



TECHNICAL REPORT:

Finalmouse, LLC Ultralight X Lion and Tiger Antenna Analysis Report

Prepared for: [Finalmouse, LLC]

Prepared by: [Timothy Milam]

1 Revision History

REV	Date	Author	Notes
[0.1]	[2024-03-21]	[Timothy Milam]	Images and Measurement Data Report for Ultralight X “Lion” and “Tiger”

Finalmouse, LLC supplied Ultralight X Lion and Ultralight X Tiger samples for antenna impedance match and radiated pattern measurements and analysis. The data below represents the result of the measurements.

2 Test Equipment Used

 Vector Network Analyzer “VNA” used was a CMT (Copper Mountain Technologies) Model: S5085; a 50 Ohm, 2-Port, 2-Path, 9 kHz to 8.5 GHz, S/N: 20107496.

 A CIA (Custom Integrated Antennas) custom designed and built, 13 ft. x 9 ft. x 9 ft. anechoic antenna measurement chamber fully lined with Cumming Microwave “C-RAM SFC-18”, 18 in. deep pyramidal absorber and associated Cumming Microwave corner treatments and walkway absorber, see image below.

 Chamber source antenna is a RF Spin Model: QRH11, Quad Ridged Horn Antenna, S/N: 200721Q11.

 Various Mini-Circuits “Flex Test” test cables and Precision Pasternack connectors and adapters were used in the closed system setup, as well as Teledyne Model: “CCR33S80T” SPDT coaxial switches.

 Calibrated 100 mm RG-178/MMCX DUT test cable.

 Calibrated 100 mm 1.37 mm /U.FL DUT test cable.

 Two Teledyne CCR33S80T coaxial switches, Lot #: TR 109-71-M.

 Two TrackLife Model MDC01 Variable Regulated (0 – 30 V / 5 A max) power supplies.

 CMT (Copper Mountain Technologies) Model: TW-SMA Torque Wrench (no S/N).

 CMT (Copper Mountain Technologies) Model: S911T 3.5 mm Calibration Kit, SN: A266049.

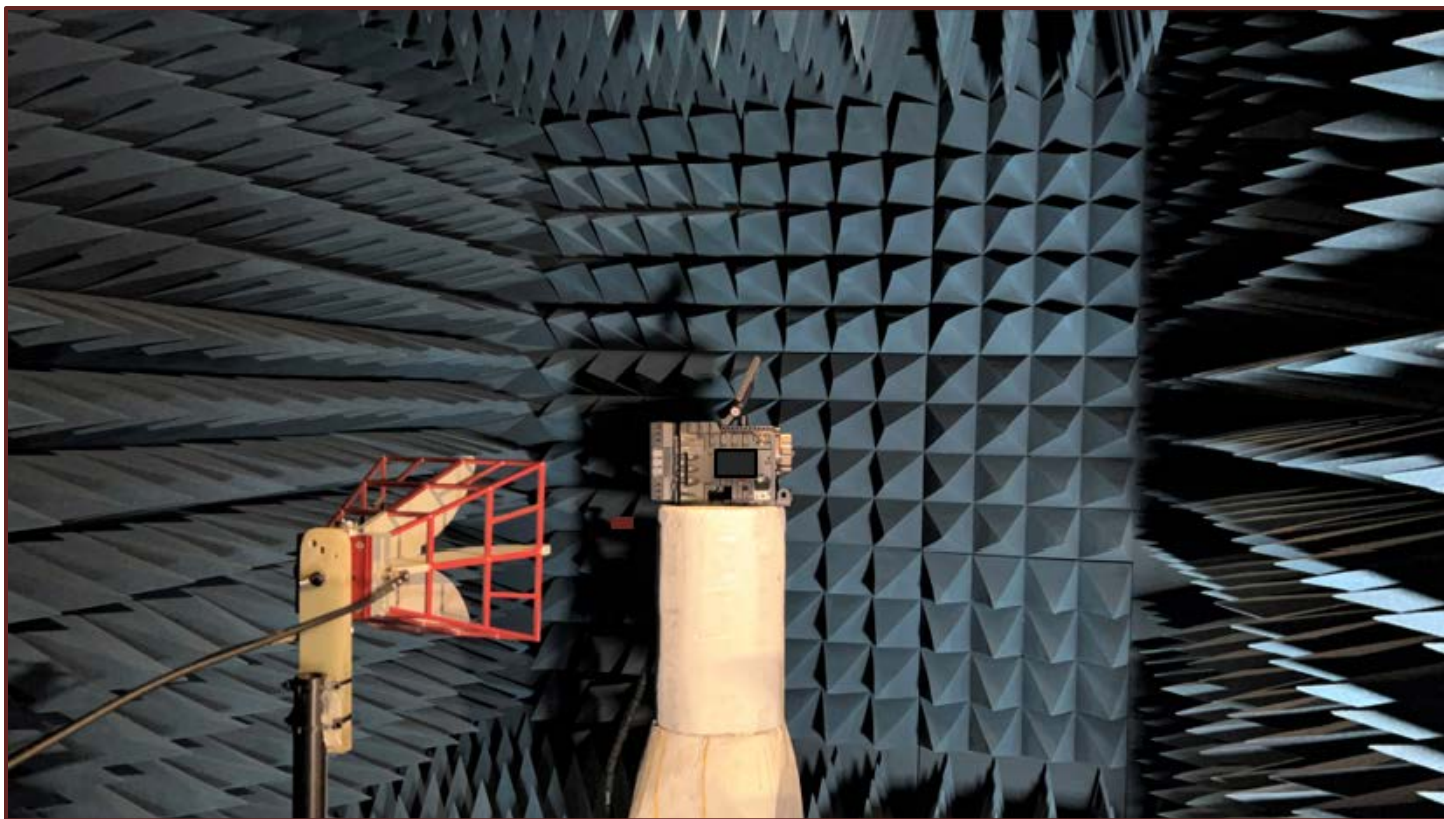
 Fluke Model 117 Digital Multimeter, S/N: 38480875WS.

