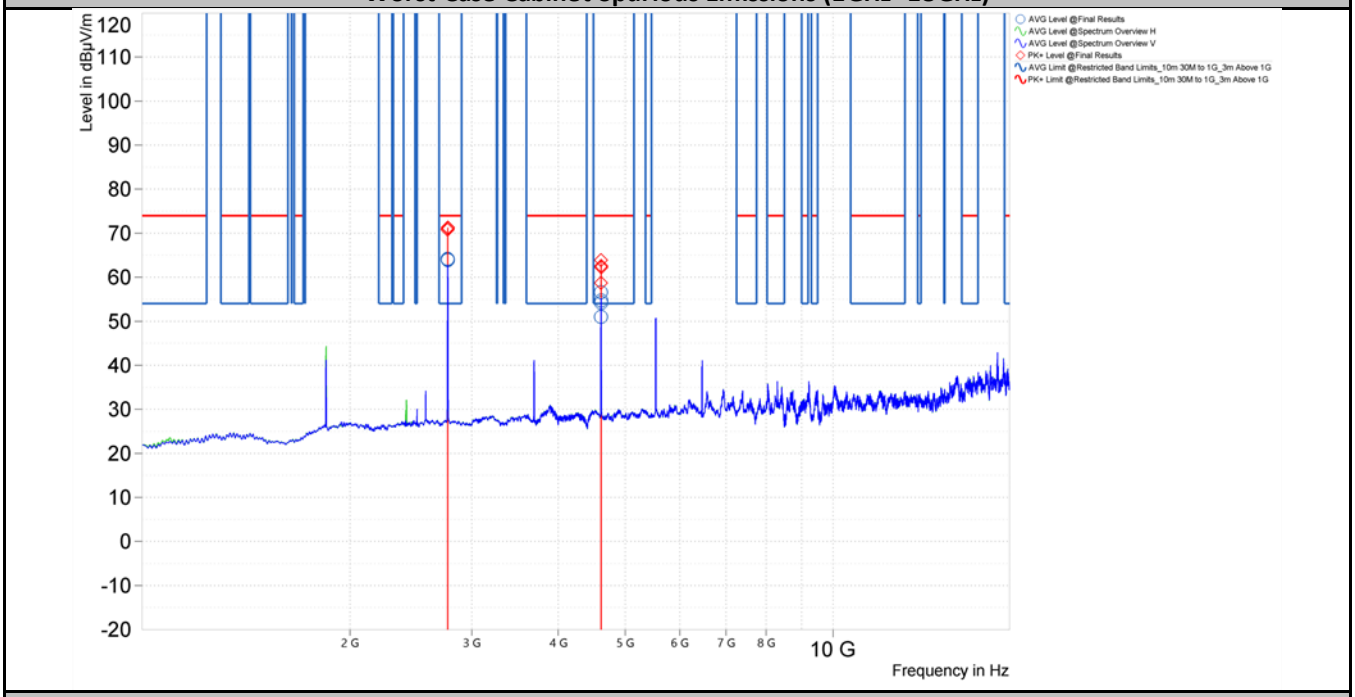
1GHz – 18GHz (Horizontal and Vertical)

Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	DCF [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Result
2,743.500	69.73	74.00	4.27	44.07*	54.00	9.93	-2.74	-18.92	H	261.5	3.45	Pass
2,743.500	68.73	74.00	5.27	43.03*	54.00	10.97	-2.74	-18.92	V	290.8	1.81	Pass
2,746.500	67.48	74.00	6.52	41.2*	54.00	12.8	-2.74	-18.92	H	255.3	2.36	Pass
2,746.500	68.82	74.00	5.18	42.56*	54.00	11.44	-2.74	-18.92	V	341.6	2	Pass
4,572.500	61.89	74.00	12.11	35.49*	54.00	18.51	-3.76	-18.92	H	342.1	3.12	Pass
4,572.500	64.35	74.00	9.65	38.15*	54.00	15.85	-3.76	-18.92	V	209.1	2.12	Pass
4,577.500	62.32	74.00	11.68	35.52*	54.00	18.48	-3.82	-18.92	H	342.9	3.09	Pass
4,577.500	64.70	74.00	9.30	38.05*	54.00	15.95	-3.82	-18.92	V	209.3	2.11	Pass

* A duty cycle correction factor was applied to the tabular data in order to arrive at an average measurement per ANSI C63.10 Section 7.5. The plots above do not include the duty cycle correction factor.

Figure 23. Worst Case Cabinet Radiation, Above 1GHz (Mid Channel)

Worst Case Cabinet Spurious Emissions (1GHz -18GHz)



1GHz – 18GHz (Horizontal and Vertical)

Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	DCF [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Result
2,767.500	70.80	74.00	3.20	45.16*	54.00	8.84	-2.75	-18.92	H	37.8	3.38	Pass
2,767.500	70.87	74.00	3.13	45.23*	54.00	8.77	-2.75	-18.92	V	331.2	2.34	Pass
2,770.500	71.19	74.00	2.81	44.98*	54.00	9.02	-2.76	-18.92	H	38.8	3.35	Pass
2,770.500	71.33	74.00	2.67	45.13*	54.00	8.87	-2.76	-18.92	V	337.5	2.34	Pass
4,612.500	58.71	74.00	15.29	32.08*	54.00	21.92	-4.16	-18.92	H	209.2	2.79	Pass
4,612.500	63.87	74.00	10.13	37.64*	54.00	16.36	-4.16	-18.92	V	128.6	3.16	Pass
4,617.500	62.22	74.00	11.78	35.3*	54.00	18.7	-4.20	-18.92	H	304.2	1.37	Pass
4,617.500	62.56	74.00	11.44	35.8*	54.00	18.2	-4.20	-18.92	V	141.7	1.06	Pass

* A duty cycle correction factor was applied to the tabular data in order to arrive at an average measurement per ANSI C63.10 Section 7.5. The plots above do not include the duty cycle correction factor.

