

EMC TEST REPORT

FCC 47 CFR Part 15B
Industry Canada ICES-003

Electromagnetic compatibility - Unintentional radiators

Report Reference No. : G0M-1611-6033-EF0115B-V01

Testing Laboratory : Eurofins Product Service GmbH

Address : Storkower Str. 38c
15526 Reichenwalde
Germany

Accreditation :



A2LA Accredited Testing Laboratory, Certificate No.: 1983.01
FCC Filed Test Laboratory, Reg.-No.: 96970
IC OATS Filing assigned code: 3470A

Applicant's name : Artis GmbH

Address : Buchenring 40
21272 Egestorf
GERMANY

Test specification:

Standard..... : 47 CFR Part 15 Subpart B
ICES-003, Issue 6:2016
ANSI C63.4:2014

Equipment under test (EUT):

Product description	4K-WISY-Rotor	
Model No.	4K-WISY-Rotor	
Additional Models	None	
Hardware version	A00475A	
Firmware / Software version	42.2.1.7	
Contains	FCC-ID: 2AKIJ-4KROTOR	ISED-ID: 22197-4KROTOR
Test result	Passed	

Test Report No.: G0M-1611-6033-EF0115B-V01

Eurofins Product Service GmbH
Storkower Str. 38c, D-15526 Reichenwalde, Germany

Possible test case verdicts:

- not applicable to test object: N/A
- test object does meet the requirement.....: P (Pass)
- test object does not meet the requirement.....: F (Fail)

Testing:

Date of receipt of test item: 2016-12-02

Date (s) of performance of tests: 2017-02-20 – 2017-02-23

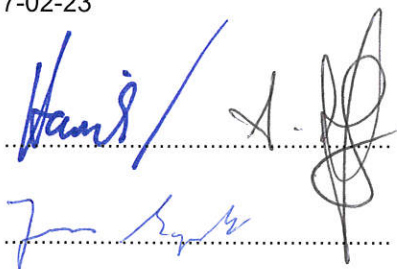
Compiled by: Matthias Handrik

Tested by (+ signature).....: Matthias Handrik / Andreas Pflug

Approved by (+ signature): Jens Marquardt
Deputy Head of Lab

Date of issue.....: 2017-03-01

Total number of pages.....: 27


General remarks:

The test results presented in this report relate only to the object tested.

The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.

This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.

Additional comments:

Version History

Version	Issue Date	Remarks	Revised by
V01	2017-03-01	Initial Release	

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1 Equipment (Test item) Description

Description	4K-WISY-Rotor
Model	4K-WISY-Rotor
Additional Models	None
Serial number	None
Hardware version	A00475A
Software / Firmware version	42.2.1.7
Contains FCC-ID	2AKIJ-4KROTOR
Contains ISED-ID	22197-4KROTOR
Power supply	5 VDC
AC/DC-Adaptor	Model : FW7710 Manufacturer : Friwo Gerätebau GmbH Input : 100-240VAC / 50-60Hz Output : 5VDC / 0.7A
Manufacturer	Artis GmbH Buchenring 40 21272 Egestorf GERMANY
Highest emission frequency	> 1000 MHz (up to 5th Harm)
Device classification	Class B
Equipment type	Tabletop
Number of tested samples	1

1.4 Supporting Equipment Used During Testing

Product Type*	Device	Manufacturer	Model No.	Comments (e.g. serial no.)
AE	Laptop	Dell	Latitude E6420	S/N HPJ4R1
AE	4K-WISY-Antennenmodul	Artis GmbH	4K-WISY-Antennenmodul	companion
AE	Software	ARTIS GmbH	4K-WiSy-Visu	V45.2.3.7
None				
<p>*Note: Use the following abbreviations:</p> <p>AE : Auxiliary/Associated Equipment, or</p> <p>SIM : Simulator (Not Subjected to Test)</p> <p>CABL : Connecting cables</p>				

1.5 Input / Output Ports

Port #	Name	Type*	Max. Cable Length	Cable Shielded	Comments (e.g. Cat. Of Cable)
1	Power	DC	-	-	-
<p>*Note: Use the following abbreviations:</p> <p>AC : AC power port</p> <p>DC : DC power port</p> <p>N/E : Non electrical</p> <p>I/O : Signal input or output port</p> <p>TP : Telecommunication port</p>					

1.6 Operating Modes and Configurations

Mode #	Description
1	Active TX/RX 2402MHz connection to 4K-Wisy-Antennenmodul, continuous measurement of torque, force, bending
2	Charging

Configuration #	EUT Configuration
Continues measurement	EUT powered up. Companion device 4K-Wisy-Antennenmodul receive and transmit data to EUT on 2402 MHz. Data: torque, force, bending
Charging	EUT connected to AC/DC adaptor for charging. Transceiver is switch off during charging.