 Omano 7x to 45 x trinocular microscope, with Hayear Model: HY-5099 (no S/N) Industrial Inspection Camera and SW.

 Mitutoyo, 6 in. ± 0.001 in., Digital Caliper, Model: CD-6 CS, S/N: 0422822.

 Canon EOS 5D Camera, with numerous lenses, ranging from MP-E 65 extreme macro to EF 100 – 400 mm Zoom (as needed), numerous flash and lighting solutions, tripods, and numerous other accessories.

 Apple iPhone Model 13 Pro Max camera.



CIA's Anechoic Chamber

3 DUTs Tested

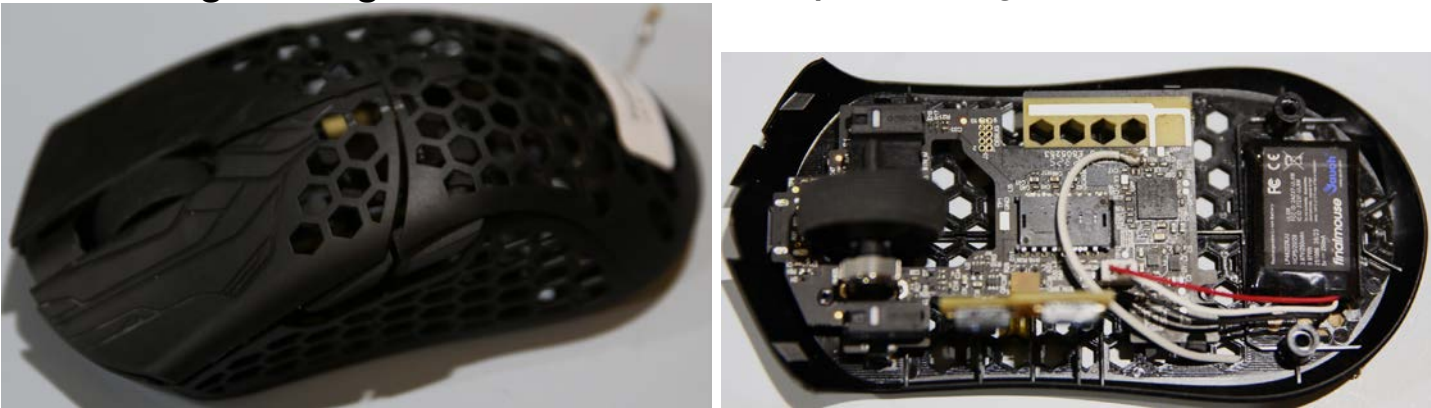
3.1 Ultralight X Lion; *also referred to in this report as “Medium”.*



Ultralight X Lion external and internal pictures intentionally showing the “as manufactured” state of the product for reference.

