HEADQUARTERS: 914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230 • PHONE (410) 354-3300 • FAX (410) 354-3313

April 15, 2025

Maztech Industries
1641 Reynolds Ave.
Irvine, CA 92614
USA

Dear Craig Cronin,

Enclosed is the EMC Wireless test report for compliance testing of the Maztech Industries X4-LRF as tested to the requirements of FCC Part 15 – F (Ultra-Wideband Operation) for Intentional Radiators. This test report pertains specifically to the Ultra-Wideband radio onboard.

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: WIRA134602_UWB Rev 2

Ultra-Wideband
Test Report

for the

Maztech Industries
X4-LRF

Tested under
FCC Part 15 – F (Ultra-Wideband Operation)
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 15.519 under normal use and maintenance.

Matthew Hinojosa
EMC Manager, Austin Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	2/13/2025	Initial Issue.
1	03/24/2025	Customer Requested Changes.
2	04/15/2025	Customer Requested Changes.

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**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ert**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 X4-LRF, with the requirements of FCC Part 15 – F (Ultra-Wideband Operation). Maztech Industries should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the X4-LRF, 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 – F (Ultra-Wideband Operation), in accordance with Maztech Industries purchase order number 1MAZ1911. All tests were conducted using measurement procedures ANSI C63.4-2014 and ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.519	Description	Compliance
Title 47 of the CFR, Part 15 §15.203, 15.519(a)(2)	Antenna Requirements	Compliant
Title 47 of the CFR, Part 15 §15.519(a)(1)	Transmission Cutoff Timing	Compliant
Title 47 of the CFR, Part 15 §15.519(b)	UWB Bandwidth for Hand-Held Device	Compliant
Title 47 of the CFR, Part 15 §15.519(c)	Radiated Emissions	Compliant
Title 47 of the CFR, Part 15 §15.519(d)	Radiated Emissions in1164-1240MHz and 1559-1610 Bands	Compliant
Title 47 of the CFR, Part 15 §15.519(e)	Radiated Emissions (Peak Level) Centered on the Frequency With Highest Emissions	Compliant
Title 47 of the CFR, Part 15 §15.521(a)	UWB cannot be used for toy operation or onboard aircraft, ships, or satellites	Compliant
Title 47 of the CFR, Part 15 §15.521(b)	The antenna requirements from part 15.203 and 15.204 apply	Compliant
Title 47 of the CFR, Part 15 §15.521(c)	Emissions from digital circuitry are subject to part 15B compliance	Compliant
Title 47 of the CFR, Part 15 §15.521(d)	The limits and criteria from part 15.519 apply since this is a hand-held UWB device	Compliant
Title 47 of the CFR, Part 15 §15.521(e)	The frequency at which the highest radiated emission occurs, fM, must be contained within the UWB bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.521(f)	Imaging systems may be employed only for the type of information exchange described in their specific definitions contained in part 15.503	Compliant
Title 47 of the CFR, Part 15 §15.521(g)	Peak EIRP measurements may use a resolution bandwidth other than 50MHz provided that the limit is adjusted to 20 log (RBW/50)	Compliant
Title 47 of the CFR, Part 15 §15.521(h)	The highest frequency employed in part 15.33 to determine the scan range for radiated measurements shall be the center frequency, fC	Compliant
Title 47 of the CFR, Part 15 §15.521(i)	The prohibition against Class B (damped wave) emissions does not apply to UWB devices operating under this part	Noted
Title 47 of the CFR, Part 15 §15.521(j)	Responsible parties are reminded that standards cross referenced under part 15.505 may be applicable.	Noted

Table 1. Executive Summary

II. Equipment Configuration

A. Overview

Eurofins MET Labs was contracted by Maztech Industries to perform testing on the X4-LRF, under Maztech Industries' purchase order number 1MAZ1911.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the X4-LRF.

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

Product Name:	X4 Laser Rangefinder (X4-LRF)	
Model(s) Tested:	X4-LRF	
FCCID:	2BKWD-LRF01	
Equipment Specifications:	Primary Power:	1.5-4.2VDC
	Transmitters Onboard:	Ultra-Wideband
	Equipment Code:	UWB
	Peak RF Output Power (EIRP):	-14.99dBm
	EUT Frequency Ranges:	UWB: 3.1GHz – 6GHz
	Antenna Gain[1]:	4.16dBi
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 and Veer Patel	
Report Date(s):	April 15, 2025	

Table 2. EUT Summary Table

[1] The antenna gain information was provided by Maztech Industries at the time of testing.

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.

ISED Lab Info:
CAB Identifier: US0004
Company Number: 2043D

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

Determines distances to items that are pointed to. It has wireless interfaces to communicate with accessories: UWB (3.1 GHz-5.8 GHz) and to communicate with smartphone for a command/control app: BLE 5.0 (2.4 GHz)

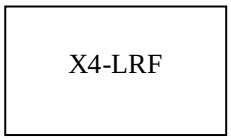


Figure 1. Block Diagram of Test Configuration

F. Equipment Configuration

The X4 Laser Rangefinder (X4-LRF) was set up as outlined in Figure 1 above. It was tested in a stand-alone configuration with special test code loaded onto the device to allow for transmission on low, mid, and high channels.

G. Support Equipment

The X4 Laser Rangefinder (X4-LRF) was tested in a stand-alone configuration. No support equipment was used during the evaluation.

H. Ports and Cabling Information

The X4 Laser Rangefinder (X4-LRF) was tested in a stand-alone configuration. No cables were connected during the evaluation.

I. Mode of Operation

The X4 Laser Rangefinder (X4-LRF) was tested in a stand-alone configuration with special test code loaded onto the device to allow for transmission on low, mid, and high channels.

Transmit Band	Modulation	Channel Frequencies Tested	Test Tool Power Setting
3.1GHz – 5.8GHz	UWB	3113.96MHz / 4423.68MHz / 5775.36MHz	9

Table 5. 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 Maztech Industries upon completion of testing.

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.

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

§ 15.519(a)(2): The use of antennas mounted on outdoor structures, e.g., antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure is prohibited. Antennas may be mounted only on the hand held UWB device.

Results: The EUT as tested is compliant with the criteria of §15.203 and 15.519(a)(2). The TX antenna is permanently attached to the unit and is not accessible by the end user. Additionally, the antenna used on this device is only attached to this device and not to any outdoor structures such as building or telephone poles.

Test Engineer(s): Bryan Taylor

Test Date(s): 1/23/2025

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.519(a)(1) Transmission Cutoff Timing

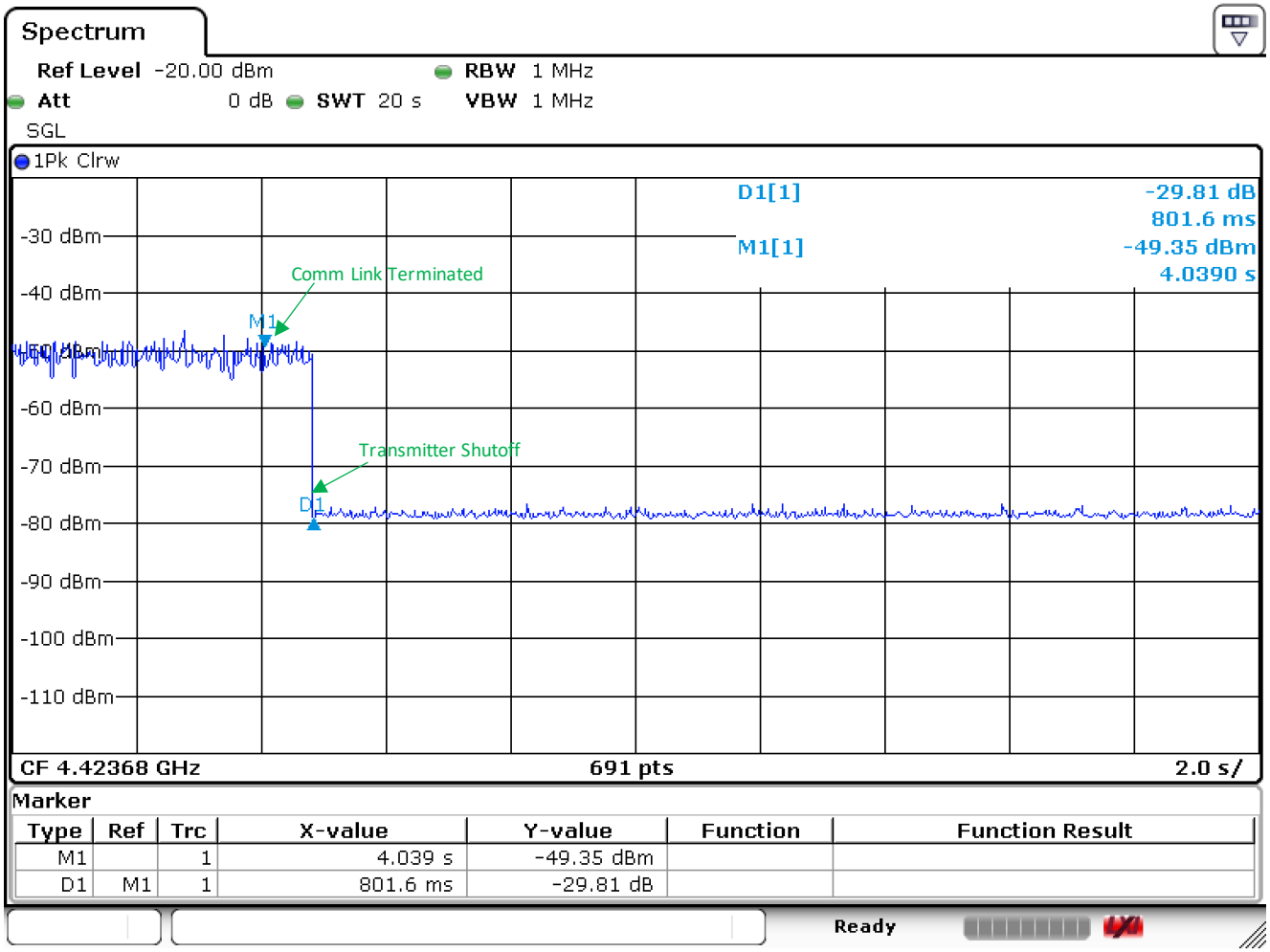
Test Requirements: **§ 15.519(a)(1):** A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting

Test Procedure: The test sample was configured to communicate via normal UWB signal to an associated UWB receiver. The receiver was shut off and the transmitted signal was observed on a spectrum analyzer. Markers were placed on the captured plots indicating when the receiver was turned off and when the transmission was observed to stop. This transmission cutoff time was recorded and compared to the 10 second limit. This measurement was performed with the receiver terminating the communication link as well as with the test sample terminating the communication link.

Test Results The EUT was compliant with § 15.519(a)(1). The transmission cutoff timing was less than 10 seconds.

Test Engineer(s): Bryan Taylor

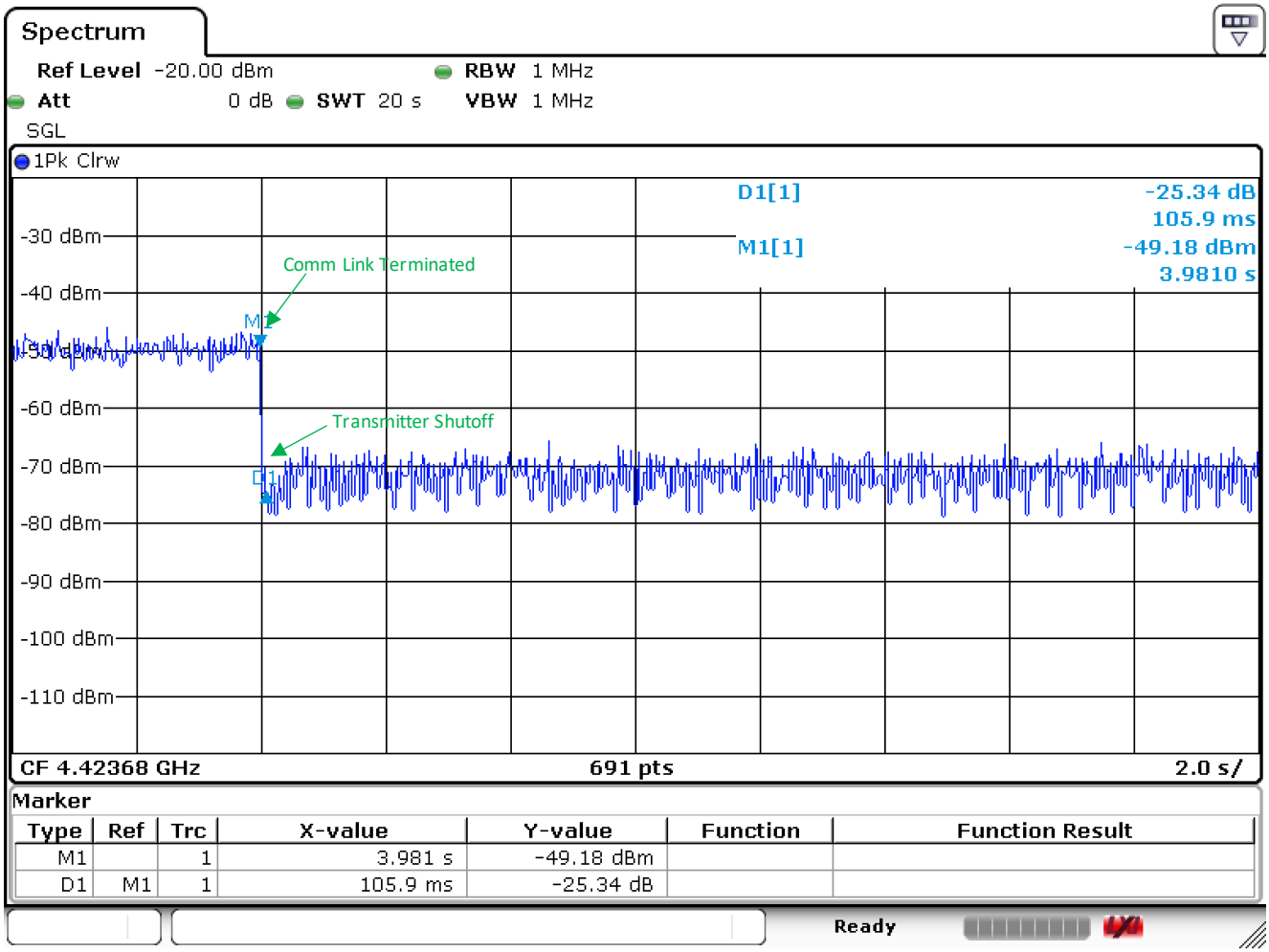
Test Date(s): 2/11/2025



Date: 11.FEB.2025 10:00:22

Transmission Cutoff Time = 801mS

Figure 2. UWB Communication Terminated by Test Sample



Date: 11.FEB.2025 10:02:22

Transmission Cutoff Time = 105.9mS

Figure 3. UWB Communication Terminated by Receiver

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.519(b) UWB Bandwidth

Test Requirements: **§ 15.519(b):** The UWB bandwidth of a device operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz

