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1/5/2024

Verge Aero
1705 Robers S Light Blvd
Unit 101
Buda Texas, 78610
USA

Dear Anthony Merlino,

Enclosed is the EMC test report for testing of the Verge Aero, X7 tested to the requirements of FCC Part 2.1091 and RSS-102 Issue 6

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

Sincerely,

Nancy LaBrecque
Documentation Department
Eurofins Electrical and Electronic Testing NA, Inc.

Reference: WIRA130068-FCC-IC-MPE

A2LA ACCREDITED
TESTING CERT #0591.06

RF Exposure Criteria
Test Report
Using Maximum Permissible Exposure (MPE) Calculations

for the

Verge Aero
X7

Tested under

FCC Part 2.1091 and RSS-102 Issue 6

Report: WIRA130068-FCC-IC-MPE

1/5/2024

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
0	1/5/2024	Initial Issue.

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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
CISPR	**C**omite **I**nternational **S**pecial des **P**erturbations **R**adioelectriques (International Special Committee on Radio Interference)
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
µ**H**	**microH**enry
µ**F**	**microF**arad
µ**s**	**micros**econds
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

1.0 Requirements Summary

Page Number	Test Name	Result
12	RSS-102 Issue 6 MPE Limits (For General Public Exposure)	**Compliant**
12	FCC Part 2.1091 MPE Limits (For General Public Exposure)	**Compliant**

Table 1. Summary of Test Results

2.0 Equipment Configuration

2.1 Overview

Eurofins MET Labs was contracted by Verge Aero to perform testing on the X7, under Verge Aero's purchase order number PO-X212112301.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Verge Aero X7.

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

Model(s) Tested:	X7	
Model(s) Covered:	X7	
Sample Number:	24069-19	
LoRa Radio Specifications:	Primary Power: 5-20VDC	
	Type of Modulations:	LoRa Chirp Spread Spectrum
	Equipment Code:	DTS
	Peak RF Output Power:	17.60dBm
	EUT Frequency Ranges:	902.5MHz – 927.5MHz
	Antenna Gain[1]:	3.9dBi (quarter-wave monopole)
802.15.4 Radio Specifications (2.4GHz Band):	Type of Modulations:	OFDM
	Equipment Code:	DTS
	Peak RF Output Power:	14.75dBm
	EUT Frequency Ranges:	2401.2MHz – 2478MHz
	Antenna Gain[1]:	5.3dBi (quarter-wave monopole)
	Type of Modulations:	OFDM
802.15.4 Radio Specifications (915MHz Band):	Type of Modulations:	OFDM
	Equipment Code:	DTS
	Peak RF Output Power:	15.56dBm
	EUT Frequency Ranges:	903.2MHz – 927.2MHz
	Antenna Gain[1]:	4.2dBi (quarter-wave monopole)
	Type of Modulations:	OFDM
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Bryan Taylor	
Test Date(s):	12/13/2023 through 1/4/2023	

Table 2. EUT Summary Table

[1] The antenna gain information was provided by Verge Aero and may affect compliance.

2.2 Test Site

All testing was performed at Eurofins E&E North America, Austin, TX. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

2.3 References

RSS-102: Issue 6	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
FCC Part 2.1091	Radiofrequency radiation exposure evaluation: mobile devices.

Table 3. References

2.4 Description of Test Sample

The X7 product is a small quad-rotor UAV, equipped with a smart battery (Li-Ion), and a high-intensity RGBW LED. It is purpose-built for performing synchronized light shows with hundreds to thousands of the drones flying in a synchronized manner.

2.5 Modifications

2.5.1 Modifications to EUT

No modifications were made to the EUT.

2.5.2 Modifications to Test Standard

No modifications were made to the test standard.

2.6 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
None	Putty (terminal application)	Simon Tatham	Putty Release 0.77	None

Table 4. Support Equipment

3.0 Maximum Permissible Exposure Results

3.1 RSS-102 RF Exposure Limits

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	0.73/ ƒ	-	6**
1.1-10	87/ $ƒ^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ $ƒ^{0.25}$	0.1540/ $ƒ^{0.25}$	8.944/ $ƒ^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 $ƒ^{0.3417}$	0.008335 $ƒ^{0.3417}$	0.02619 $ƒ^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $ƒ^{1.2}$
150000-300000	0.158 $ƒ^{0.5}$	4.21 x 10^{-4} $ƒ^{0.5}$	6.67 x 10^{-5} ƒ	616000/$ƒ^{1.2}$

Note: ƒ is frequency in MHz.
* Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

3.2 FCC Exposure Limits

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(i) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*(100)	≤6
3.0-30	1842/f	4.89/f	*(900/f^2)	<6
30-300	61.4	0.163	1.0	<6
300-1,500			f/300	<6
1,500-100,000			5	<6
(ii) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	<30
1.34-30	824/f	2.19/f	*(180/f^2)	<30
30-300	27.5	0.073	0.2	<30
300-1,500			f/1500	<30
1,500-100,000			1.0	<30

f = frequency in MHz. * = Plane-wave equivalent power density.

Test Procedure:

An MPE evaluation for was performed in order to show that the device was compliant with the general population exposure limits. The maximum power density was calculated for each transmitter band at a separation distance of 20cm using the maximum declared output power including tune up tolerance.

For each transmitter the maximum RF exposure at a 20 cm distance using the formula:

$$ConductedPower_{mW} = 10^{ConductedBwer(dBm)/10}$$

$$PowerDensity = \frac{ConductedPower_{mW} \times Ant.Gain}{4\pi \times (20_{cm})^2}$$

For transmitters that could operate simultaneously, the MPE to limit ratio for each was calculated and then summed. If the sum of the MPE to limit ratios was less than 1, that specific combination of transmitters was deemed to comply.

Test Results:

The Verge Aero X7 Drone was **compliant** with FCC Part 2.1091 and RSS-102 Issue 6. The calculated maximum power density at 20cm distance was equal to or less than the required limits for general population exposure for FCC Part 2.1091 and RSS-102 Issue 6. Additionally, the sum of the worst case for each MPE to Limit ratio is less than 1 indicating that all radios may transmit simultaneously.

Test Data:

Duty Cycle	100 (%)							
Separation Dist.	20 (cm)							
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value (mW/cm^2)	MPE Limit (mW/cm^2)	Margin to Limit (mW/cm^2)	MPE / Limit Ratio (for Co-Location)
2.4GHz 802.15.4	2400	14.75	14.75	5.3	0.0201	1.0000	0.9799	0.0201
915MHz 802.15.4	902	15.56	15.56	4.2	0.0188	0.6013	0.5825	0.0313
915MHz LoRa	902	17.6	17.60	3.9	0.0281	0.6013	0.5732	0.0467
							Sum:	0.0982

FCC MPE Data

Duty Cycle	100 (%)							
Separation Dist.	20 (cm)							
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value (W/m^2)	MPE Limit (W/m^2)	Margin to Limit (W/m^2)	MPE / Limit Ratio (for Co-Location)
2.4GHz 802.15.4	2400	14.75	14.75	5.3	0.2012	5.3478	5.1465	0.0376
915MHz 802.15.4	902	15.56	15.56	4.2	0.1882	2.7398	2.5516	0.0687
915MHz LoRa	902	17.6	17.60	3.9	0.2810	2.7398	2.4588	0.1026
							Sum:	0.2089

ISED MPE Data

Test Engineer(s): Bryan Taylor

Test Date(s): 12/13/2023 - 1/4/2023