NOTE: The same PCBA was (is) used in the Ultralight X Lion and Ultralight X Tiger during testing of both products. Therefore, the PCBA and assembly used for testing the Lion model is shown in the internal picture of the Ultralight X Tiger below. The only difference between the physical configuration of the two products is a slight increase in the distance between the PCBA and the Ultralight X Tiger housing, due to the larger housing of the Ultralight X Tiger vs. the slightly smaller housing of the Ultralight X Lion.

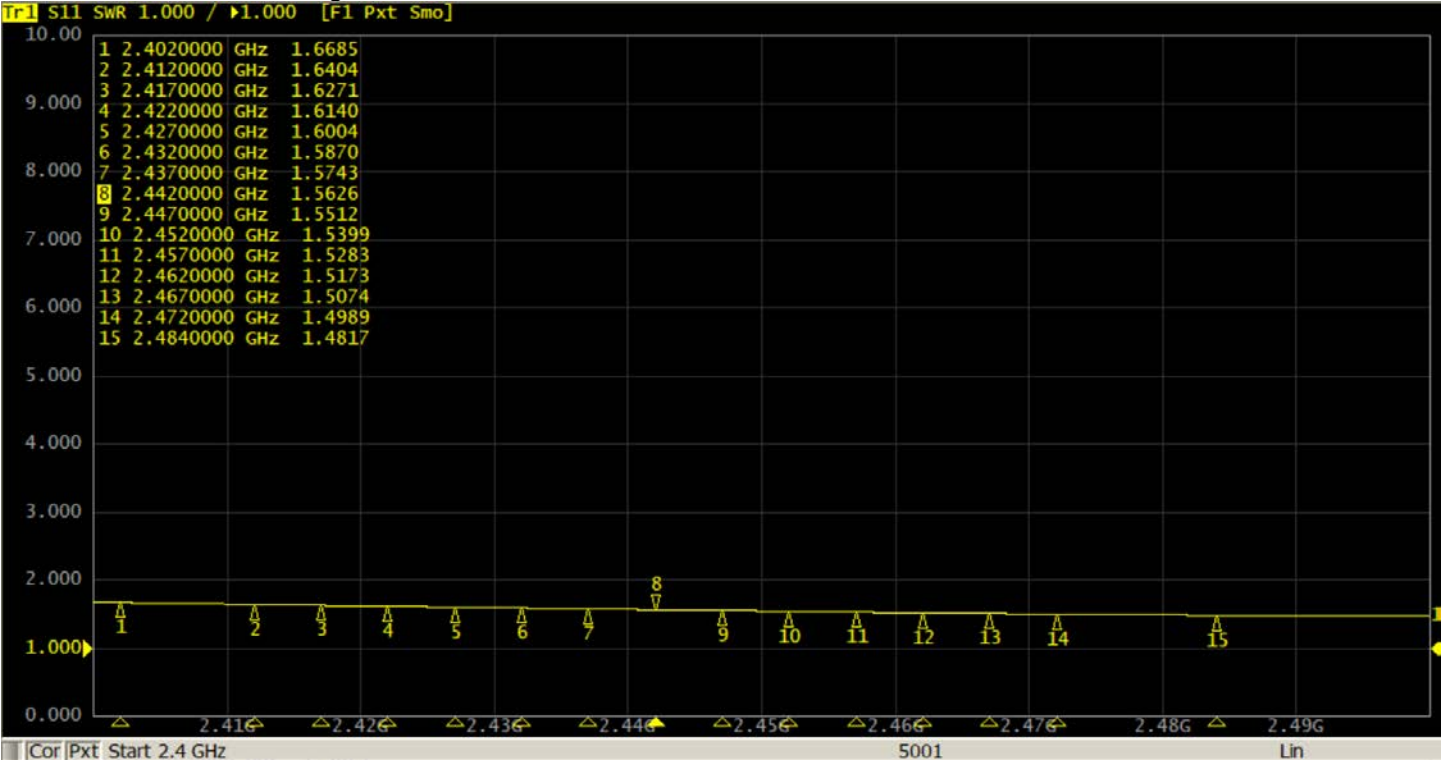
3.2 Ultralight X Tiger; also referred to in this report as “Large”.