1.7 Test Equipment Used During Testing

Measurement Software			
Description	Manufacturer	Name	Version
EMC Test Software	Dare Instruments	Radimation	2016.1.10

Radiated emissions – 3m Chamber					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Biconical Antenna	R&S	HK 116	EF00012	2016-05	2019-05
LPD-Antenne	R&S	HL 223	EF00187	2016-05	2019-05
Horn antenna	Schwarzbeck	BBHA 9120D	EF00018	2016-09	2019-09
EMI Test Receiver	R&S	ESU26	EF00887	2017-01	2018-01
RF Cable			-	System Cal.	System Cal
RF Cable			-	System Cal.	System Cal

Conducted emissions					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
AMN	R&S	ESH2-Z5	EF00182	2017-01	2019-01
AMN	R&S	ESH3-Z5	EF00036	2017-01	2019-01
EMI Test Receiver	R&S	ESR7	EF00943	2016-10	2017-10
Cable	-	RG58/U	-	System Cal.	System Cal.

1.8 Sample emission level calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyzer in dB μ V. Any external preamplifiers used are taken into account through internal analyzer settings.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strengths to voltages, which can be measured directly on the spectrum analyzer. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

$$\text{Reading on Analyzer (dB}\mu\text{V)} + \text{A.F. (dB)} = \text{Net field strength (dB}\mu\text{V/m)}$$

Net:

This is the net field strength measurement (as shown above).

Limit:

This is the FCC Class B radiated emission limit (in units of dB μ V/m). The FCC limits are given in units of μ V/m. The following formula is used to convert the units of μ V/m to dB μ V/m:

$$\text{Limit (dB}\mu\text{V/m)} = 20 * \log (\mu\text{V/m})$$

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

$$\begin{array}{rclclcl} \text{Reading} & + & \text{AF} & = & \text{Net Reading} & : & \text{Net reading - FCC limit} & = & \text{Margin} \\ 21.5 \text{ dB}\mu\text{V} & + & 26 \text{ dB} & = & 47.5 \text{ dB}\mu\text{V/m} & : & 47.5 \text{ dB}\mu\text{V/m} - 57.0 \text{ dB}\mu\text{V/m} & = & -9.5 \text{ dB} \end{array}$$

2 Result Summary

FCC 47 CFR Part 15B, Industry Canada ICES-003				
Product Specific Standard	Requirement – Test	Reference Method	Result	Remarks
47 CFR 15.109 ICES-003 Item 6.2	Radiated emissions	ANSI C 63.4	PASS	
47 CFR 15.107 ICES-003 Item 6.1	AC power line conducted emissions	ANSI C63.4	PASS	
Remarks:				

3 Test Conditions and Results

3.1 Test Conditions and Results – Radiated emissions

Radiated emissions acc. FCC 47 CFR 15.109 / ICES-003				Verdict: PASS		
Laboratory Parameters:		Required prior to the test		During the test		
Ambient Temperature		15 to 35 °C		22°C		
Relative Humidity		30 to 60 %		36%		
Test according referenced standards		Reference Method				
		ANSI C63.4				
Sample is tested with respect to the requirements of the equipment class		Equipment class				
		Class B				
Test frequency range determined from highest emission frequency		Highest emission frequency				
		> 1000 MHz (up to 5th Harm)				
Fully configured sample scanned over the following frequency range		Frequency range				
		30 MHz to 13 GHz				
Operating mode		1				
Configuration		Continues measurement				
Limits and results Class B						
Frequency [MHz]	Quasi-Peak [dBµV/m]	Result	Average [dBµV/m]	Result	Peak [dBµV/m]	Result
30 – 88	40	PASS	-		-	-
88 – 216	43.5	PASS	-		-	-
216 – 960	46	PASS	-		-	-
960 – 1000	54	PASS	-		-	-
> 1000	-	-	54	PASS	74	PASS
Comments:						

Test Procedure:

The test site is in accordance with ANSI C63-4:2014 requirements and is listed by FCC.
The measurement procedure is as follows:

Exploratory measurement:

- The EUT was placed on a non-conductive table at a height of 0.8m.
- The EUT and support equipment, if needed, were set up to simulate typical usage.
- Cables, of type and length specified by the manufacturer, were connected to at least one port of each type and were terminated by a device or simulating load of actual usage.
- The antenna was placed at a distance of 3 or 10 m.
- The received signal was monitored at the measurement receiver.
 - Cables not bundled were manipulated within the range of likely arrangements to produce the highest emission amplitude
 - To maximize the suspected emissions the EUT is rotated 360 degrees. If the signal exceeds the previous amplitude, go back to the corresponding azimuth and manipulate the cables again for maximizing the emissions if possible.
 - Move the antenna from 1 to 4m to maximize the suspected highest amplitude signal.
- This procedure has to be performed in both antenna polarizations, horizontal and vertical.
- The arrangement of the equipment with the maximum emission level is shown on the setup picture at item 1.3.