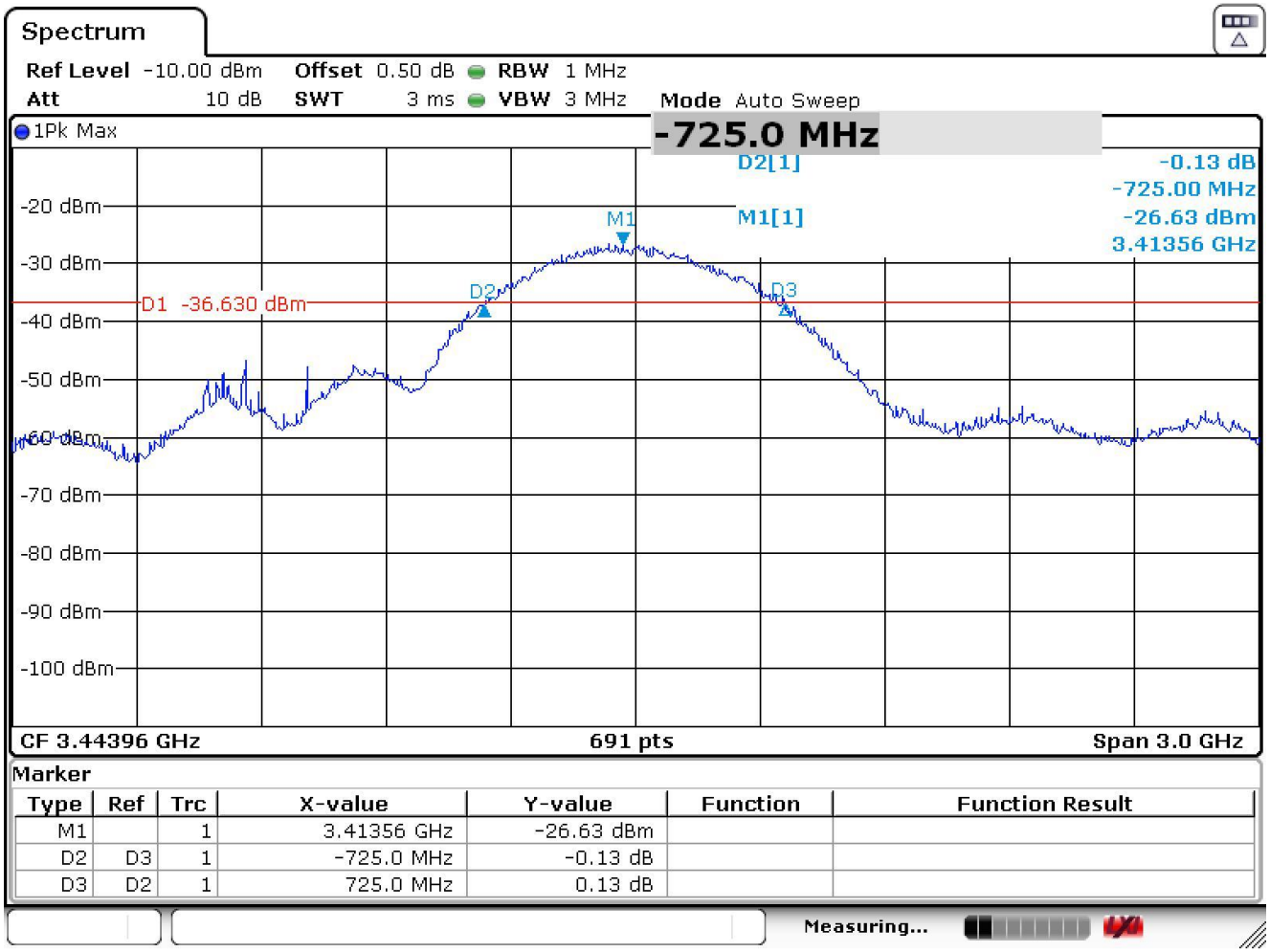
Test Procedure: The UWB signal was maximized by rotating the device on a turntable and raising / lowering an antenna and adjusting the antennas polarity for maximum received signal. A marker was placed at the peak of the UWB signal. Markers were then placed at the lower edge and upper edge of the UWB signal 10dB lower than the peak marker (searching from the outside of the signal toward the center of the signal). The delta between these markers at the 10dB down points was recorded as the UWB Bandwidth. Delta markers were used on the plots so that the UWB Bandwidth could be read directly.

Test Results The EUT was compliant with § 15.519(b). The UWB bandwidth was entirely within the range of 3100 MHz and 10,600 MHz for low, mid, and high channels. Additionally, the UWB Bandwidth for each measured channel was greater than 500MHz.

Test Engineer(s): Bryan Taylor

Test Date(s): 1/23/2025

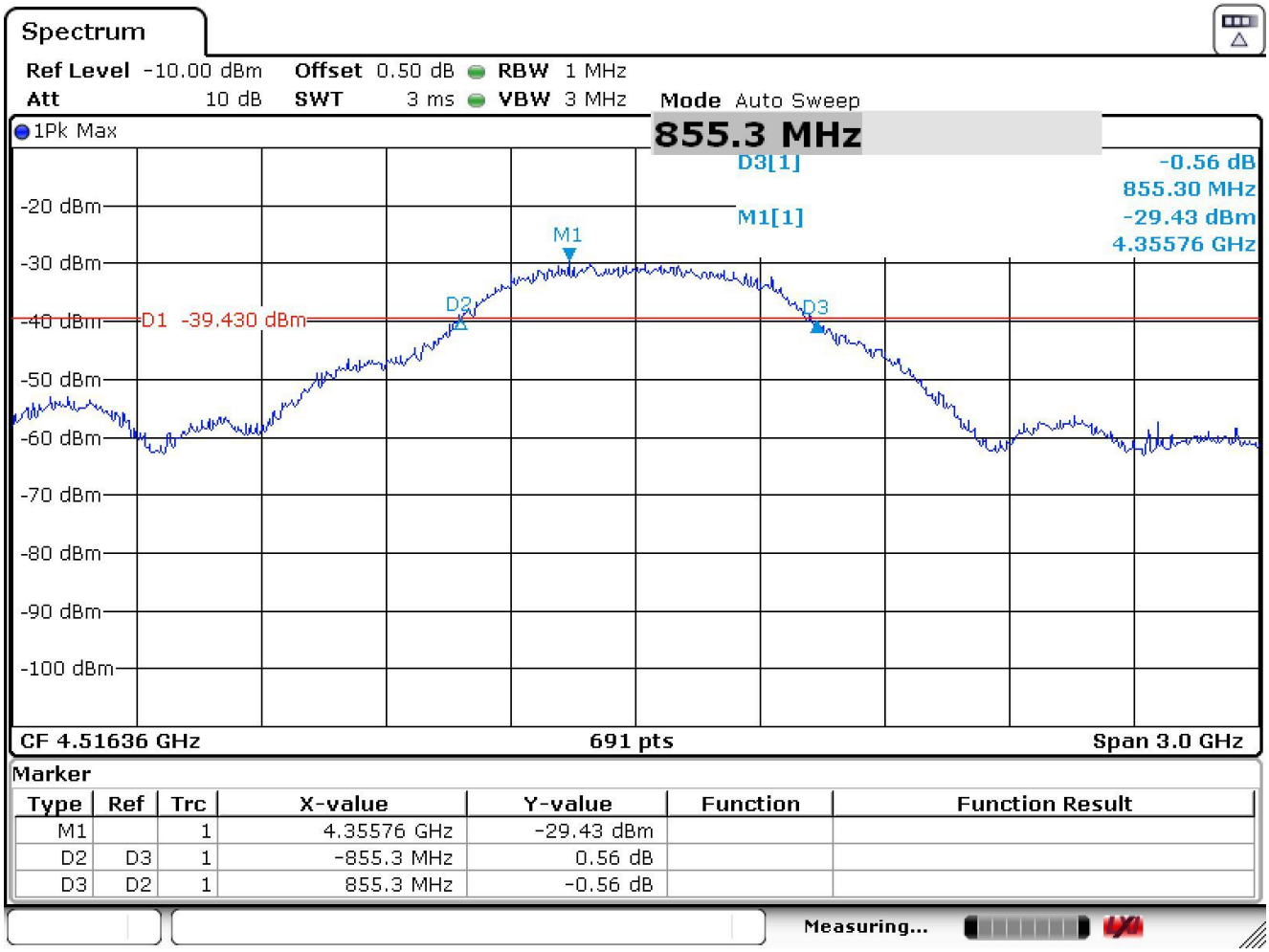
UWB Bandwidth Test Results



Date: 23.JAN.2025 10:48:15

UWB Bandwidth = 725MHz

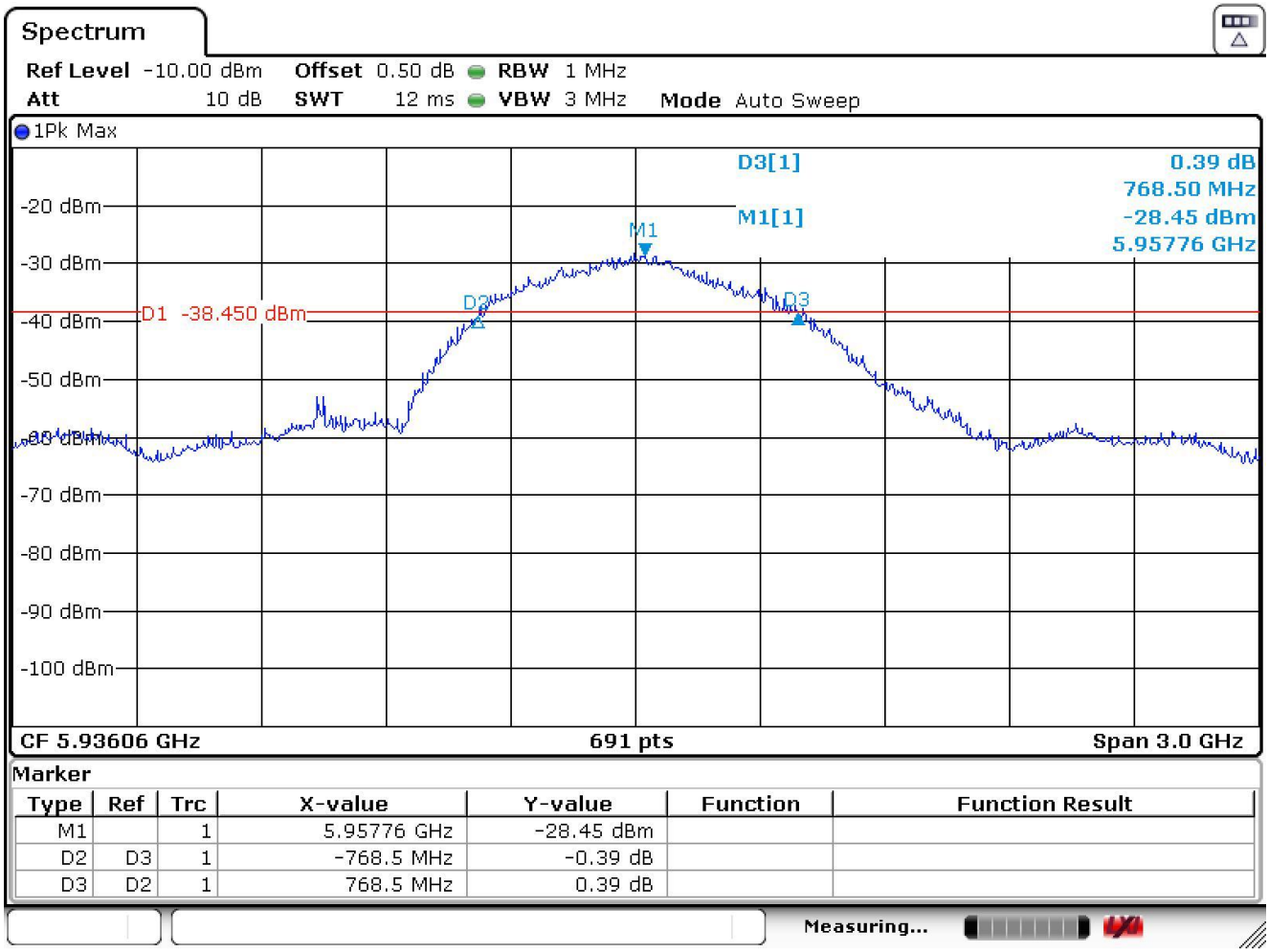
Figure 4. UWB Bandwidth (Low Channel)



Date: 23.JAN.2025 10:55:10

UWB Bandwidth = 855.3MHz

Figure 5. UWB Bandwidth (Mid Channel)



Date: 23.JAN.2025 10:57:24

UWB Bandwidth = 768.5MHz

Figure 6. UWB Bandwidth (High Channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.519(c) Radiated Emissions

Test Requirements: **§15.519(c):** radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in § 15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency (MHz)	§ 15.209(a),Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
Above 960	54.0

Figure 7. Radiated Field Strength Emissions Limits from FCC Part 15.209 (a)

Frequency (MHz)	§ 15.519(c),Radiated Emission Limits (dBm)	§ 15.519(c),Radiated Emission Limits (dBuV/m @ 3m)	§ 15.519(c),Radiated Emission Limits (dBuV/m @ 1m)
960 – 1610	-75.3	20.0	29.54
1610 – 1990	-63.3	32.0	41.54
1990 – 3100	-61.3	34.0	43.54
3100 – 10,600	-41.3	54.0	63.54
Above 10,600	-61.3	34.0	43.54

Figure 8. Radiated Field Strength Emissions Limits from FCC Part 15.519 (c)

Test Procedures:

The radiated emission methodology referenced in ANSI C63.10: 2013 was utilized in order to assess the unwanted emissions. The test sample was placed on an 80cm high table (for emissions below 1GHz) and on a 150cm high table (for emissions above 1GHz). The test sample was rotated 360 degrees and examined in three orthogonal axis during the test.