External and internal pictures of the Ultralight X Tiger as tested.
NOTE: The PCBA shown on the right is the same PCBA used in the Ultralight X Lion product during testing of its impedance and radiated gain patterns.

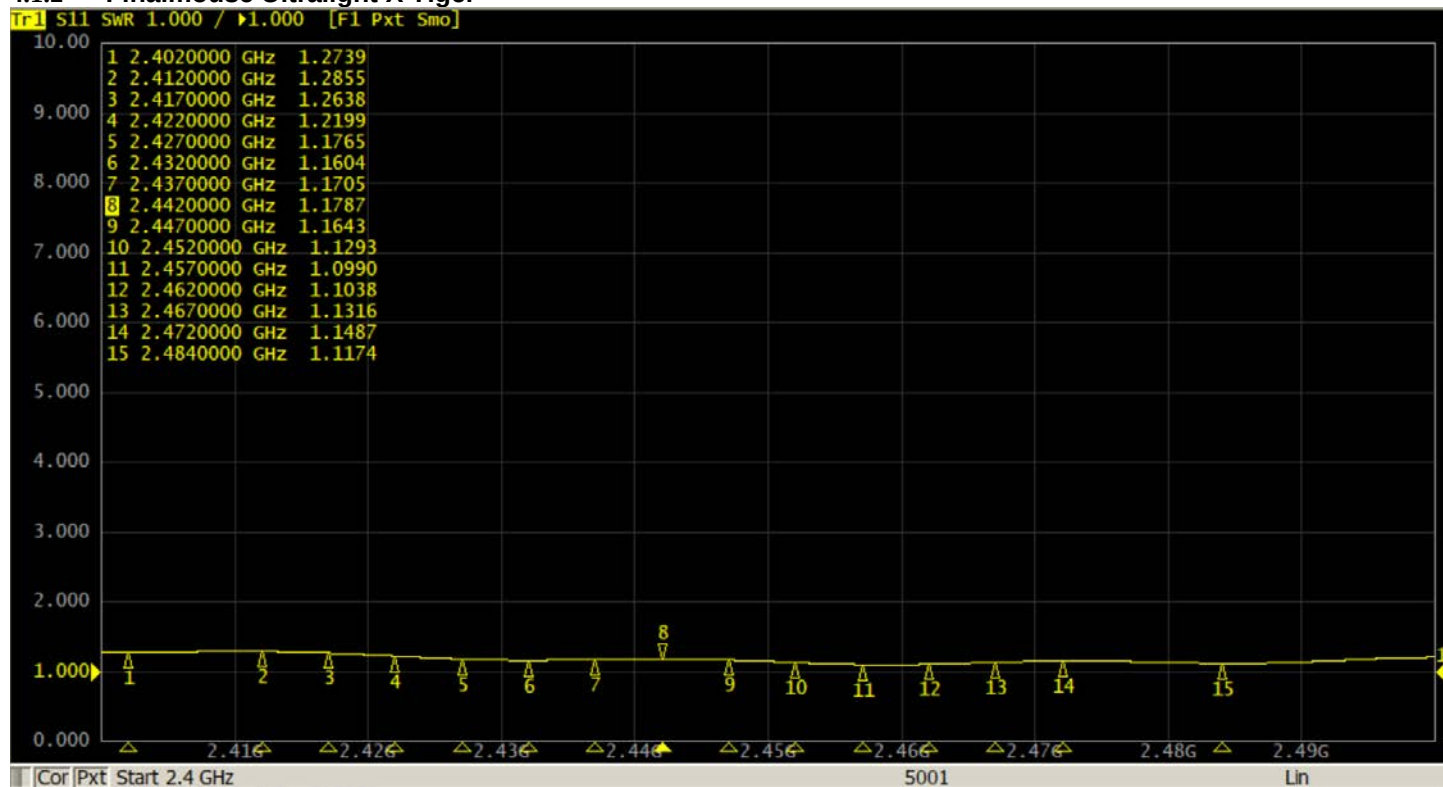
4 Measured Data

4.1 VSWR Data
4.1.1 Finalmouse Ultralight X Lion



VSWR of the Ultralight X Lion as tested.