Final measurement:

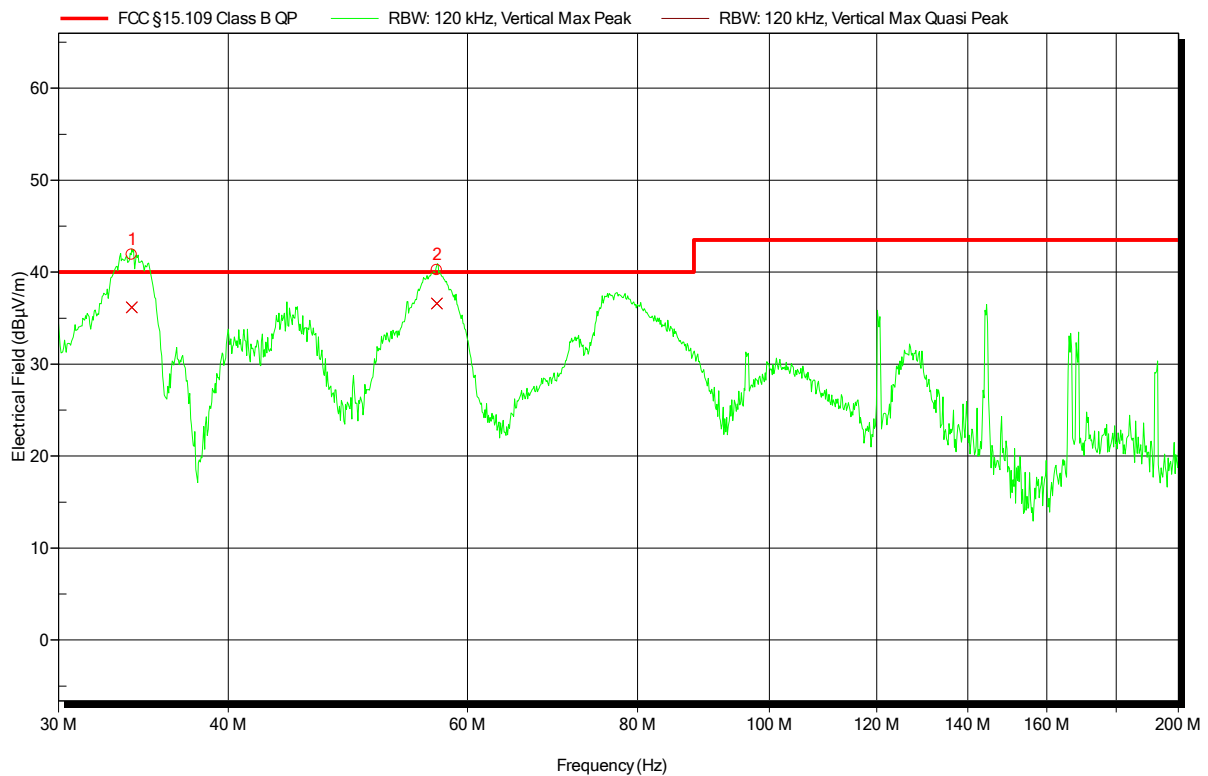
- The EUT was placed on a 0.8 m non-conductive table at a 3 m distance from the receive antenna. The antenna output was connected to the measurement receiver
- A biconical antenna was used for the frequency range 30 – 200 MHz, a logarithmic periodical antenna was used for the frequency range from 200 – 1000 MHz. Above one 1 GHz a Double Ridged Broadband Horn antenna was used. The antenna was placed on an adjustable height antenna mast
- The EUT and cable arrangement were based on the exploratory measurement results
- Emissions were maximized at each frequency by rotating the EUT and adjusting the receive antenna height and polarization. The maximum values were recorded.
- The test data of the worst-case conditions were recorded and shown on the next pages.

Spurious emissions under normal conditions according to FCC Part 15b

Project number: G0M-1611-6033

Applicant: Artis GmbH
 EUT Name: 4-K WISY Rotor und Sensorsystem
 Model: 4K-WISY-Rotor
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Handrik
 Test Conditions: Tnom: 24°C, Unom: 5.0 V DC
 Antenna: Rohde & Schwarz HK 116, Vertical
 Measurement distance: 3m
 Mode: Mode# 1
 Test Date: 2017-02-20
 Note:

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Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	33.963 MHz	36.19 dBµV/m	40 dBµV/m	-3.81 dB	Pass	271 Degree	1 m
2	56.962 MHz	36.58 dBµV/m	40 dBµV/m	-3.42 dB	Pass	271 Degree	1 m