For measurements below 30MHz a magnetic field loop was utilized at a distance of 3m away. The magnetic loop remained fixed at 1m height and the test was performed with the loop positioned in a co-axial (0 degrees) and co-planar (90 degrees) position. Radiated measurements below 30MHz were performed in a semi-anechoic chamber that has been correlated to an open area site. Emissions were compared to the limits from 15.209.

Measurements from 30MHz – 960MHz were performed with a Hybrid BiLog type antenna positioned 10m from the test sample. This antenna was moved from 1 to 4m in height and in vertical and horizontal polarities. Emissions were compared to the limits from 15.209.

Measurements from 960MHz – 18GHz were performed with a horn antenna positioned 1m away from the test sample. This antenna was moved from 1 to 4m in height and in vertical and horizontal polarities. Emissions were measured in terms of field strength (dBuV/m) and then extrapolated to a distance of 3m using an inverse distance correction factor of 20 dB / decade. It was then converted to power terms (in dBm) for comparison to the limits in part 15.519(c). The formula from ANSI C63.10 Section 10.3.9 (formula 34) was used to convert from field strength to power terms:

$$\mathrm{EIRP}\left(\mathrm{dBm}\right) = E\left(\mathrm{dB\mu V/m}\right) - 95.3$$

Measurements from 18GHz to 40GHz were performed with a horn antenna positioned 0.5m from the test sample as well as via a prescan using conducted methods with the test sample connected directly to a spectrum analyzer. Any emissions detected from the test sample above the measurement noise floor were then measured at 1m distance using the same methodology as was used from 960MHz – 18GHz. Where no actual emissions were detected a plot of the measurement noise floor is submitted in the results.

Test Software: TILE Version 7.4.2.5 (Manufactured by ETS Lindgren) and ELEKTRA Version 4.61 (Manufactured by Rohde&Schwarz) was utilized to perform these measurements.

Test Results: The EUT was compliant with the radiated emission limits from rule part **15.209** (below 960MHz) and **15.519(c)** (above 960MHz).

Test Engineer(s): Bryan Taylor and Veer Patel

Test Date(s): 1/13/2025 – 1/27/2025

Radiated Emissions Test Results

Frequency [MHz]	Peak Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
0.015	58.32	124.36	66.04	16.61	V	336.4	1	0.200	Pass
0.018	62.35	122.73	60.37	15.31	H	137.1	1	0.200	Pass
0.488	46.02	93.84	47.83	11.32	V	205.8	1	9.000	Pass
0.677	42.35	71.00	28.65	11.45	H	133.8	1	9.000	Pass
10.001	25.38	69.50	44.12	10.83	V	91.3	1	9.000	Pass
25.013	24.45	69.50	45.05	9.71	H	130.7	1	9.000	Pass

Figure 9. Worst Case Field Strength Below 30MHz (Valid for low, mid, and high channels)

Frequency [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
116.580	6.41	33.07	26.66	-6.64	H	352.9	3.91	120.000	Pass
123.870	6.59	33.07	26.48	-6.17	V	135.2	1.26	120.000	Pass
126.720	6.83	33.07	26.24	-6.25	H	165.9	3.54	120.000	Pass
273.660	7.06	35.57	28.51	-5.92	V	270.4	2.32	120.000	Pass
553.140	13.82	35.57	21.75	0.31	H	360.3	1.76	120.000	Pass
612.150	14.00	35.57	21.57	1.26	H	175.8	1.65	120.000	Pass

Figure 10. Worst Case Field Strength 30MHz – 960MHz (Low channel)

Frequency [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
37.860	7.18	29.55	22.37	-5.94	H	209.6	2.97	120.000	Pass
115.800	5.28	33.07	27.79	-7.50	V	174.6	3.07	120.000	Pass
127.290	6.90	33.07	26.17	-6.28	H	142	1.92	120.000	Pass
133.620	6.06	33.07	27.01	-6.71	V	220.2	2.91	120.000	Pass
277.620	9.47	35.57	26.10	-5.92	H	195.7	3.54	120.000	Pass
597.270	14.15	35.57	21.42	0.53	H	347.5	1.08	120.000	Pass

Figure 11. Worst Case Field Strength 30MHz – 960MHz (Mid channel)

Frequency [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
37.530	7.36	29.55	22.19	-5.69	H	278.9	1.47	120.000	Pass
111.930	5.38	33.07	27.69	-7.64	V	48.9	3.65	120.000	Pass
124.170	6.55	33.07	26.52	-6.16	V	218.7	3.32	120.000	Pass
127.110	6.88	33.07	26.19	-6.26	H	68.4	3.64	120.000	Pass
584.310	21.66	35.57	13.91	0.97	V	69	1.04	120.000	Pass
612.390	14.39	35.57	21.18	1.26	H	352.8	1.21	120.000	Pass

Figure 12. Worst Case Field Strength 30MHz – 960MHz (High channel)

Frequency (GHz)	Polarity (V/H)	Amplitude (dBm)	Limit (dBm)	Margin (dB)	RBW	Result
1.347	V	-79.19	-75.3	3.89	1MHz	Pass
3.390	V	-63.88	-41.3	22.58	1MHz	Pass
12.418	V	-68.91	-61.3	7.61	1MHz	Pass
16.755	V	-66.18	-61.3	4.88	1MHz	Pass
1.884	H	-67.57	-63.3	4.27	1MHz	Pass
3.225	H	-61.66	-41.3	20.36	1MHz	Pass
12.515	H	-69.14	-61.3	7.84	1MHz	Pass
16.753	H	-66.12	-61.3	4.82	1MHz	Pass

Figure 13. Worst Case Spurious Emissions 960MHz – 40GHz (Low Channel)

Frequency (GHz)	Polarity (V/H)	Amplitude (dBm)	Limit (dBm)	Margin (dB)	RBW	Result
1.348	V	-79.73	-75.3	4.43	1MHz	Pass
4.545	V	-59.29	-41.3	17.99	1MHz	Pass
12.418	V	-68.69	-61.3	7.39	1MHz	Pass
17.295	V	-67.12	-61.3	5.82	1MHz	Pass
1.443	H	-79.63	-75.3	4.33	1MHz	Pass
4.467	H	-54.63	-41.3	13.33	1MHz	Pass
14.356	H	-67.93	-61.3	6.63	1MHz	Pass
16.773	H	-66.37	-61.3	5.07	1MHz	Pass

Figure 14. Worst Case Spurious Emissions 960MHz – 40GHz (Mid Channel)

Frequency (GHz)	Polarity (V/H)	Amplitude (dBm)	Limit (dBm)	Margin (dB)	RBW	Result
1.963	V	-75.92	-63.3	12.62	1.963	Pass
5.808	V	-58.37	-41.3	17.07	5.808	Pass
12.418	V	-69.03	-61.3	7.73	12.418	Pass
17.253	V	-65.77	-61.3	4.47	17.253	Pass
1.441	H	-79.89	-75.3	4.59	1.441	Pass
5.923	H	-58.69	-41.3	17.39	5.923	Pass
14.355	H	-68.10	-61.3	6.80	14.355	Pass
16.910	H	-66.34	-61.3	5.04	16.910	Pass

Figure 15. Worst Case Spurious Emissions 960MHz – 40GHz (High Channel)

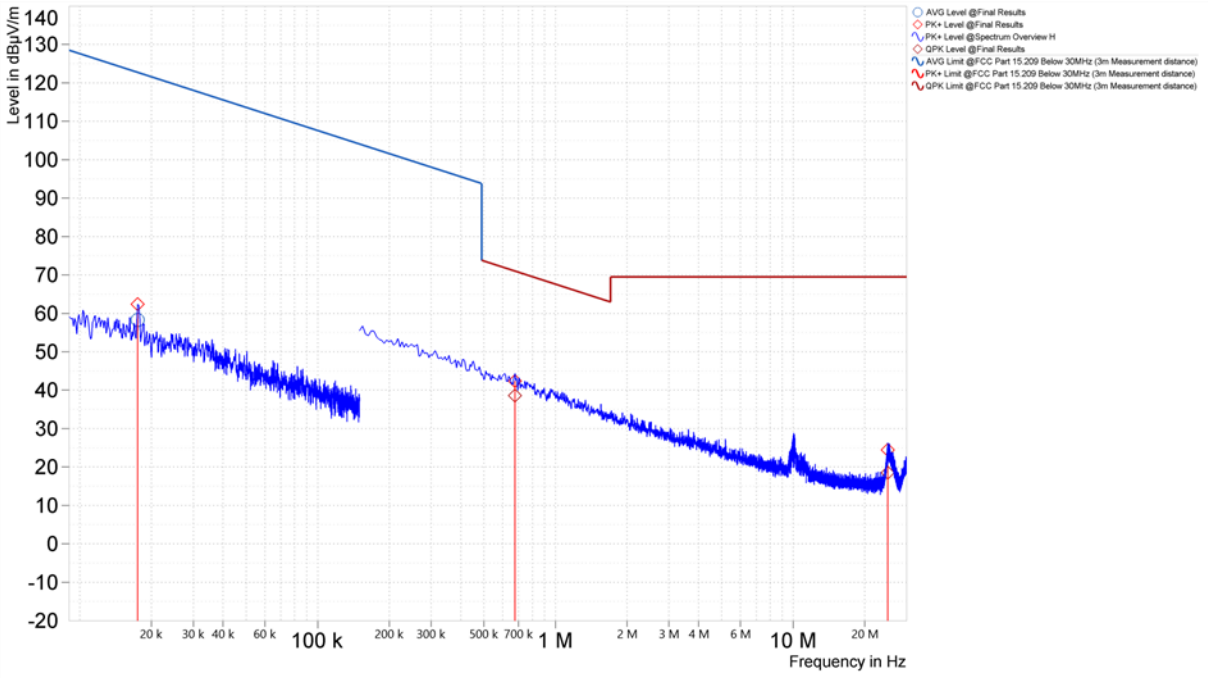


Figure 16. Radiated Emissions 9kHz – 30MHz (Coplanar Loop)

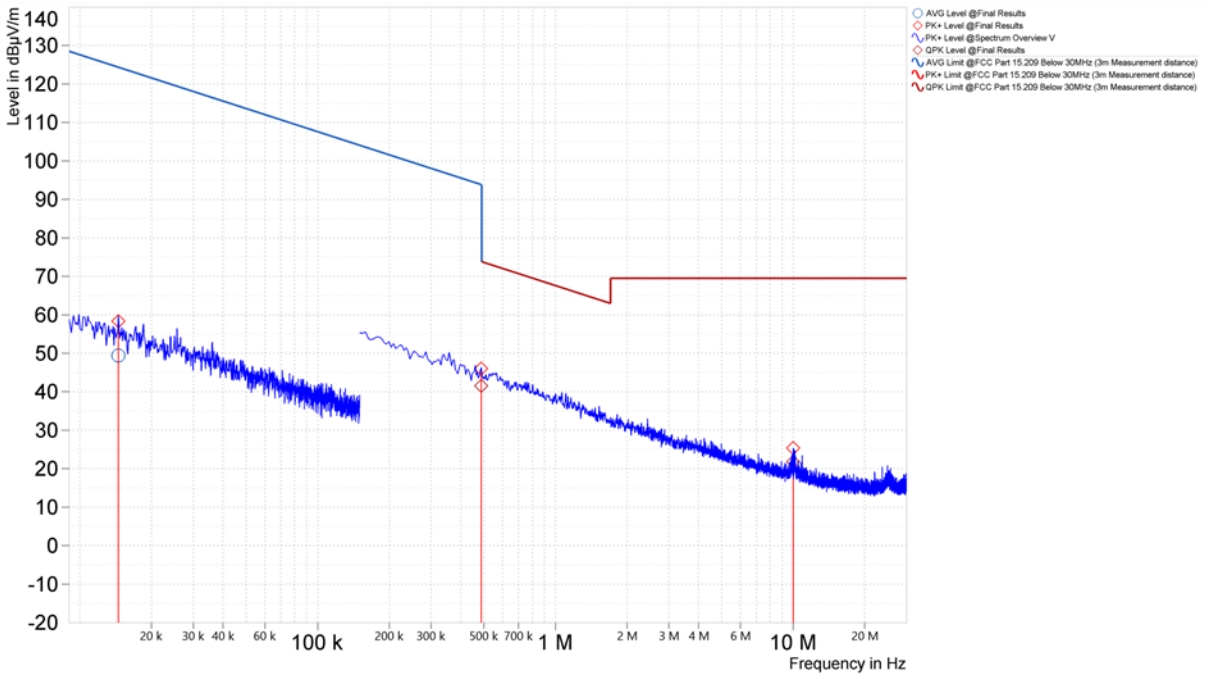


Figure 17. Radiated Emissions 9kHz – 30MHz (Coaxial Loop)