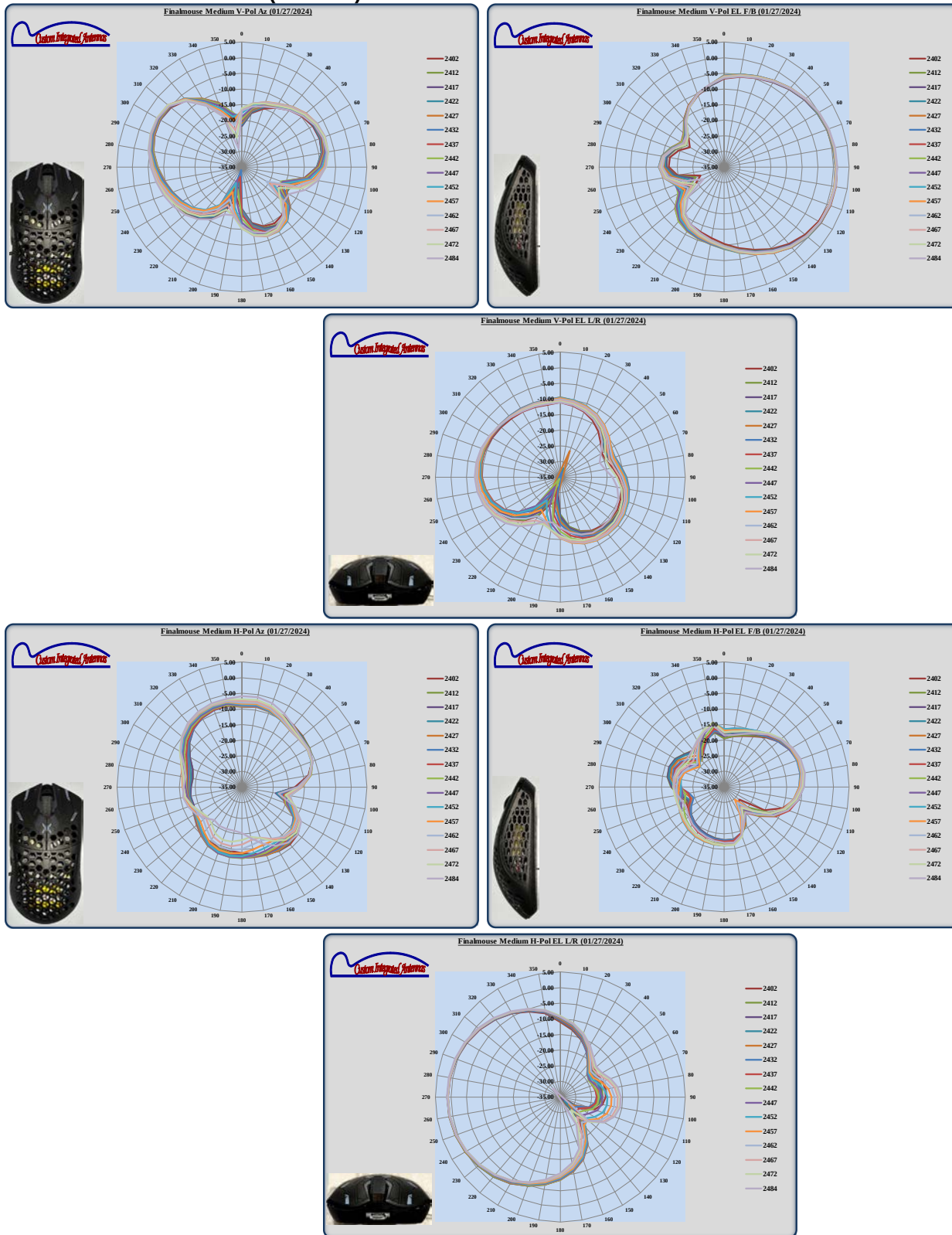
4.1.2 Finalmouse Ultralight X Tiger