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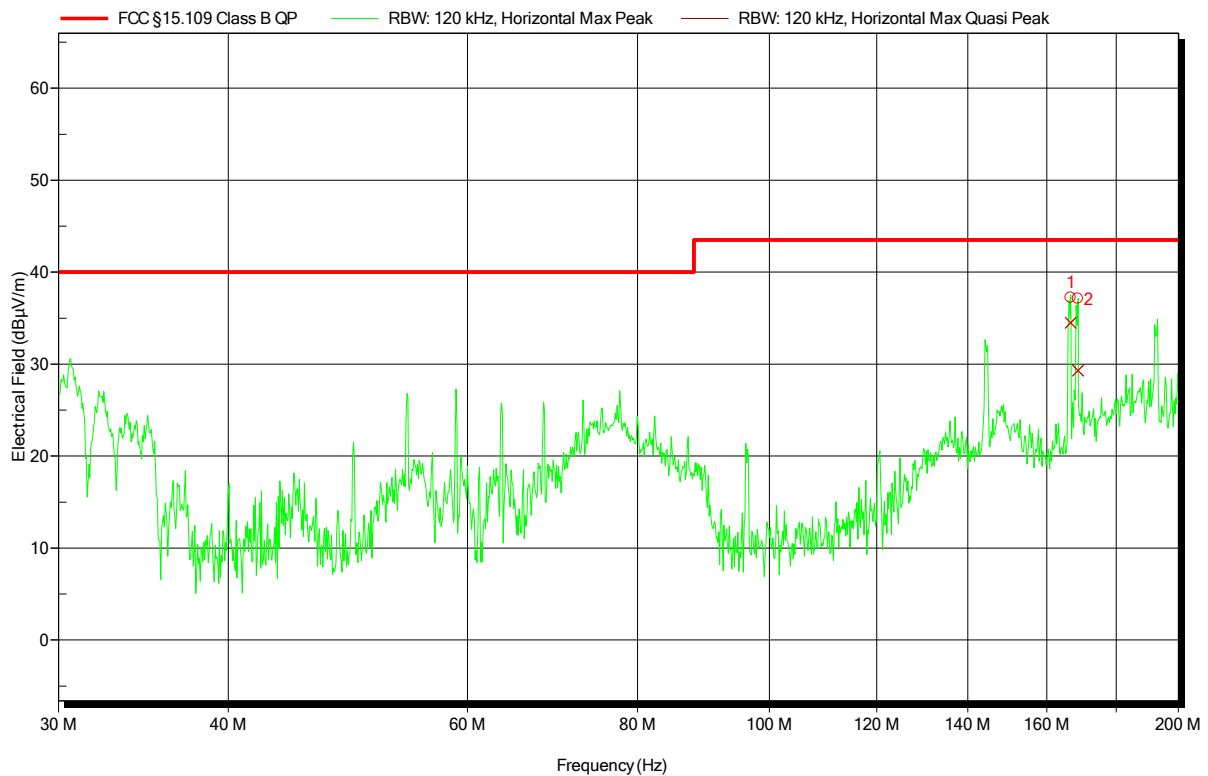
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Spurious emissions under normal conditions according to FCC Part 15b

Project number: G0M-1611-6033

Applicant: Artis GmbH
 EUT Name: 4-K WISY Rotor und Sensorsystem
 Model: 4K-WISY-Rotor
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Handrik
 Test Conditions: Tnom: 24°C, Unom: 5.0 V DC
 Antenna: Rohde & Schwarz HK 116, Horizontal
 Measurement distance: 3m
 Mode: Mode# 1
 Test Date: 2017-02-20
 Note:

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Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	166.588 MHz	34.5 dBµV/m	43.52 dBµV/m	-9.02 dB	Pass	323 Degree	1.43 m
2	168.665 MHz	29.31 dBµV/m	43.52 dBµV/m	-14.21 dB	Pass	323 Degree	1.43 m

Test Report No.: G0M-1611-6033-EF0115B-V01

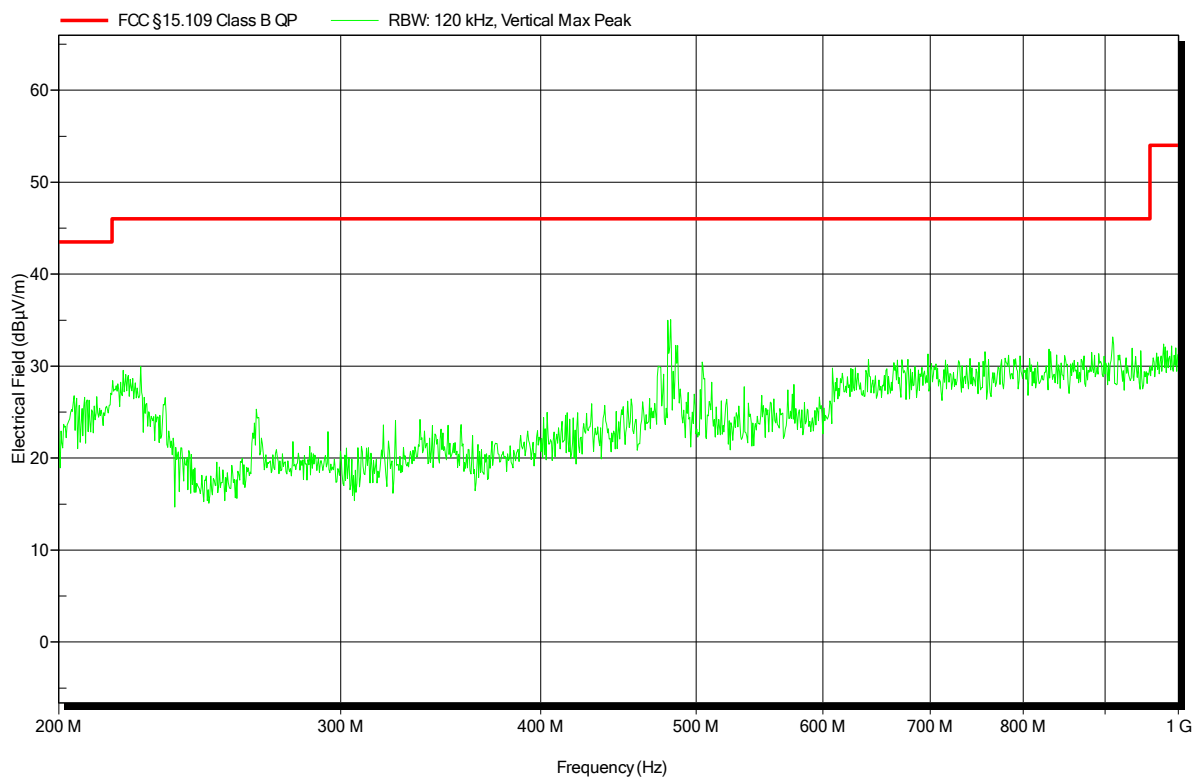
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Spurious emissions under normal conditions according to FCC Part 15b