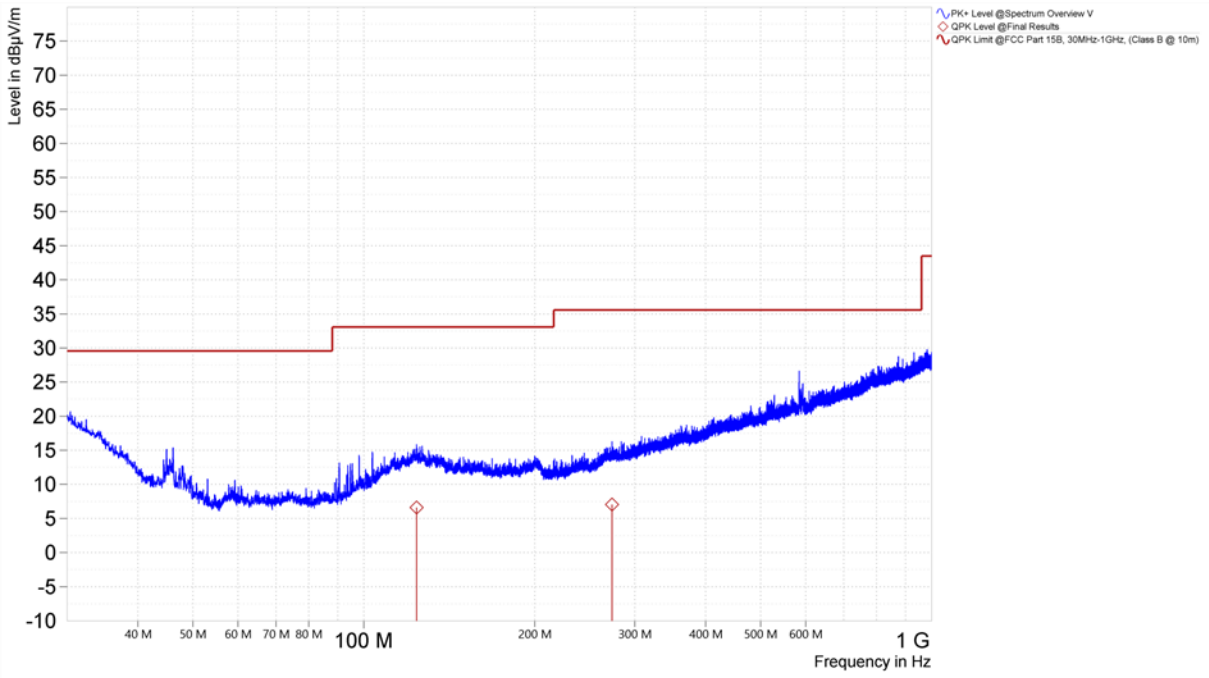


Figure 18. Radiated Emissions 30MHz-1GHz (Vertical, Low Channel)

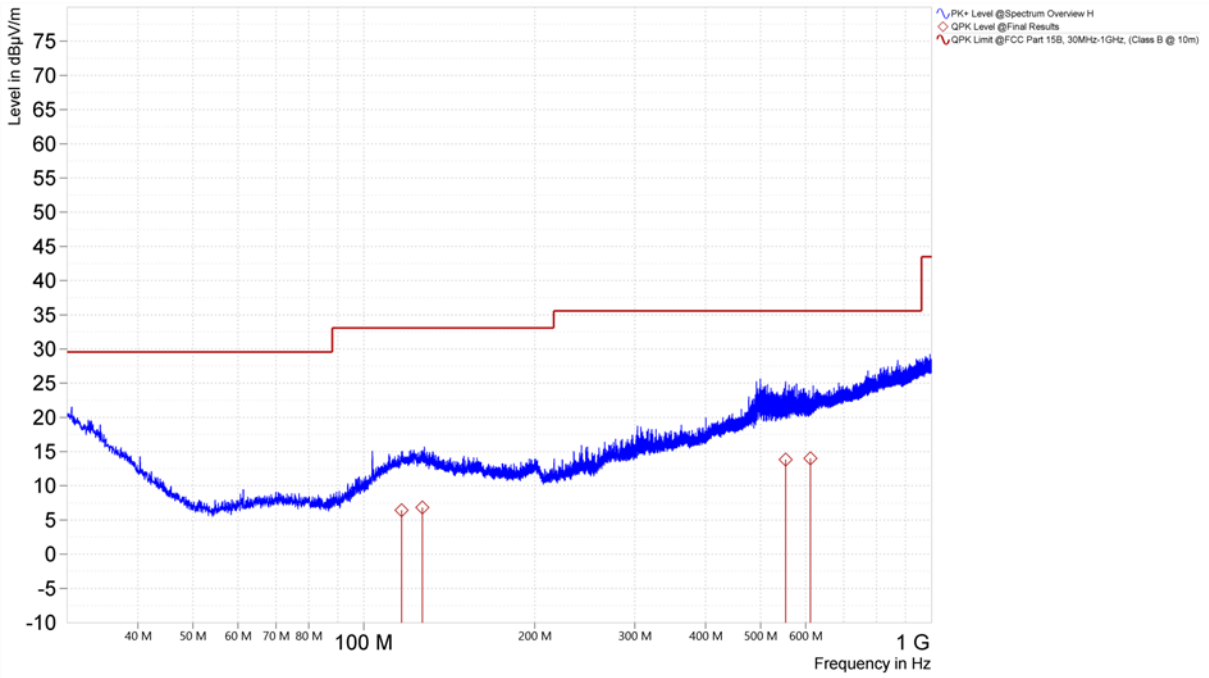


Figure 19. Radiated Emissions 30MHz-1GHz (Horizontal, Low Channel)

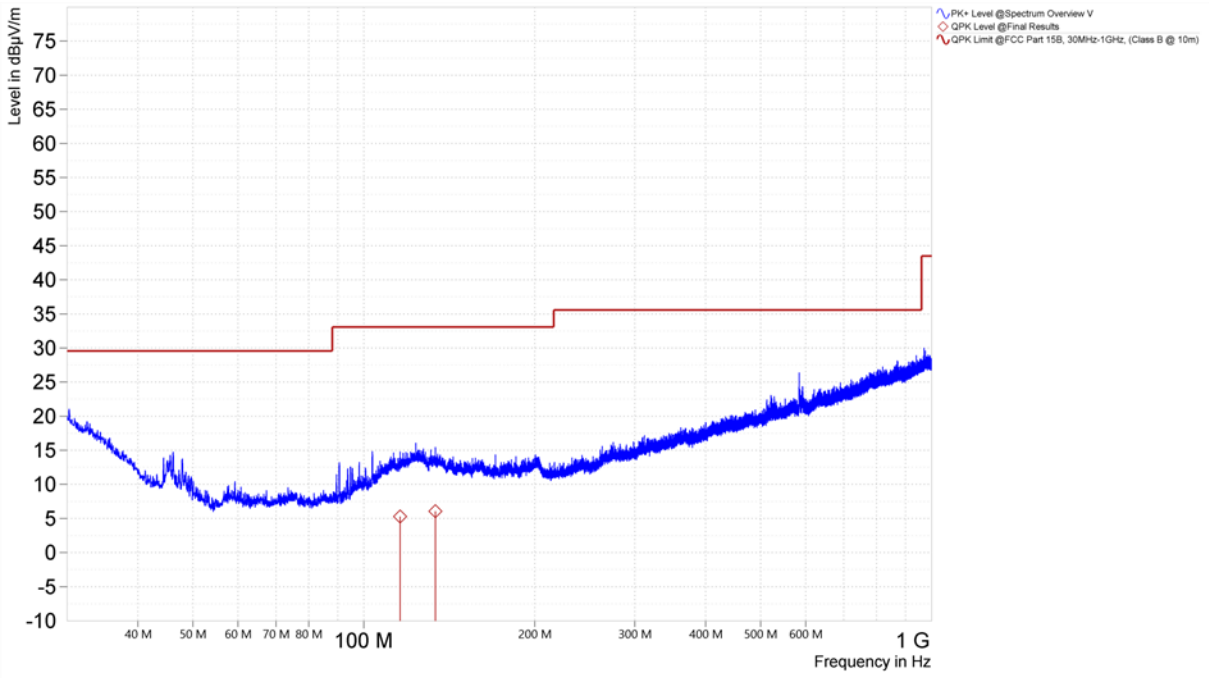


Figure 20. Radiated Emissions 30MHz-1GHz (Vertical, Mid Channel)

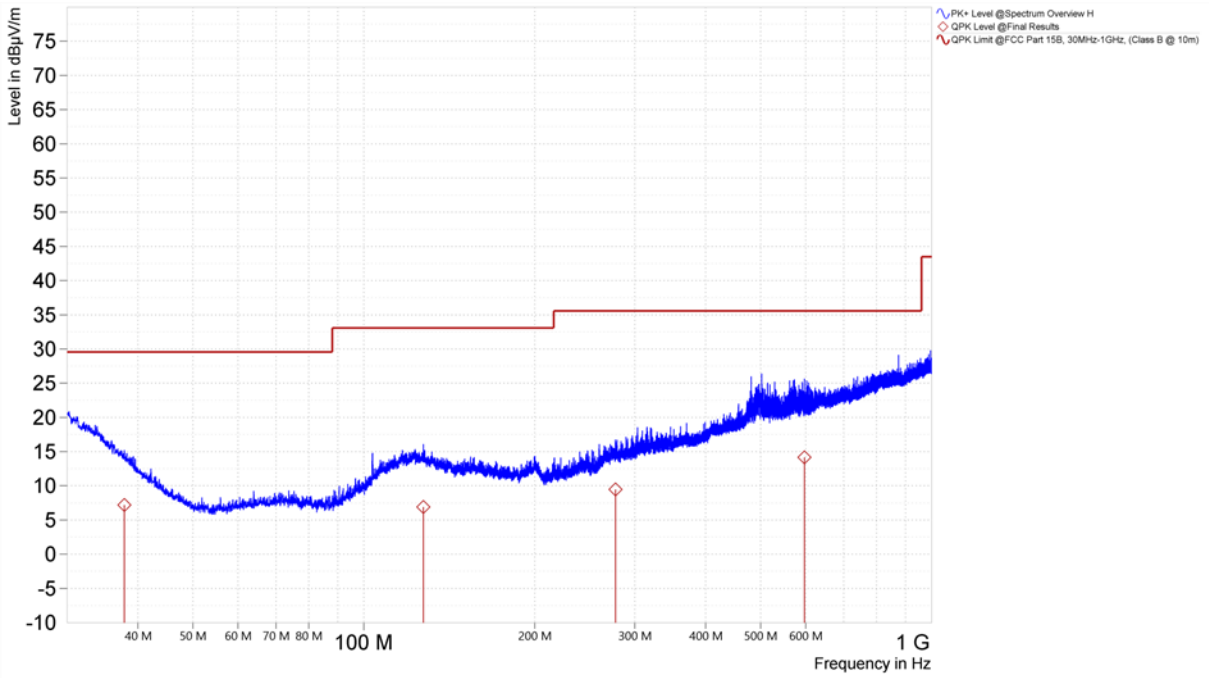


Figure 21. Radiated Emissions 30MHz-1GHz (Horizontal, Mid Channel)

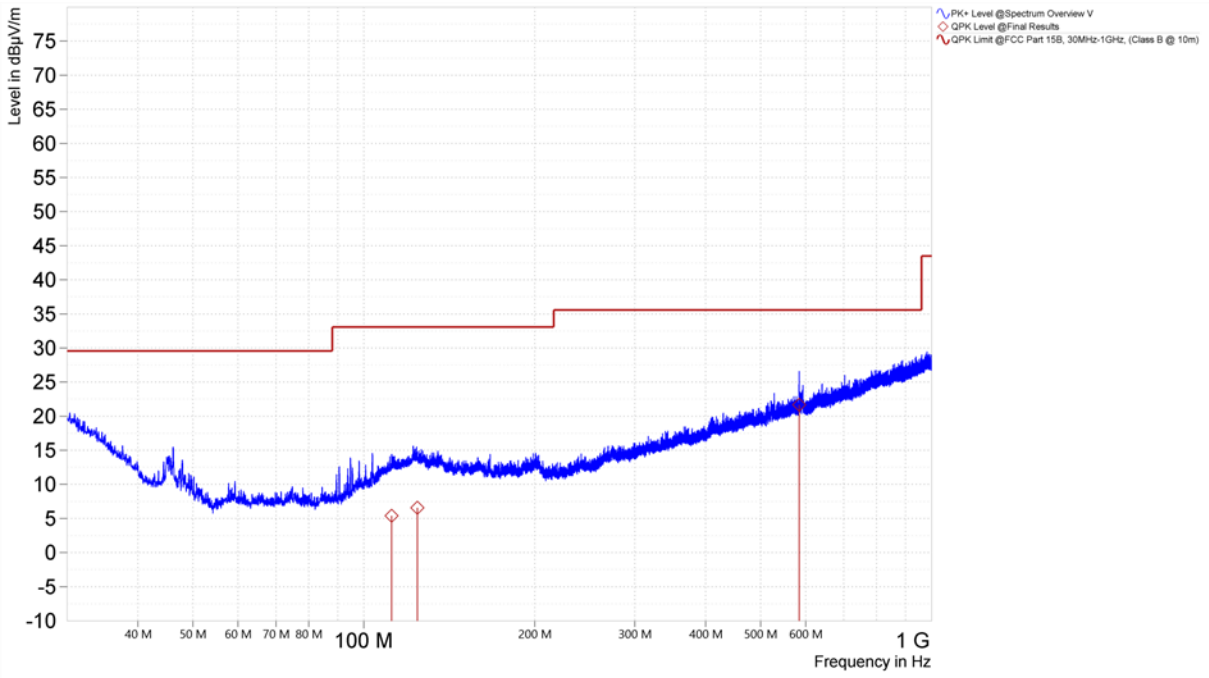


Figure 22. Radiated Emissions 30MHz-1GHz (Vertical, High Channel)