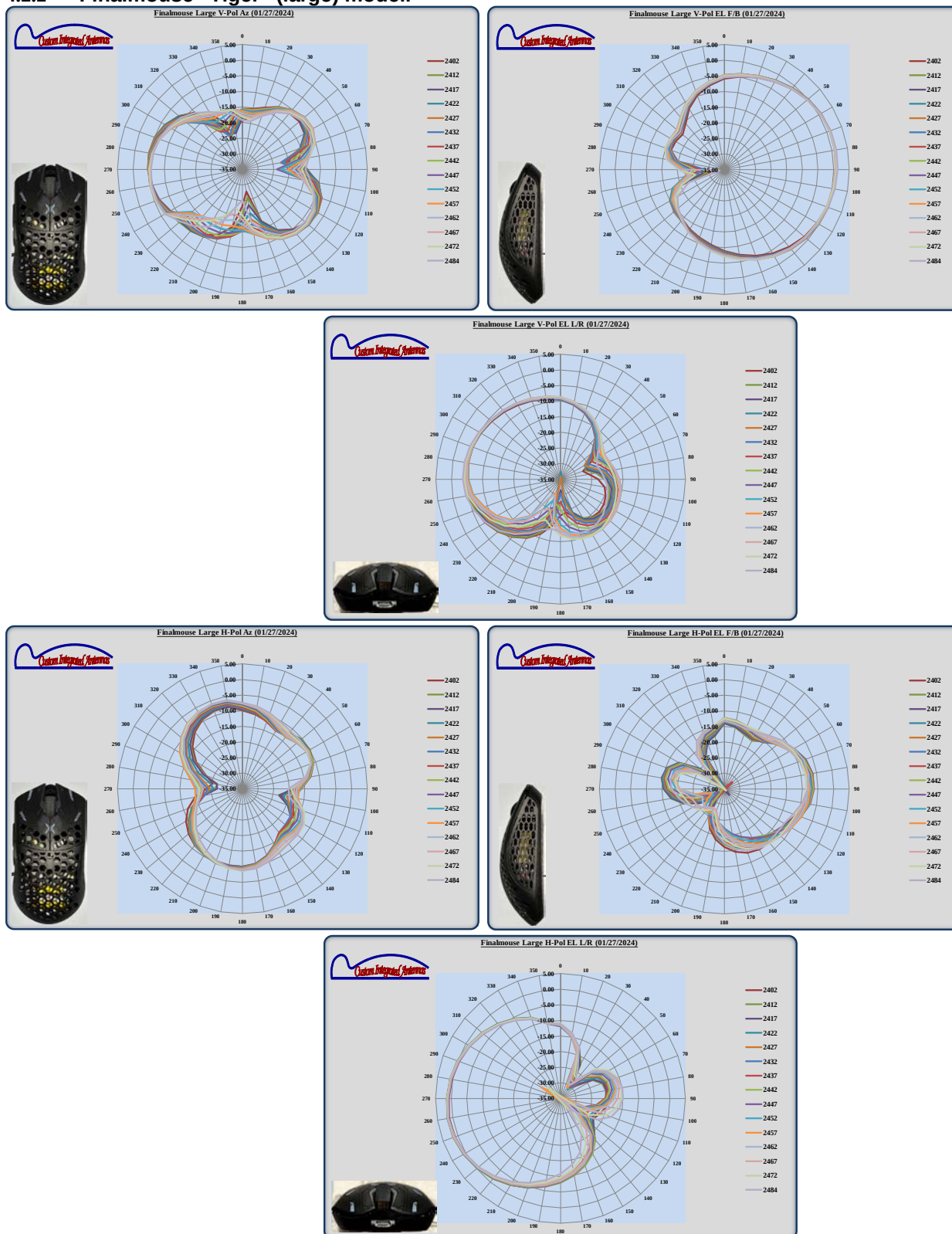
VSWR of the Ultralight X Tiger as tested.