Figure 24. Worst Case Cabinet Radiation, Above 1GHz (High Channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ ANSI C63.10 Duty Cycle Correction Factor

Test Procedure: In order to obtain the average value of pulsed emissions ANSI C63.10 Section allows the use of a duty cycle correction factor defined as follows:

DCF(dB) = 20log(Δ) where:

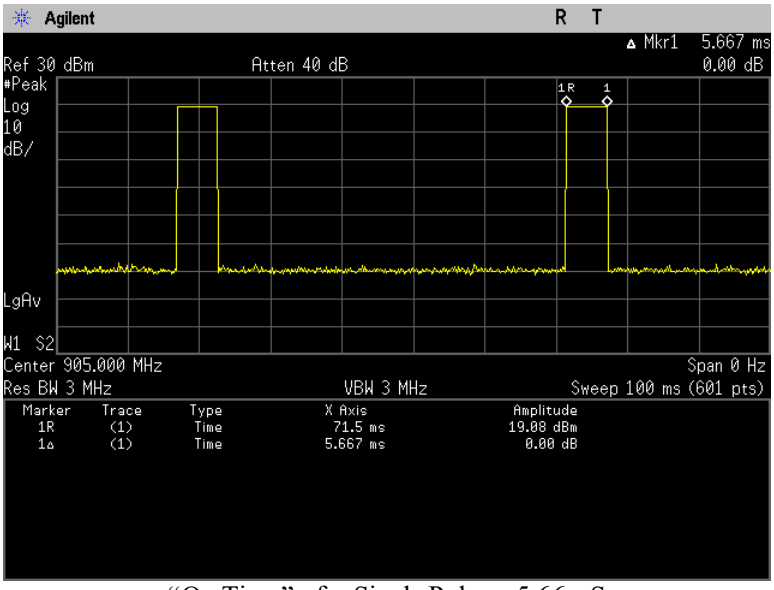
DCF = the duty cycle correction factor in dB
Δ = the duty cycle in decimal form over 100mS

The Omni Receiver in normal operation will transmit a pulsed signal requiring the use of the duty cycle correction factor in order to achieve a true average value. In order to determine the duty cycle correction factor, the test sample was configured to transmit its worst-case pulse train. The duty cycle over 100mS was measured by setting a spectrum analyzer to zero span mode and capturing the number of pulses over 100mS. The on time of all pulses in this 100mS window was measured and divided by 100mS in order to arrive at the duty cycle. This duty cycle was then used to calculate the duty cycle correction factor via the formula above. When necessary, the duty cycle correction factor was applied to emissions where comparison to an average limit was required. When the DCF is utilized, a note will appear in the tabular data alongside the measurement.

Results: The duty cycle correction factor was determined to be -18.92dB.

Test Engineer(s): Bryan Taylor

Test Date(s): 3/3/2025



"On Time" of a Single Pulse = 5.66mS
2 Pulses in 100mS
Total "On Time" = 2 x 5.66mS = 11.32mS
Duty Cycle Correction Factor = 20log(11.32/100) = -18.92dB

IV. Test Equipment

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

MET Asset #	Description	Manufacturer	Model	Last Cal Date	Cal Due Date
MY46180897	Spectrum Analyzer	Keysight	E4448A	8/28/2024	8/28/2025
1A1250	Receiver	Rohde & Schwarz	ESW44	4/8/2024	4/8/2025
1A1234	FSV Signal Analyzer	Rohde & Schwarz	FSV 40	3/13/2025	3/1/2026
1A1176	Active Loop Antenna (9KHz-30MHz)	ETS-Lindgren	6502	8/22/2024	8/22/2026
1A1147	Bi-Log Antenna	Suno Sciences Corp	JB3	04/06/2023	4/06/2025
1A1183	Horn Antenna	ETS - Lindgren	3117	2/20/2024	2/20/2025
1A1065	EMI Receiver	Rohde & Schwarz	ESCI	08/20/2024	08/20/2025
1A1123	LISN	Teseq	NNB 51	12/11/2024	12/11/2025
3A3215	ATC Digital Ohmmeter	Valhalla Scientific	4150	05/24/2024	05/24/2025
1A1099	Generator	Com-Power	CGO-51000	See Note	
1A1088	Preamplifier	Rohde & Schwarz	TS-PR1	See Note	
1A1044	Generator	Com-Power	CG-520	See Note	
1A1073	Multi Device Controller	ETS	2090	See Note	
1A1074	System Controller	Panasonic	WV-CU101	See Note	
1A1080	Multi-Device	ETS	2090	See Note	
1A1180	Preamplifier	Miteq	AMF-7D-01001800-22-10P	See Note	

Table 18. Test Equipment List

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

End of Report