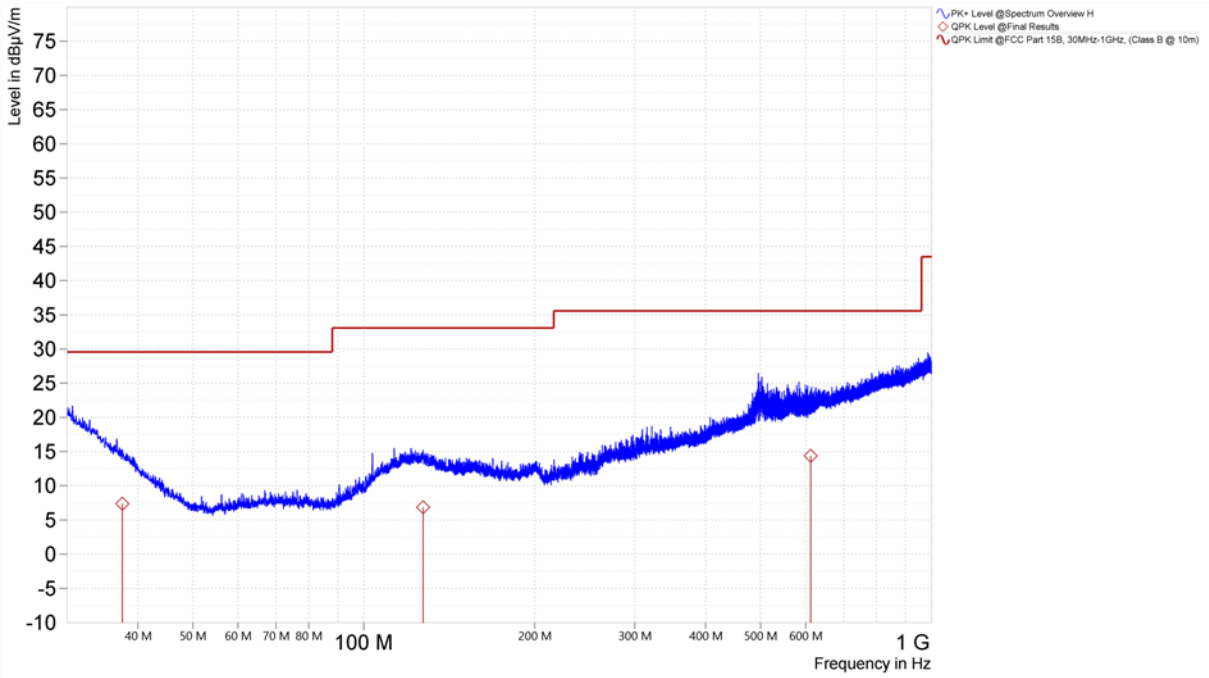


Figure 23. Radiated Emissions 30MHz-1GHz (Horizontal, High Channel)

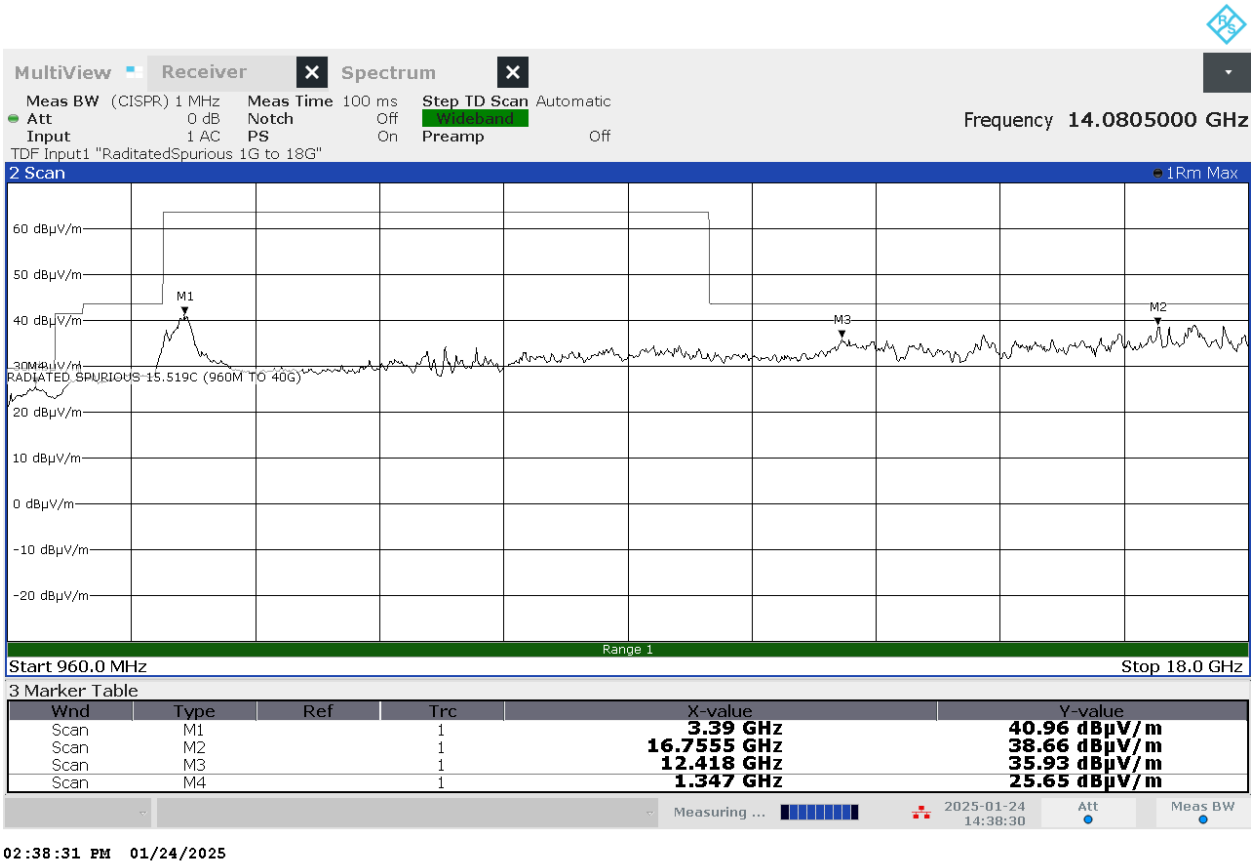


Figure 24. Radiated Emissions 960MHz – 18GHz (Vertical, Low Channel)

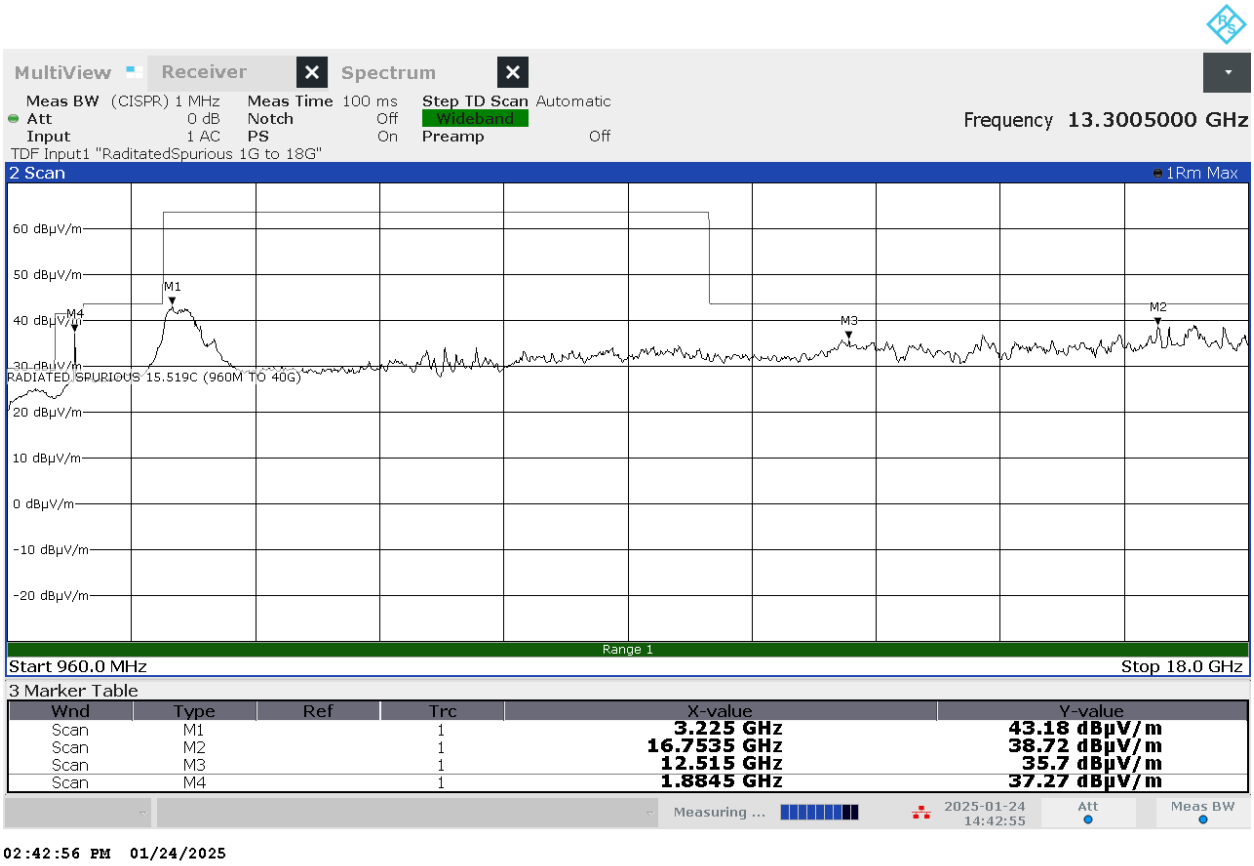


Figure 25. Radiated Emissions 960MHz – 18GHz (Horizontal, Low Channel)

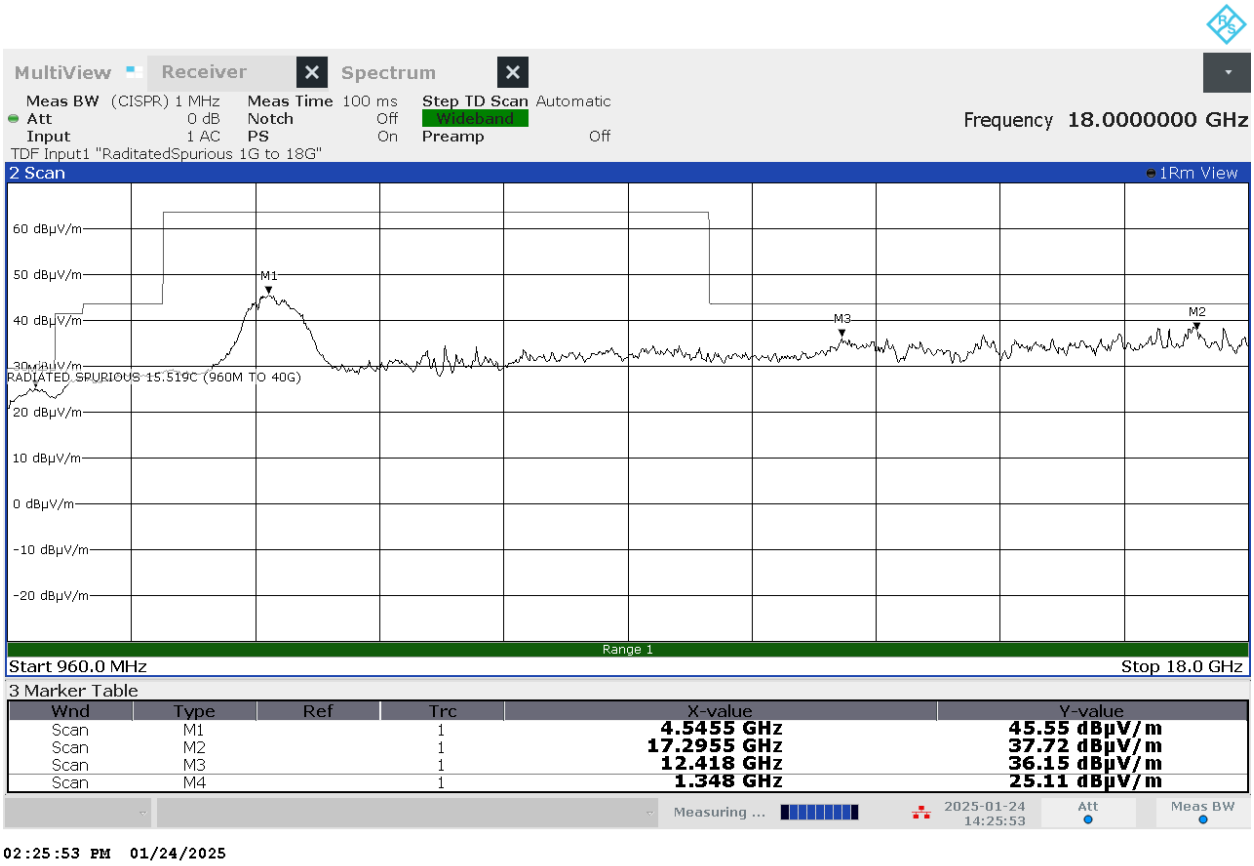


Figure 26. Radiated Emissions 960MHz – 18GHz (Vertical, Mid Channel)