Project number: G0M-1611-6033

Applicant:	Artis GmbH
EUT Name:	4-K WISY Rotor und Sensorsystem
Model:	4K-WISY-Rotor
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 24°C, Unom: 5.0 V DC
Antenna:	Rohde & Schwarz HL 223, Vertical
Measurement distance:	3m
Mode:	Mode# 1
Test Date:	2017-02-20
Note:	

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Test Report No.: G0M-1611-6033-EF0115B-V01

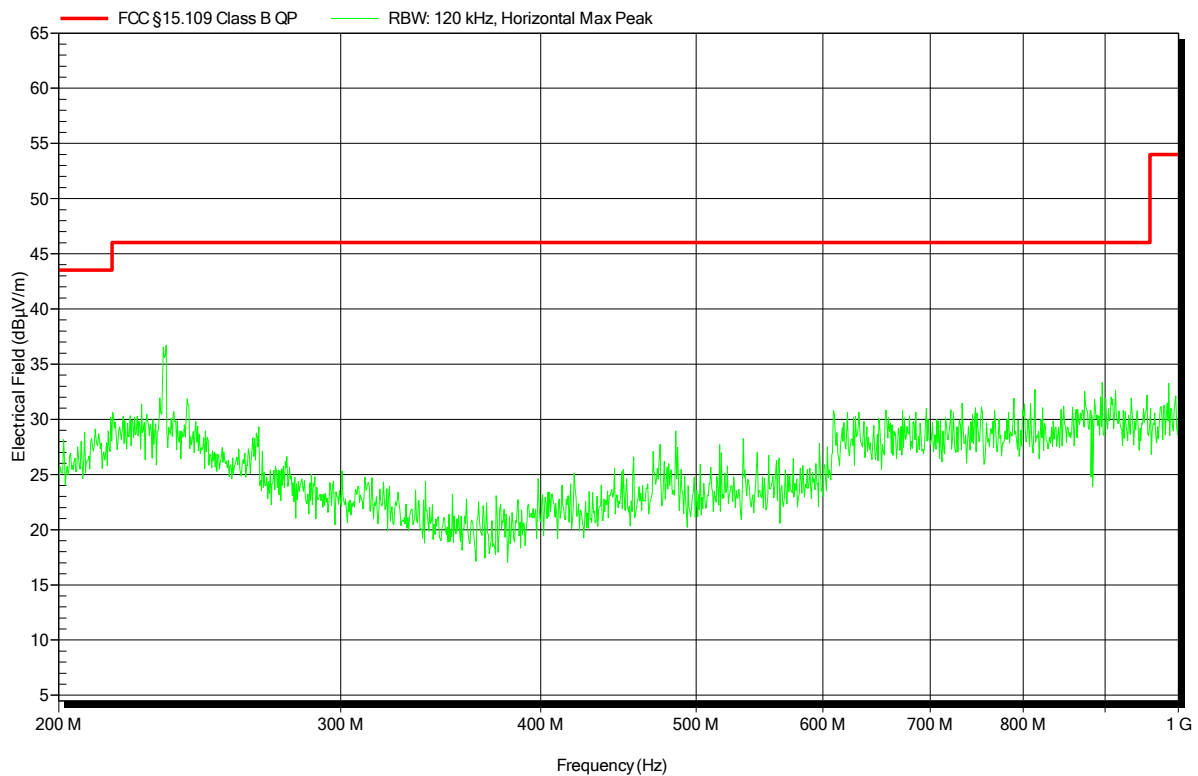
Eurofins Product Service GmbH
Storkower Str. 38c, D-15526 Reichenwalde, Germany

Spurious emissions under normal conditions according to FCC Part 15b

Project number: G0M-1611-6033

Applicant: Artis GmbH
 EUT Name: 4-K WISY Rotor und Sensorsystem
 Model: 4K-WISY-Rotor
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Handrik
 Test Conditions: Tnom: 24°C, Unom: 5.0 V DC
 Antenna: Rohde & Schwarz HL 223, Horizontal
 Measurement distance: 3m
 Mode: Mode# 1
 Test Date: 2017-02-20
 Note:

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Test Report No.: G0M-1611-6033-EF0115B-V01