4.2 Radiated Pattern Data

4.2.1 Finalmouse "Lion" (medium) model.



4.2.2 Finalmouse “Tiger” (large) model.



4.2.3 Tabular Data

Average Gain Comparison: All data points averaged for each frequency and all angles (dBi)									
Frequency (MHz)	2402	2412	2417	2422	2427	2432	2437	2442	2447
Finalmouse Medium V-Pol Az (01/27/2024)	-10.49	-10.32	-10.41	-10.37	-10.35	-10.45	-10.42	-10.25	-10.07
Finalmouse Medium H-Pol Az (01/27/2024)	-11.85	-11.95	-12.07	-11.99	-12.04	-12.22	-12.22	-12.12	-12.09
Finalmouse Medium V-Pol EL F/B (01/27/2024)	-4.47	-4.22	-4.24	-4.12	-4.01	-4.03	-3.98	-3.95	-4.00
Finalmouse Medium H-Pol EL F/B (01/27/2024)	-15.84	-15.50	-15.38	-15.31	-15.51	-15.65	-15.48	-15.45	-15.50
Finalmouse Medium V-Pol EL L/R (01/27/2024)	-13.06	-12.72	-12.74	-12.70	-12.58	-12.48	-12.28	-12.00	-11.85
Finalmouse Medium H-Pol EL L/R (01/27/2024)	-4.50	-4.31	-4.36	-4.25	-4.24	-4.36	-4.33	-4.32	-4.40
Finalmouse Large V-Pol Az (01/27/2024)	-10.00	-9.76	-9.83	-9.77	-9.78	-9.89	-9.92	-9.93	-9.99
Finalmouse Large H-Pol Az (01/27/2024)	-12.30	-12.25	-12.24	-12.03	-11.96	-11.99	-11.80	-11.54	-11.33
Finalmouse Large V-Pol EL F/B (01/27/2024)	-4.05	-3.83	-3.87	-3.76	-3.69	-3.72	-3.68	-3.65	-3.70
Finalmouse Large H-Pol EL F/B (01/27/2024)	-13.49	-13.28	-13.28	-13.20	-13.29	-13.38	-13.28	-13.43	-13.64
Finalmouse Large V-Pol EL L/R (01/27/2024)	-9.87	-9.79	-10.00	-10.09	-10.11	-10.22	-10.23	-10.17	-10.20
Finalmouse Large H-Pol EL L/R (01/27/2024)	-4.80	-4.50	-4.49	-4.34	-4.34	-4.44	-4.34	-4.26	-4.32

Average Gain Comparison: All data points averaged for each frequency and all angles (dBi)							Avg Gain (dBi)	Max Gain (dBi)
Frequency (MHz)	2452	2457	2462	2467	2472	2484	2.4 GHz ISM Band	
Finalmouse Medium V-Pol Az (01/27/2024)	-9.81	-9.62	-9.52	-9.44	-9.38	-9.55	-10.01	-3.63
Finalmouse Medium H-Pol Az (01/27/2024)	-11.96	-11.89	-11.88	-11.71	-11.47	-11.08	-11.89	-5.80
Finalmouse Medium V-Pol EL F/B (01/27/2024)	-3.99	-4.01	-4.04	-4.05	-4.04	-4.05	-4.08	1.32
Finalmouse Medium H-Pol EL F/B (01/27/2024)	-15.42	-15.41	-15.33	-15.05	-14.89	-14.98	-15.37	-8.75
Finalmouse Medium V-Pol EL L/R (01/27/2024)	-11.80	-11.75	-11.69	-11.71	-11.83	-12.14	-12.20	-7.61
Finalmouse Medium H-Pol EL L/R (01/27/2024)	-4.41	-4.43	-4.47	-4.42	-4.32	-4.24	-4.36	1.27
Finalmouse Large V-Pol Az (01/27/2024)	-10.01	-10.04	-10.11	-10.14	-10.15	-10.28	-9.97	-4.63
Finalmouse Large H-Pol Az (01/27/2024)	-11.12	-11.03	-11.03	-10.94	-10.79	-10.91	-11.52	-6.14
Finalmouse Large V-Pol EL F/B (01/27/2024)	-3.72	-3.75	-3.81	-3.81	-3.78	-3.71	-3.77	1.44
Finalmouse Large H-Pol EL F/B (01/27/2024)	-13.60	-13.65	-13.85	-13.87	-13.79	-13.65	-13.51	-6.24
Finalmouse Large V-Pol EL L/R (01/27/2024)	-10.25	-10.15	-9.96	-9.75	-9.55	-9.31	-9.97	-3.62
Finalmouse Large H-Pol EL L/R (01/27/2024)	-4.36	-4.41	-4.51	-4.56	-4.60	-4.83	-4.47	1.80

Overall Average Gain of All Frequencies and Orientations Tested (dBi)	
AUT	2.4 GHz ISM Band
Finalmouse Medium V-Pol (01/27/2024)	-7.36
Finalmouse Medium V-Pol (01/27/2024)	-8.14
Finalmouse Large V-Pol (01/27/2024)	-6.84
Finalmouse Large V-Pol (01/27/2024)	-8.03

Overall Average Gain	
AUT	2.4 GHz ISM Band
Finalmouse Medium (01/27/2024)	-7.73
Finalmouse Large (01/27/2024)	-7.39

6 Conclusions

The gain data indicates the Finalmouse Ultralight X Lion and Finalmouse Ultralight X Tiger meet the regulatory requirements specifically relative to the antenna performance.