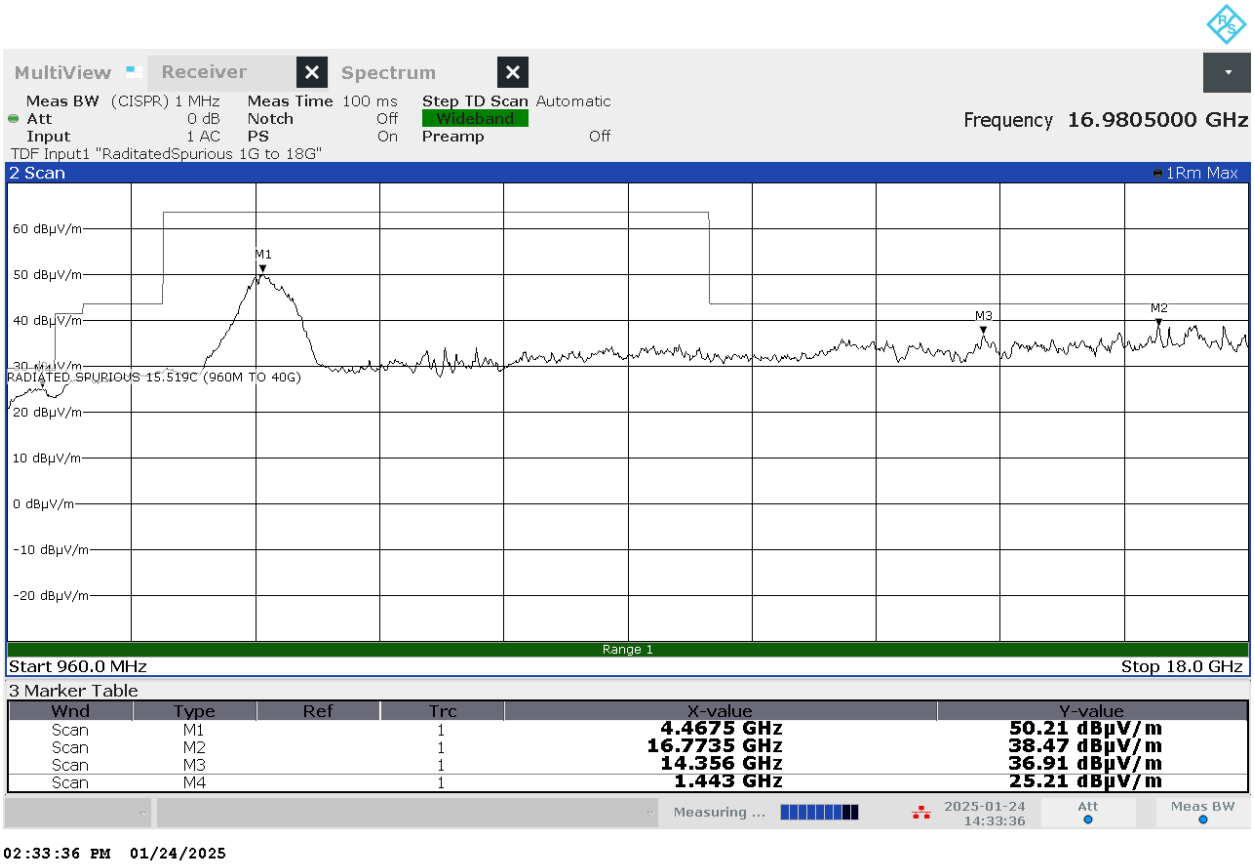


Figure 27. Radiated Emissions 960MHz – 18GHz (Horizontal, Mid Channel)

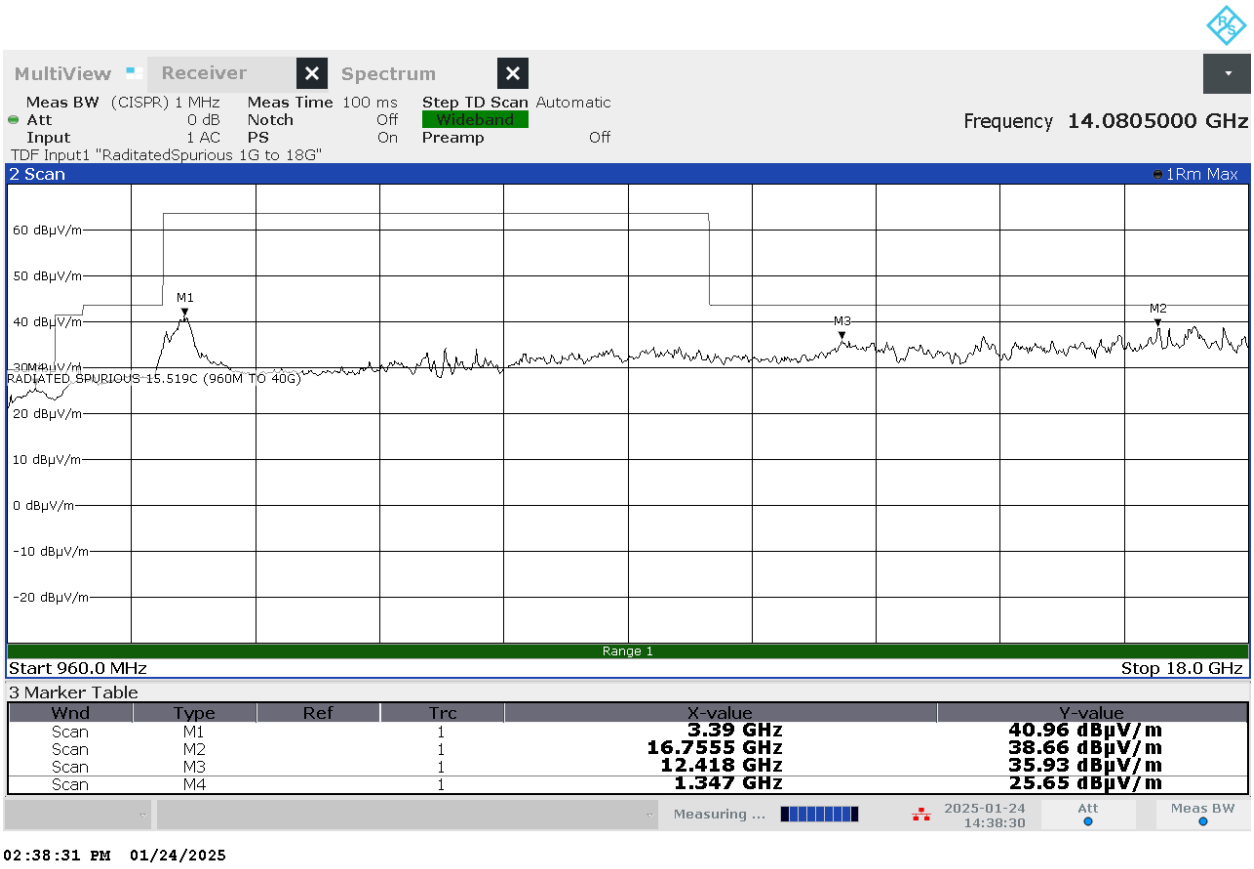


Figure 28. Radiated Emissions 960MHz – 18GHz (Vertical, High Channel)

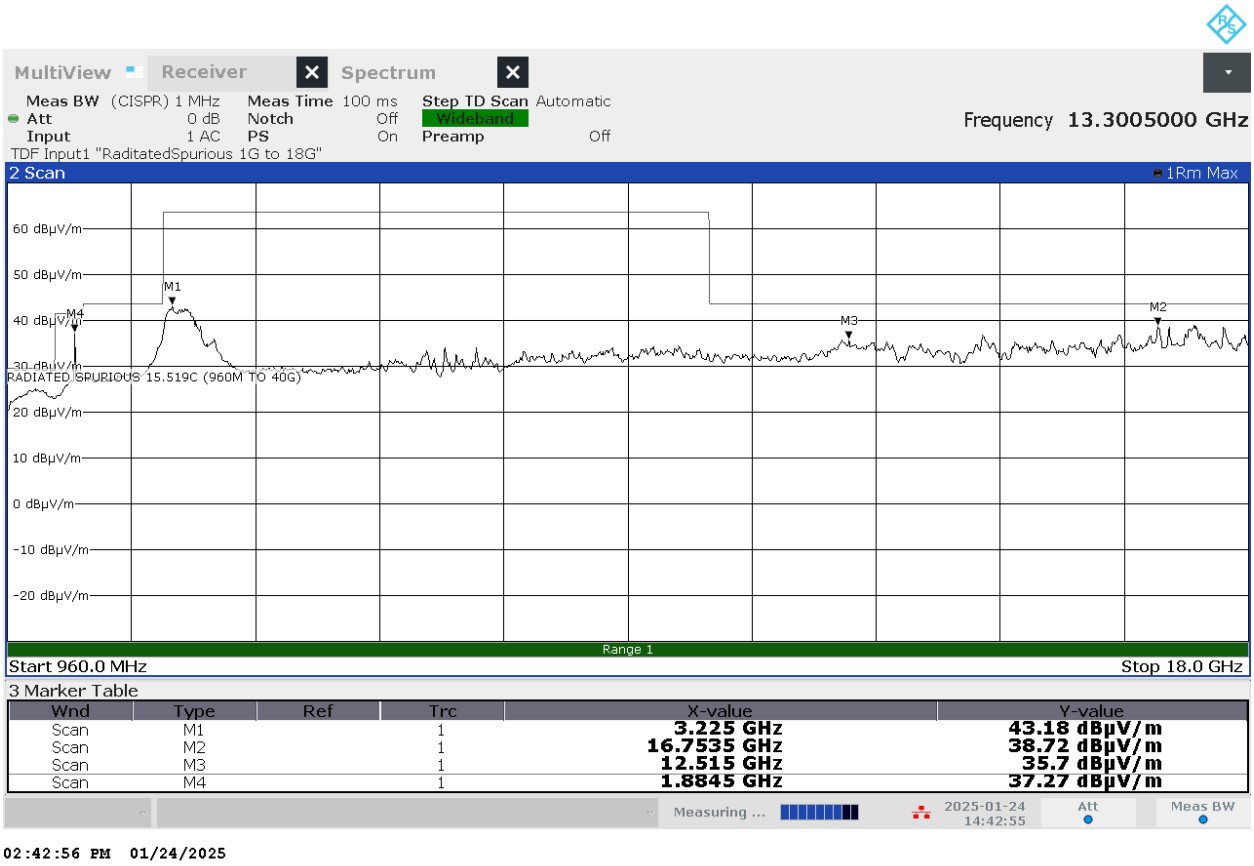


Figure 29. Radiated Emissions 960MHz – 18GHz (Horizontal, High Channel)

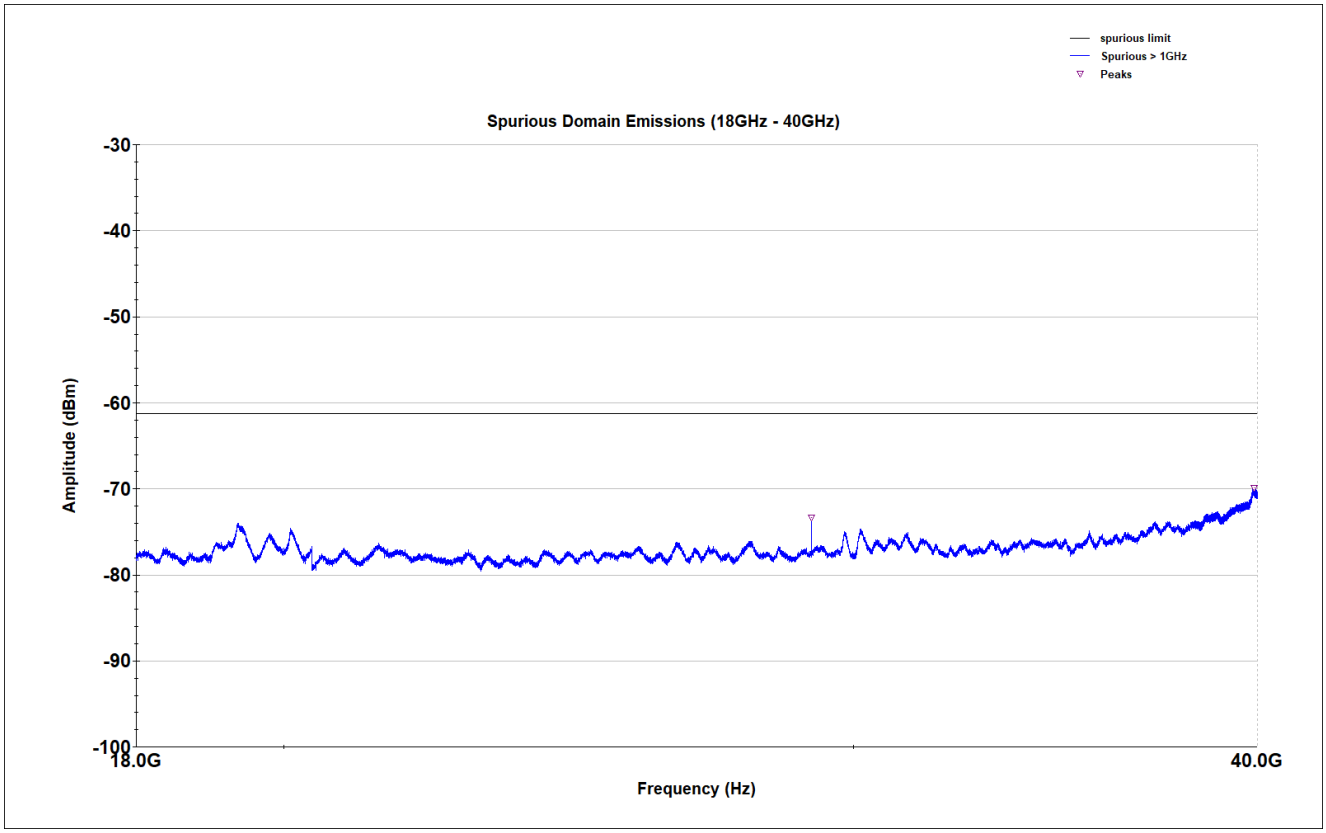


Figure 30. Radiated Emissions 18GHz – 40GHz (Low Channel)