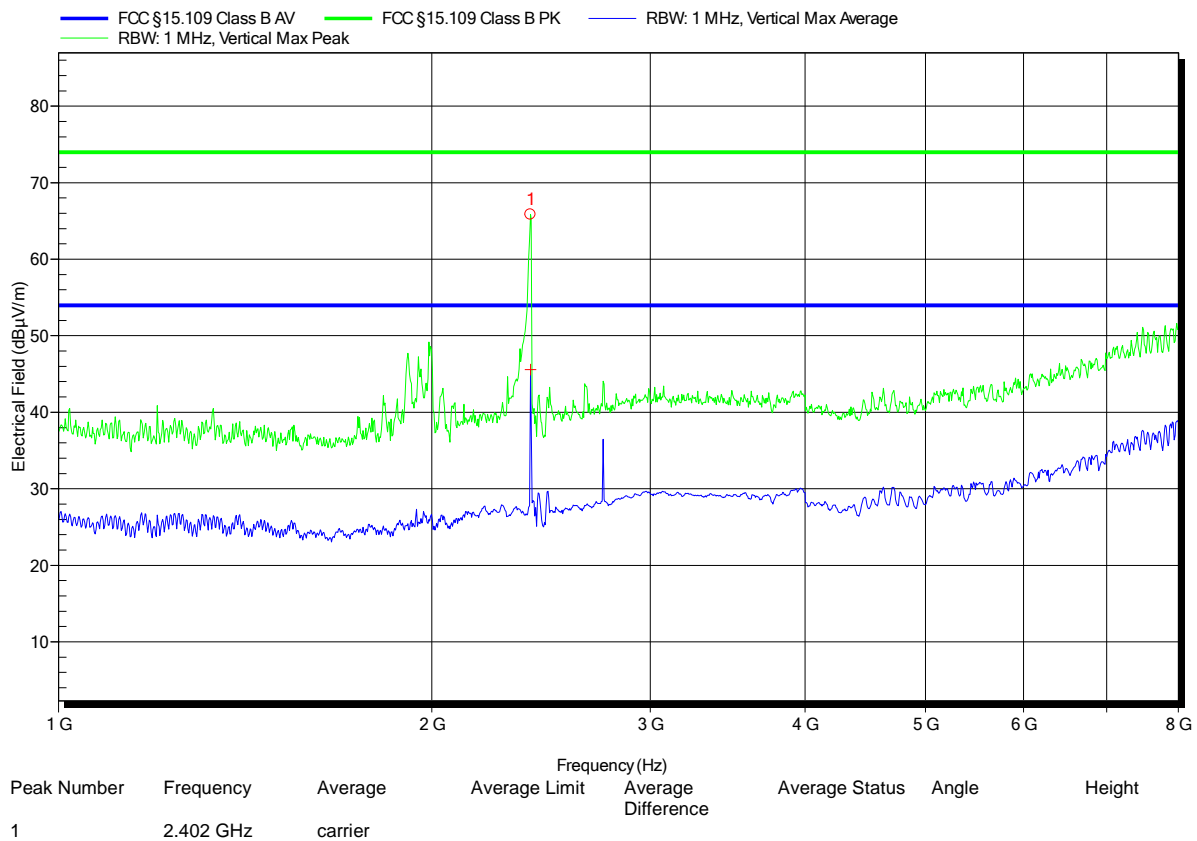
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Spurious emissions under normal conditions according to FCC Part 15b

Project number: G0M-1611-6033

Applicant: Artis GmbH
 EUT Name: 4-K WISY Rotor und Sensorsystem
 Model: 4K-WISY-Rotor
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Handrik
 Test Conditions: Tnom: 24°C, Unom: 5.0 V DC
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 3m
 Mode: Mode# 1
 Test Date: 2017-02-20
 Note:

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Test Report No.: G0M-1611-6033-EF0115B-V01

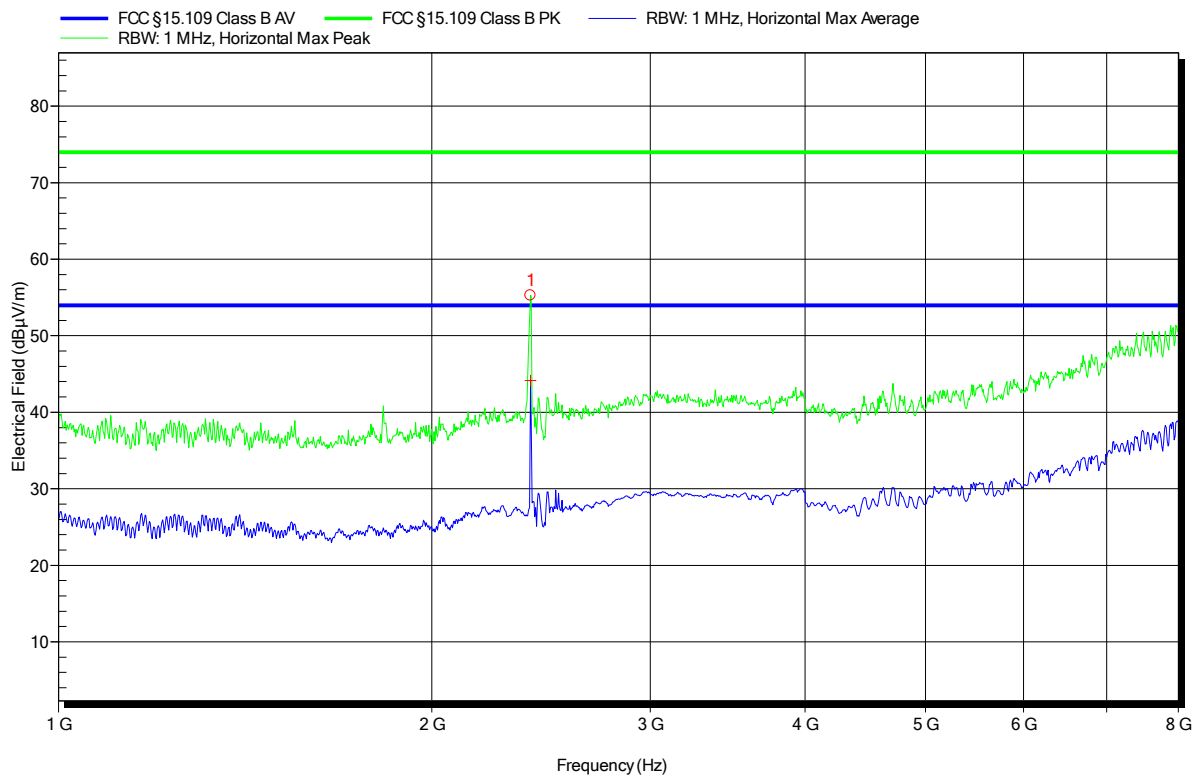
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Spurious emissions under normal conditions according to FCC Part 15b

