

4/25/2023

Mikado Model Helicopters GmbH (MIK3)
Graf-von-Schwerin-Str. 40
Potsdam, 14469
Germany

Dear Edward Eckstein,

Enclosed is the EMC test report for testing of the Mikado Model Helicopters GmbH (MIK3), VBar EVO tested to the requirements of FCC Part 15.1091 and RSS-102 Issue 5

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: WIRA125540_MPE



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

for the

Mikado Model Helicopters GmbH (MIK3)
VBar EVO

Tested under

FCC Part 15.1091 and RSS-102 Issue 5

Report: WIRA125540_MPE

4/25/2023



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	4/25/2023	Initial Issue.

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List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dBμA	Decibels above one microamp
dBμV	Decibels above one microvolt
dBμA/m	Decibels above one microamp per meter
dBμV/m	Decibels above one microvolt per meter
DC	Direct Current
E	Electric Field
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
CISPR	Comite International Special des Perturbations Radioelectriques (International Special Committee on Radio Interference)
GRP	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	kiloHertz
kPa	kiloPascal
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	MegaHertz
μH	microHenry
μF	microFarad
μs	microseconds
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
V/m	Volts per meter
VCP	Vertical Coupling Plane

1.0 Requirements Summary

Page Number	Test Name	Result
12	RSS-102 Issue 5 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 Mikado Model Helicopters GmbH (MIK3) to perform testing on the VBar EVO, under Mikado Model Helicopters GmbH (MIK3)'s purchase order number 428234.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Mikado Model Helicopters GmbH (MIK3) VBar EVO.

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

Model(s) Tested:	VBar EVO	
Model(s) Covered:	VBar EVO	
EUT Specifications:	Primary Power: 4.8VDC	
	Type of Modulations:	MSK
	Equipment Code:	DSS
	Peak RF Output Power (Conducted):	16.74dBm
	EUT Frequency Ranges:	2401MHz - 2481MHz
	Antenna Gain ¹ :	2dBi
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 Sergio Gutierrez	
Report Date(s):	3/10/2023 through 3/31/2023	

Table 2. EUT Summary Table

¹ The antenna gain information was provided by Mikado Model Helicopters GmbH (MIK3).

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

FCC Part 2.1091	Radiofrequency radiation exposure evaluation: mobile devices.
RSS-102: Issue 5	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

Table 3. References

2.4 Description of Test Sample

The Mikado Model Helicopters GmbH (MIK3) VBar EVO is a small device that is placed inside a model helicopter. It receives data from the transmitter and dispatches it to the connected servos with standard PWM signals. Additionally, it manages received telemetry data like currents and voltages, and sends it back to the Transmitter device, where it is shown on the display.

The Device is powered by an external battery. It powers the servos directly from this battery.

VBar EVO only works in combination with a VBar Control Radio. It is bound together once at installation time, and from then on will only work in this combination.

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 Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Mikado Model Helicopters GmbH (MIK3) upon completion of testing.

Ref. ID	Name / Description	Manufacturer	Model Number	Customer Supplied Calibration Data
None	VBar Control	Mikado Model Helicopters GmbH (MIK3)	VBar Control	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/ f	-	6**
1.1-10	87/ f ^{0.5}	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ f ^{0.25}	0.1540/ f ^{0.25}	8.944/ f ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 f ^{0.3417}	0.008335 f ^{0.3417}	0.02619 f ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ f ^{1.2}
150000-300000	0.158 f ^{0.5}	4.21 x 10 ⁻⁴ f ^{0.5}	6.67 x 10 ⁻⁵ f	616000/ f ^{1.2}

Note: f 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	1(100)	<6
3.0-30	1842/f	4.89/f	1(900/f ²)	<6
30-300	61.4	0.163	1.0	<6
300-1,500			1/300	<6
1,500-100,000			5	<6
(ii) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	1(100)	<30
1.34-30	824/f	2.79/f	1(180/f ²)	<30
30-300	27.5	0.073	0.2	<30
300-1,500			1/1500	<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:

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

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

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 VBar EVO was **compliant** with FCC Part 15.1091 and RSS-102 Issue 5. The calculated maximum power density at 20cm distance was equal to or less than the required limits for general population exposure for FCC Part 15.1091 and RSS-102 Issue 5.

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/cm²)	MPE Limit (mW/cm²)	Margin to Limit (mW/cm²)
Maximum Output Power	2401	16.74	16.74	2	0.0149	1.0000	0.9851

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/m²)	MPE Limit (W/m²)	Margin to Limit (W/m²)
Maximum Output Power	2401	16.74	16.74	2	0.1488	5.3493	5.2004

ISED MPE Data
Test Engineer(s): Bryan Taylor

Test Date(s): 3/10/2023 to 3/31/2023