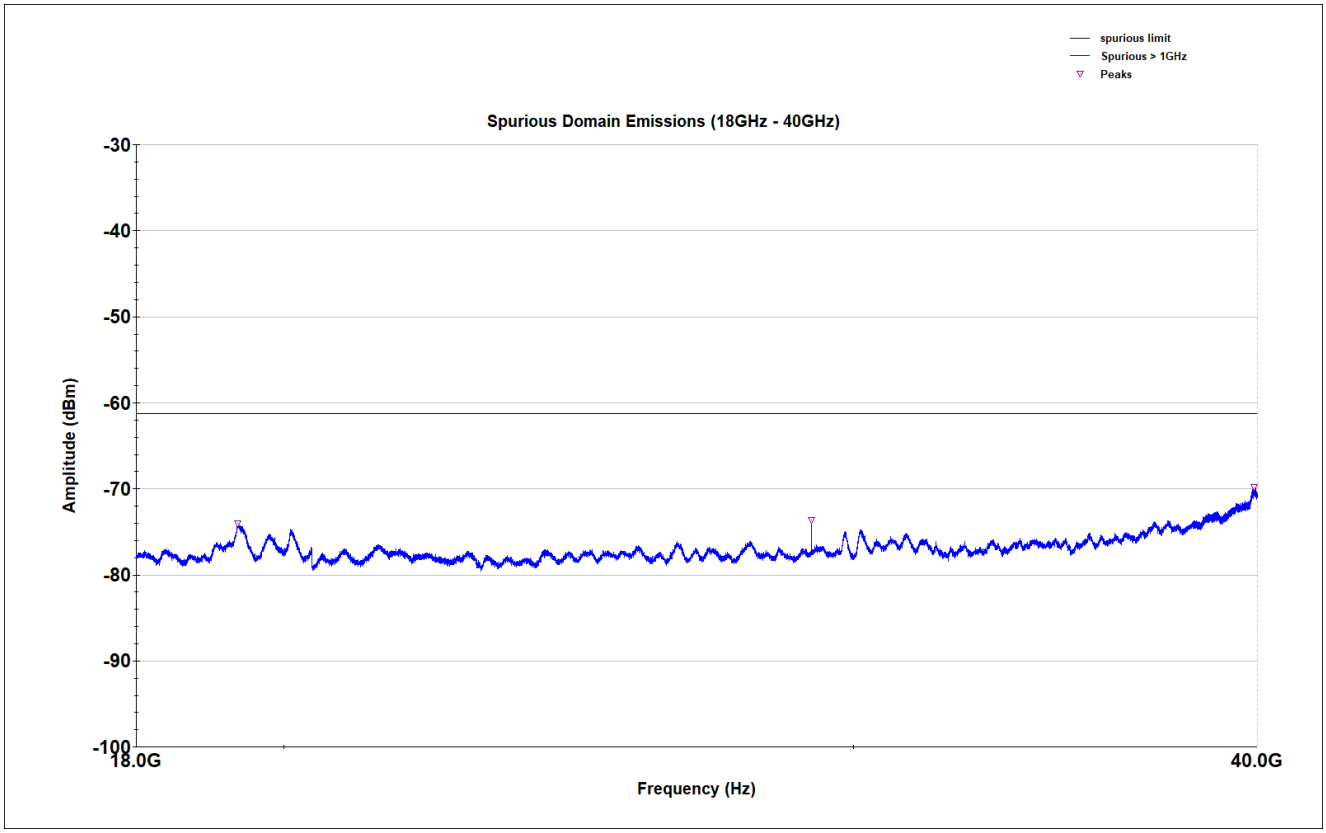


Figure 31. Radiated Emissions 18GHz – 40GHz (Mid Channel)

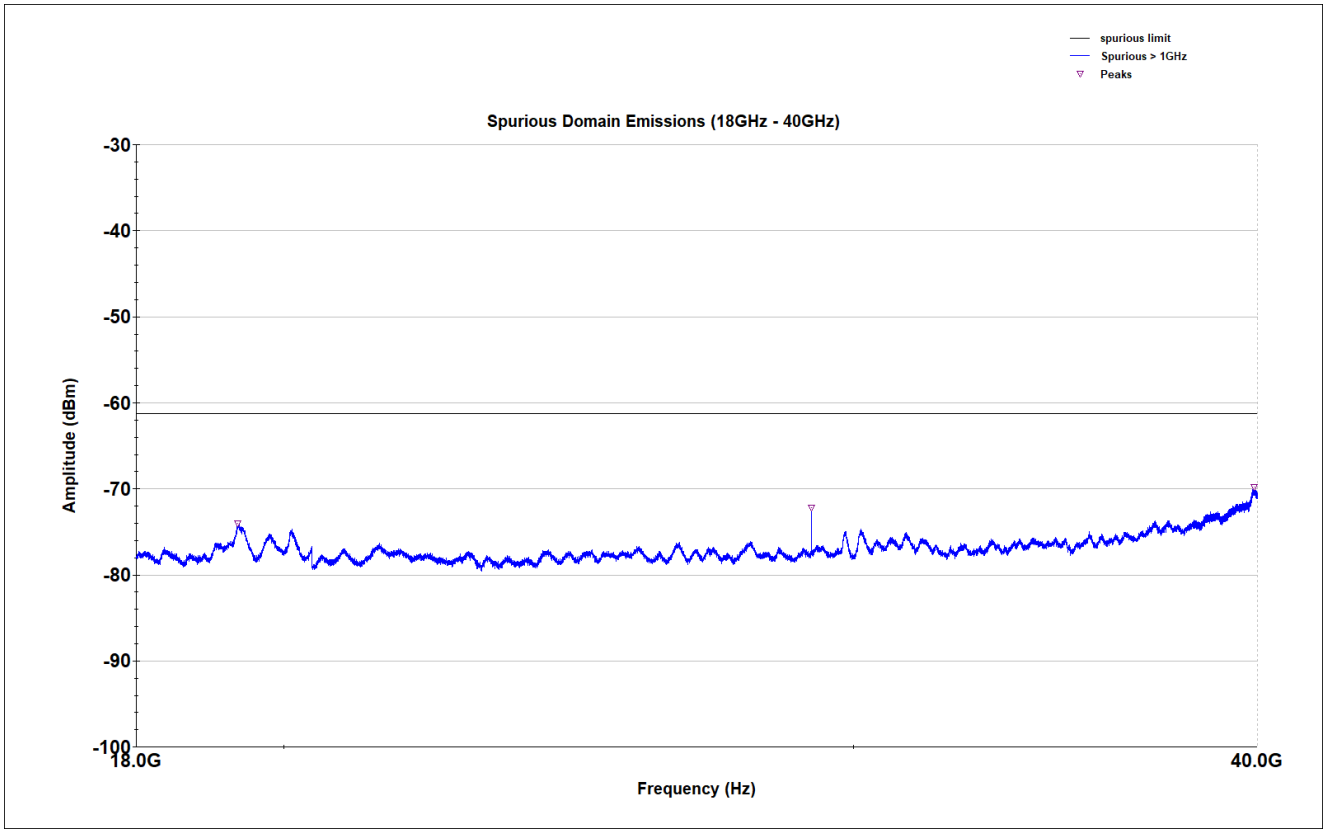


Figure 32. Radiated Emissions 18GHz – 40GHz (High Channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.519(d) Emissions in the 1164-1240MHz and 1559-1610MHz Bands

Test Requirements: **§15.519(d):** In addition to the radiated emission limits specified in the table in paragraph (c) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz

Frequency (MHz)	EIRP in dBm
1160 - 1240	-85.3
1559 - 1610	-85.3

Figure 33. Radiated Field Strength Emissions Limits from FCC Part 15.209 (a)

Test Procedure: Measurements in the 1164-1240MHz and 1559-1610MHz bands were performed using the same methodology as was used for the 15.519(c) spurious emission measurements. Per ANSI C63.10 section 10.3.10 a resolution bandwidth of 30kHz was used on the measurement instrument with RMS detection.

The analyzer settings are shown in the following table:

RBW:	30kHz	Detector:	RMS	Reference Level:	-50dBm
VBW:	100kHz	Sweep Time:	Auto	Internal Attenuation:	0dB

Figure 34. 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 **§ 15.519 (d)**.

Test Engineer: Bryan Taylor and Veer Patel

Test Date: 1/13/2025 – 1/27/2025

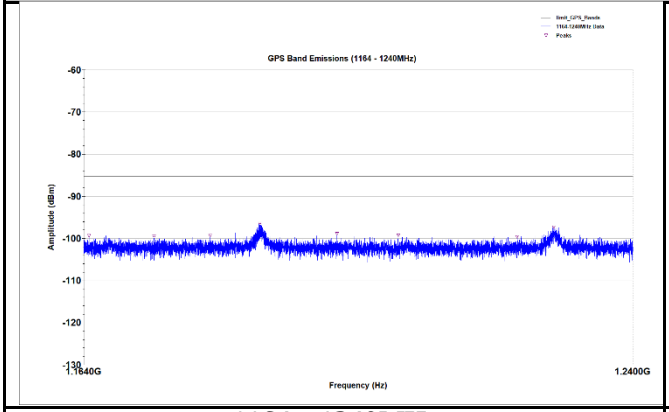
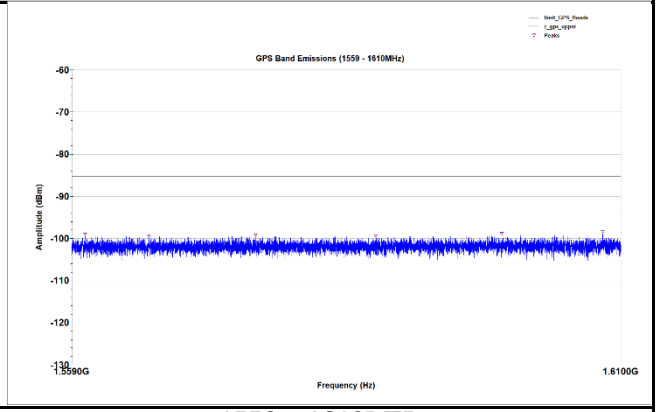
Emissions in the 1164 – 1240MHz and 1559 – 1610MHz Bands	
	
1164 – 1240MHz	1559 – 1610MHz

Figure 35. Emissions in the 1164 – 1240MHz and 1559 – 1610MHz Bands (Low Channel)

Tested Band	Frequency (MHz)	Amplitude (dBm)	Limit (dBm)	Margin (dB)	RBW	Result
1164MHz – 1240MHz	1164.722	-99.303	-85.3	14.003	30kHz	Pass
	1173.477	-99.54	-85.3	14.24	30kHz	Pass
	1181.092	-99.319	-85.3	14.019	30kHz	Pass
	1187.849	-96.462	-85.3	11.162	30kHz	Pass
	1198.451	-98.873	-85.3	13.573	30kHz	Pass
	1206.955	-99.186	-85.3	13.886	30kHz	Pass
	1223.592	-99.614	-85.3	14.314	30kHz	Pass
	1228.76	-97.335	-85.3	12.035	30kHz	Pass
1559MHz – 1610MHz	1560.219	-99.007	-85.3	13.707	30kHz	Pass
	1566.053	-99.451	-85.3	14.151	30kHz	Pass
	1575.881	-99.215	-85.3	13.915	30kHz	Pass
	1587.035	-99.39	-85.3	14.09	30kHz	Pass
	1598.8	-98.876	-85.3	13.576	30kHz	Pass
	1608.297	-98.483	-85.3	13.183	30kHz	Pass

Figure 36. Emissions in the 1164 – 1240MHz and 1559 – 1610MHz Bands (Low Channel)

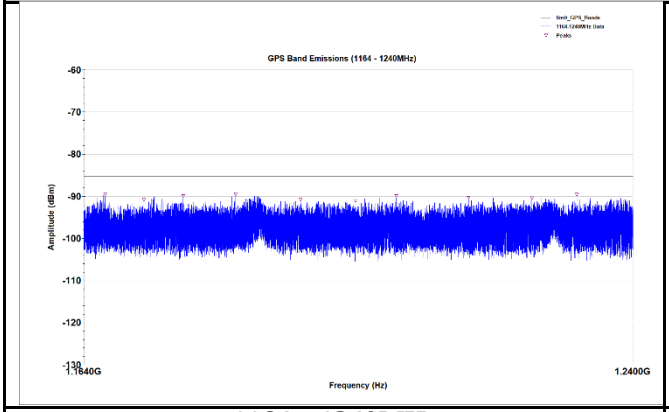
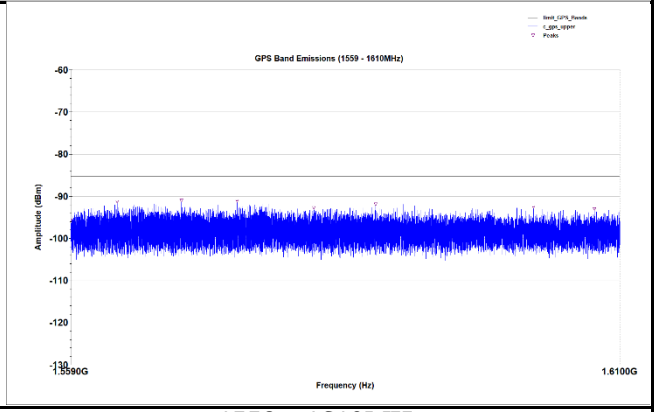
Emissions in the 1164 – 1240MHz and 1559 – 1610MHz Bands	
	
1164 – 1240MHz	1559 – 1610MHz

Figure 37. Emissions in the 1164 – 1240MHz and 1559 – 1610MHz Bands (Mid Channel)