Project number: G0M-1611-6033

Applicant: Artis GmbH
 EUT Name: 4-K WISY Rotor und Sensorsystem
 Model: 4K-WISY-Rotor
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Handrik
 Test Conditions: Tnom: 24°C, Unom: 5.0 V DC
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 3m
 Mode: Mode# 1
 Test Date: 2017-02-20
 Note:

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Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height
1	2.402 GHz	carrier					

Test Report No.: G0M-1611-6033-EF0115B-V01

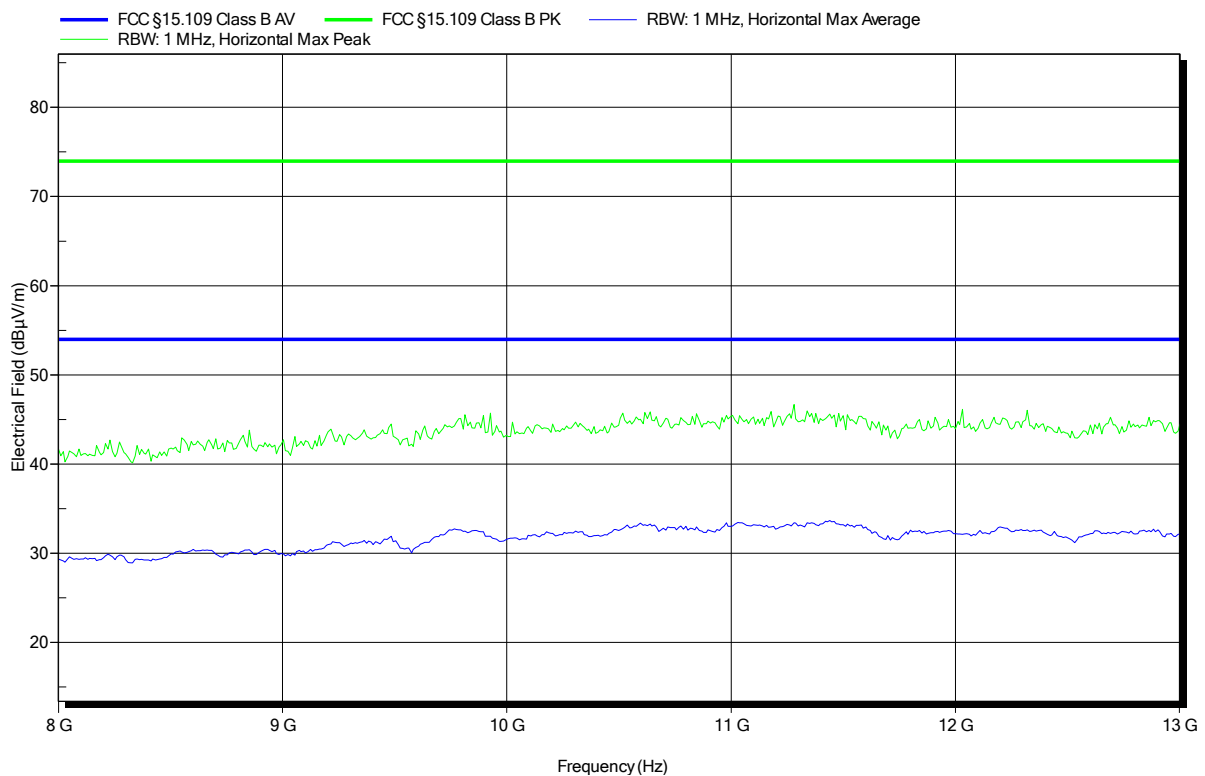
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Spurious emissions according to FCC 15B

Project number: G0M-1611-6033

Applicant:	Artis GmbH
EUT Name:	4-K WISY Rotor und Sensorsystem
Model:	4K-WISY-Rotor
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 24°C, Vnom: 5.0 V DC
Antenna:	Schwarzbeck BBHA 9120D, Horizontal
Measurement distance:	3m
Mode:	Mode# 1
Test Date:	2017-02-23
Note:	

