

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

Tancy Labucque



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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

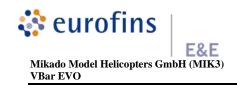
**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the 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

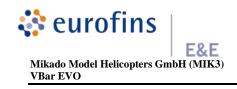
# **Report Status Sheet**

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
d	Measurement Distance
dB	<b>D</b> eci <b>b</b> els
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
f	Frequency
CISPR	Comite International Special des Perturbations Radioelectriques (International Special Committee on Radio Interference)
GRP	Ground Reference Plane
Н	Magnetic Field
НСР	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	kiloHertz
kPa	kiloPascal
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	MegaHertz
μΗ	microHenry
μ <b>F</b>	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	Compliant	
12	(For General Public Exposure)	Compliant	
12	FCC Part 2.1091 MPE Limits	Compliant	
12	(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	VBar EVO			
	Primary Power: 4.8VDC				
	Type of Modulations:	MSK			
EUT	Equipment Code:	DSS			
Specifications:	Peak RF Output Power (Conducted):	16.74dBm			
	EUT Frequency Ranges:	2401MHz - 2481MHz			
	Antenna Gain <sup>1</sup> :	2dBi			
Analysis:	The results obtained relate	only to the item(s) tested.			
	Temperature: 15-35° C				
Environmental Test Conditions:	Relative Humidity: 30-60%				
	Barometric Pressure: 860-1060 mbar				
Evaluated by:	Bryan Taylor and Sergio	Gutierrez			
Report Date(s):	3/10/2023 through 3/31/20	023			

**Table 2. EUT Summary Table** 

<sup>&</sup>lt;sup>1</sup> 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	VBar Control	None
		(MIK3)		

**Table 4. Support Equipment** 

# 3.0 Maximum Permissible Exposure Results

## 3.1 RSS-102 RF Exposure Limits

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m²)	Reference Perioc (minutes)
0.003-10 <sup>21</sup>	83	90	150	Instantaneous*
0.1-10	190	0.73/ f	190	6**
1.1-10	87/ f <sup>0.5</sup>	100	(9)	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ f <sup>0.25</sup>	0.1540/ f <sup>0.25</sup>	8.944/ f <sup>0.5</sup>	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 f <sup>0,3417</sup>	0.008335 f <sup>0.3417</sup>	0.02619 f <sup>0.6834</sup>	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/f <sup>1.2</sup>
150000-300000	0.158 f <sup>0.5</sup>	4.21 x 10 <sup>-4</sup> f <sup>0.5</sup>	6.67 x 10 <sup>-5</sup> f	616000/f <sup>1.2</sup>

Note: f is frequency in MHz.

# 3.2 FCC Exposure Limits

range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm²)	Averaging time (minutes)
		(i) Limits for Occupational/Controlled Exposure		
0.3-3.0	614	1.63	1(100)	16
3.0-30	1842/1	4.86/1	*(900/f <sup>0</sup> )	+6
30-300	61.4	0.163	1.0	<6
300 1,580			1/300	<6
1,500-100,000			6	<6
	(4)	Limits for General Population/Uncontrolled Exposure		
0.3-7.34	614	1.63	*(100)	<30
1.34-30	824/1	2.99/9	*(180/f²)	<30
90-360	27.5	0.673	0.2	×38
300-1.500			1/1500	<30
1,500-100,000			1.0	×30

<sup>\*</sup> Based on nerve stimulation (NS).
\*\* Based on specific absorption rate (SAR).

bases on specific absorption rate (area).

#### **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 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)						
		Declared Max Cond. Power	Duty Cycle Adjusted Cond.				
	Frequency	(Inc. Tolerance)	Output Power	Antenna Gain	MPE Value	MPE Limit	Margin to Limit
Operating Mode	(MHz)	(dBm)	(dBm)	(dB)	(mW/cm²)	(mW/cm <sup>2</sup> )	(mW/cm <sup>2</sup> )
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)						
		Declared Max	Duty Cycle				
		Cond. Power	Adjusted Cond.				
	Frequency	(Inc. Tolerance)	Output Power	Antenna Gain	MPE Value	MPE Limit	Margin to Limit
Operating Mode	(MHz)	(dBm)	(dBm)	(dB)	(W/m²)	(W/m²)	(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