Tested Band	Frequency (MHz)	Amplitude (dBm)	Limit (dBm)	Margin (dB)	RBW	Result
1164MHz – 1240MHz	1166.865	-89.503	-85.3	4.203	30kHz	Pass
	1172.109	-90.774	-85.3	5.474	30kHz	Pass
	1177.414	-89.942	-85.3	4.642	30kHz	Pass
	1184.543	-89.58	-85.3	4.28	30kHz	Pass
	1193.435	-90.816	-85.3	5.516	30kHz	Pass
	1200.989	-91.106	-85.3	5.806	30kHz	Pass
	1206.651	-89.929	-85.3	4.629	30kHz	Pass
	1216.767	-90.328	-85.3	5.028	30kHz	Pass
	1225.644	-90.42	-85.3	5.12	30kHz	Pass
	1231.99	-89.57	-85.3	4.27	30kHz	Pass
1559MHz – 1610MHz	1559	-95.675	-85.3	10.375	30kHz	Pass
	1563.269	-91.218	-85.3	5.918	30kHz	Pass
	1569.149	-91.001	-85.3	5.701	30kHz	Pass
	1574.28	-91.032	-85.3	5.732	30kHz	Pass
	1581.374	-92.712	-85.3	7.412	30kHz	Pass
	1587.116	-91.87	-85.3	6.57	30kHz	Pass
	1601.86	-92.514	-85.3	7.214	30kHz	Pass
	1607.593	-93.012	-85.3	7.712	30kHz	Pass

Figure 38. Emissions in the 1164 – 1240MHz and 1559 – 1610MHz Bands (Mid Channel)

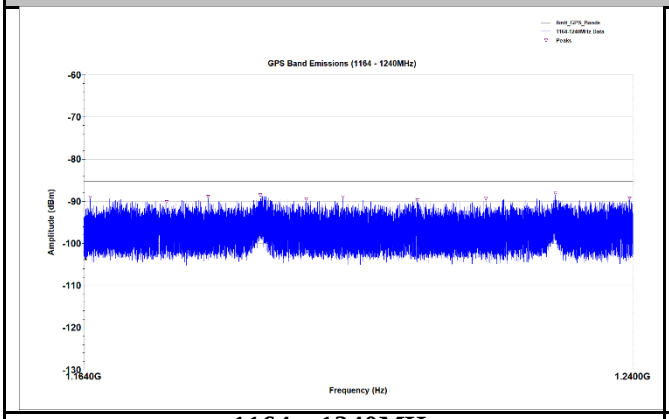
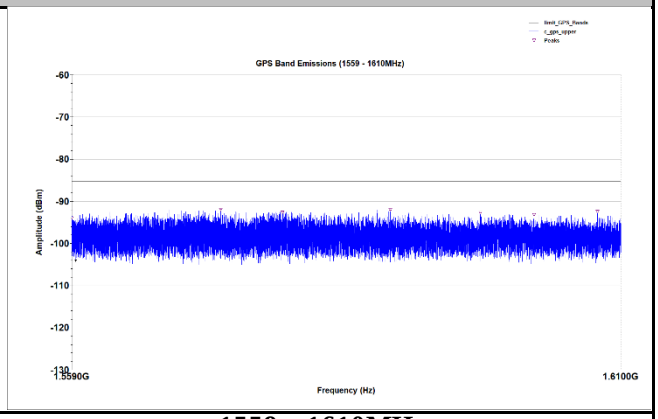
Emissions in the 1164 – 1240MHz and 1559 – 1610MHz Bands	
	
1164 – 1240MHz	1559 – 1610MHz

Figure 39. Emissions in the 1164 – 1240MHz and 1559 – 1610MHz Bands (High Channel)

Tested Band	Frequency (MHz)	Amplitude (dBm)	Limit (dBm)	Margin (dB)	RBW	Result
1164MHz – 1240MHz	1164.874	-88.983	-85.3	3.683	30kHz	Pass
	1175.149	-90.088	-85.3	4.788	30kHz	Pass
	1180.811	-88.898	-85.3	3.598	30kHz	Pass
	1187.925	-88.498	-85.3	3.198	30kHz	Pass
	1194.24	-89.565	-85.3	4.265	30kHz	Pass
	1199.272	-88.949	-85.3	3.649	30kHz	Pass
	1209.608	-89.698	-85.3	4.398	30kHz	Pass
	1219.168	-89.322	-85.3	4.022	30kHz	Pass
	1228.98	-88.075	-85.3	2.775	30kHz	Pass
	1239.521	-89.263	-85.3	3.963	30kHz	Pass
1559MHz – 1610MHz	1559	-93.995	-85.3	8.695	30kHz	Pass
	1572.673	-91.895	-85.3	6.595	30kHz	Pass
	1578.39	-92.577	-85.3	7.277	30kHz	Pass
	1588.401	-92.083	-85.3	6.783	30kHz	Pass
	1596.781	-92.746	-85.3	7.446	30kHz	Pass
	1601.825	-93.172	-85.3	7.872	30kHz	Pass
	1607.792	-92.409	-85.3	7.109	30kHz	Pass

Figure 40. Emissions in the 1164 – 1240MHz and 1559 – 1610MHz Bands (High Channel)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.519(e) Peak EIRP

Test Requirement: **15.519(e)** There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, fM. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in § 15.521.

Test Procedure: The radiated emission methodology referenced in ANSI C63.10: 2013 was utilized in order to assess peak EIRP of the UWB device. The test sample was placed on an 150cm high table and was rotated 360 degrees and examined in three orthogonal axis during the test. A horn antenna was positioned 3m away and was scanned from 1-4 meters in height in vertical and horizontal polarities. The measurement instrument used was configured for peak detection using a 50MHz resolution bandwidth. The worst case field strength contained within a 50MHz bandwidth centered on the frequency at which the highest emission occurred was recorded (in dBuV/m). The field strength measurement was then converted to power terms (in dBm) for comparison to the 0dBm limit in part 15.519(e). The formula from ANSI C63.10 Section 10.3.9 (formula 34) was used to convert from field strength to power terms:

$$\mathrm{EIRP}\left(\mathrm{dBm}\right) = E\left(\mathrm{dB\mu V/m}\right) - 95.3$$

Test Results: The EUT was compliant with the peak EIRP limit from **§15.519(e)**.

Test Engineer: Bryan Taylor and Veer Patel

Test Date: 1/24/2025

Transmit Channel	Frequency (GHz)	Polarity (V/H)	Amplitude (dBuV/m)	Amplitude (dBm)	Limit (dBm)	Margin (dB)	RBW	Result
Low	3.1139	V	76.85	-18.45	0	18.45	50MHz	Pass
Low	3.1139	H	78.79	-16.51	0	16.51	50MHz	Pass
Mid	4.4286	V	75.97	-19.33	0	19.33	50MHz	Pass
Mid	4.4286	H	79.10	-16.20	0	16.20	50MHz	Pass
High	5.7753	V	77.66	-17.64	0	17.64	50MHz	Pass
High	5.7753	H	78.18	-17.12	0	17.12	50MHz	Pass

Figure 41. Peak EIRP Measurements

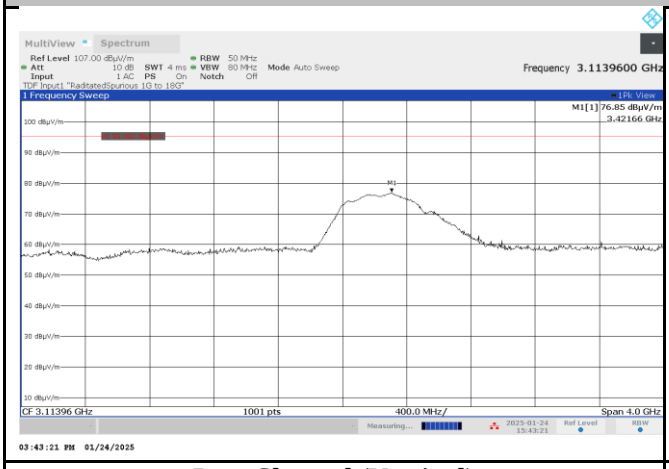
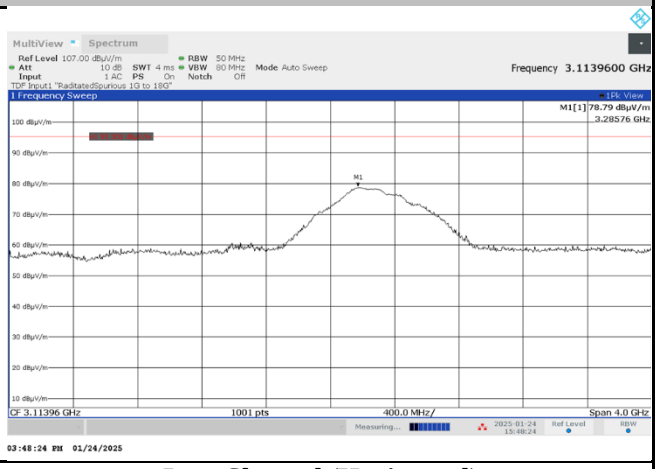
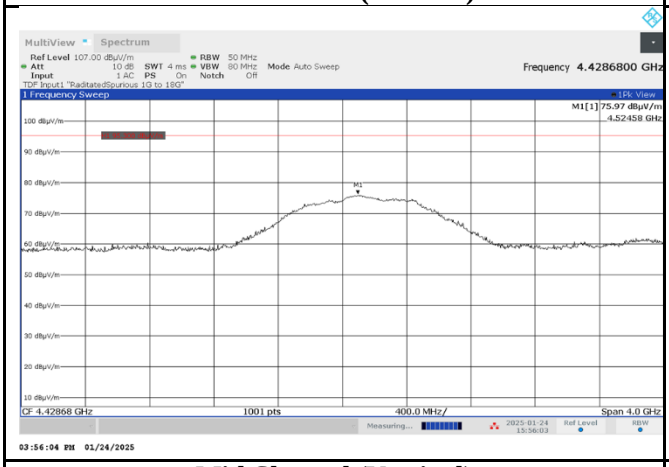
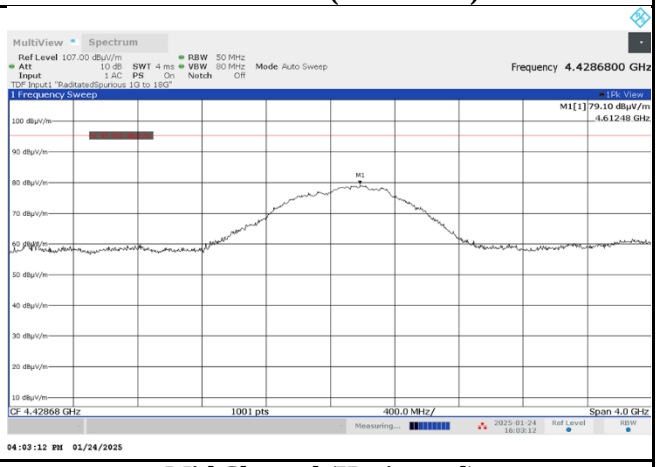
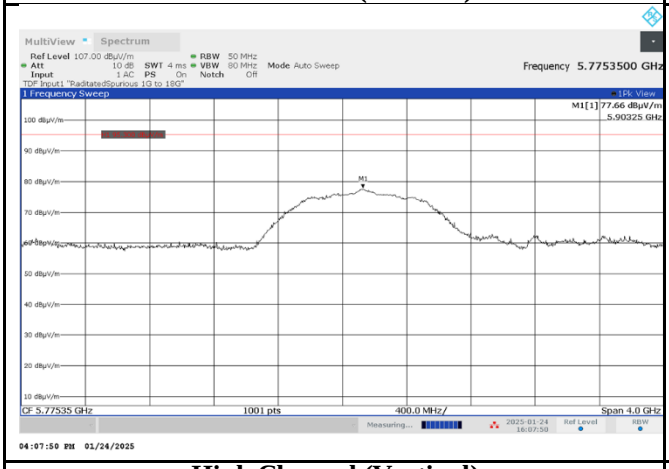
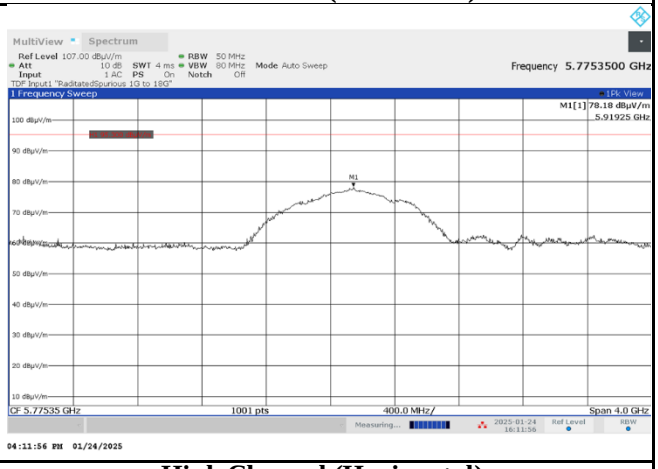
Peak EIRP Power Plots	
	
Low Channel (Vertical)	Low Channel (Horizontal)
	
Mid Channel (Vertical)	Mid Channel (Horizontal)
	
High Channel (Vertical)	High Channel (Horizontal)

Figure 42. Peak EIRP Power Plots

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.

Asset #	Description	Manufacturer	Model	Last Cal Date	Cal Due Date
1A1250	Receiver	Rohde & Schwarz	ESW44	04/08/2024	04/08/2025
1A1234	FSV Signal Analyzer	Rohde & Schwarz	FSV 40	1/23/2023	02/23/2025
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	04/06/2025
1A1047	Horn Antenna (1GHz – 18GHz)	ETS - Lindgren	3117	06/26/2024	06/26/2025
1A1161	Horn Antenna (18GHz – 40GHz)	ETS Lindgren	3116C	08/01/2024	08/01/2026
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 6. Test Equipment List

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

End of Report