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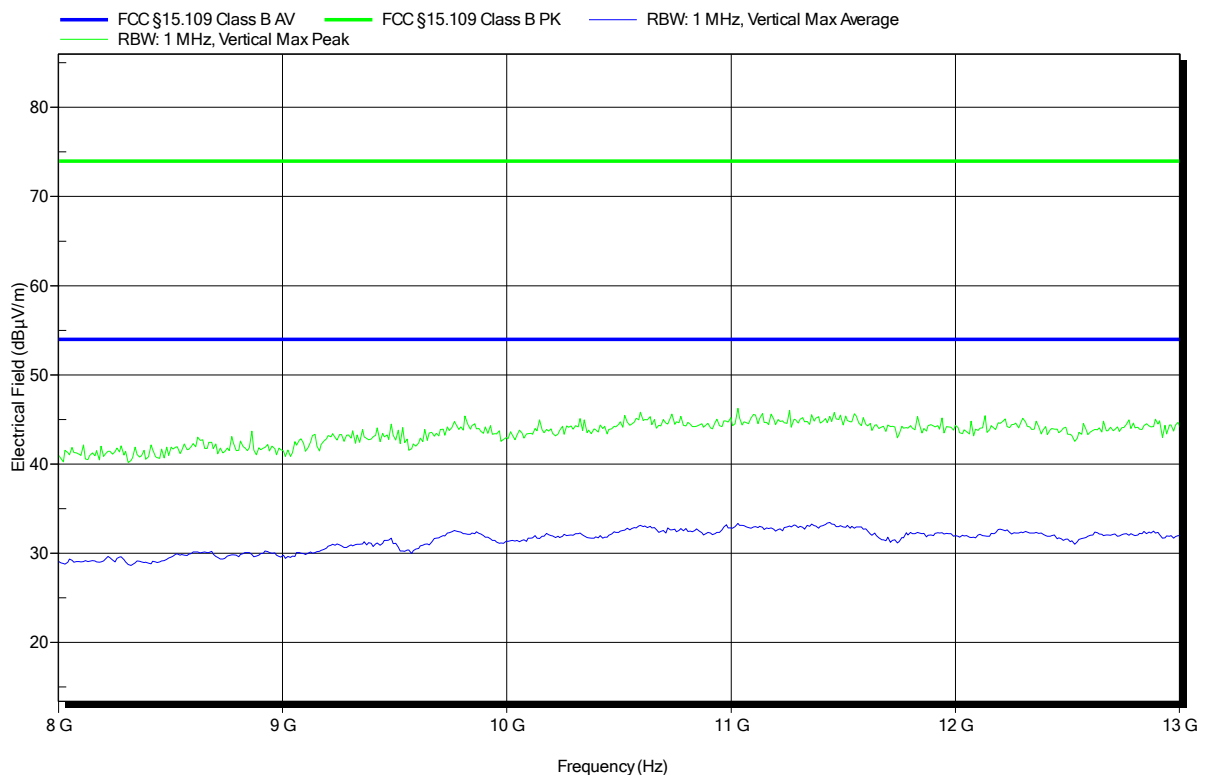


Spurious emissions according to FCC 15B

Project number: G0M-1611-6033

Applicant:	Artis GmbH
EUT Name:	4-K WISY Rotor und Sensorsystem
Model:	4K-WISY-Rotor
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 24°C, Vnom: 5V DC
Antenna:	Schwarzbeck BBHA 9120D, Vertical
Measurement distance:	3m
Mode:	Mode# 1
Test Date:	2017-02-23
Note:	

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3.2 Test Conditions and Results – AC power line conducted emissions

Conducted emissions acc. FCC 47 CFR 15.107 / ICES-003			Verdict: PASS	
Laboratory Parameters:		Required prior to the test		During the test
Ambient Temperature		15 to 35 °C		22°C
Relative Humidity		30 to 60 %		34%
Test according referenced standards		Reference Method		
		ANSI C63.4		
Fully configured sample scanned over the following frequency range		Frequency range		
		0.15 MHz to 30 MHz		
Sample is tested with respect to the requirements of the equipment class		Equipment class		
		Class B		
Points of Application		Application Interface		
AC Mains		LISN		
Operating mode		2		
Configuration		Charging		
Limits and results Class B				
Frequency [MHz]	Quasi-Peak [dBμV]	Result	Average [dBμV]	Result
0.15 to 5	66 to 56*	PASS	56 to 46*	PASS
0.5 to 5	56	PASS	46	PASS
5 to 30	60	PASS	50	PASS
Comments:				
* Limit decreases linearly with the logarithm of the frequency.				

Test Procedure:

The test site is in accordance with ANSI C63-4:2014 requirements and is listed by FCC.
The measurement procedure is as follows:

Exploratory measurement:

- The EUT was placed on a non conductive table 0.8 m above the reference ground plane and 0.4 m away from the vertical conducting plane (ANSI C63.4: 2014 item 7.3.1)
- The power cord that is normally supplied or recommended by the manufacturer was connected to the LISN.
- The distance between the outer edge of the EUT and the LISN shall be set to 0.8 m. A longer power cord shall be bundled to this length (bundling shall not exceed 40 cm in length).
- The LISN measurement port was connected to a measurement receiver
- I/O cables were bundled not longer than 0.4 m
- Measurement was performed in the frequency range 0.15 – 30MHz on each current-carrying conductor
- To maximize the emissions the cable positions were manipulated
- The worst configuration of EUT and cables is shown on a test setup picture at item 1.3

Test Procedure:**Final measurement:**

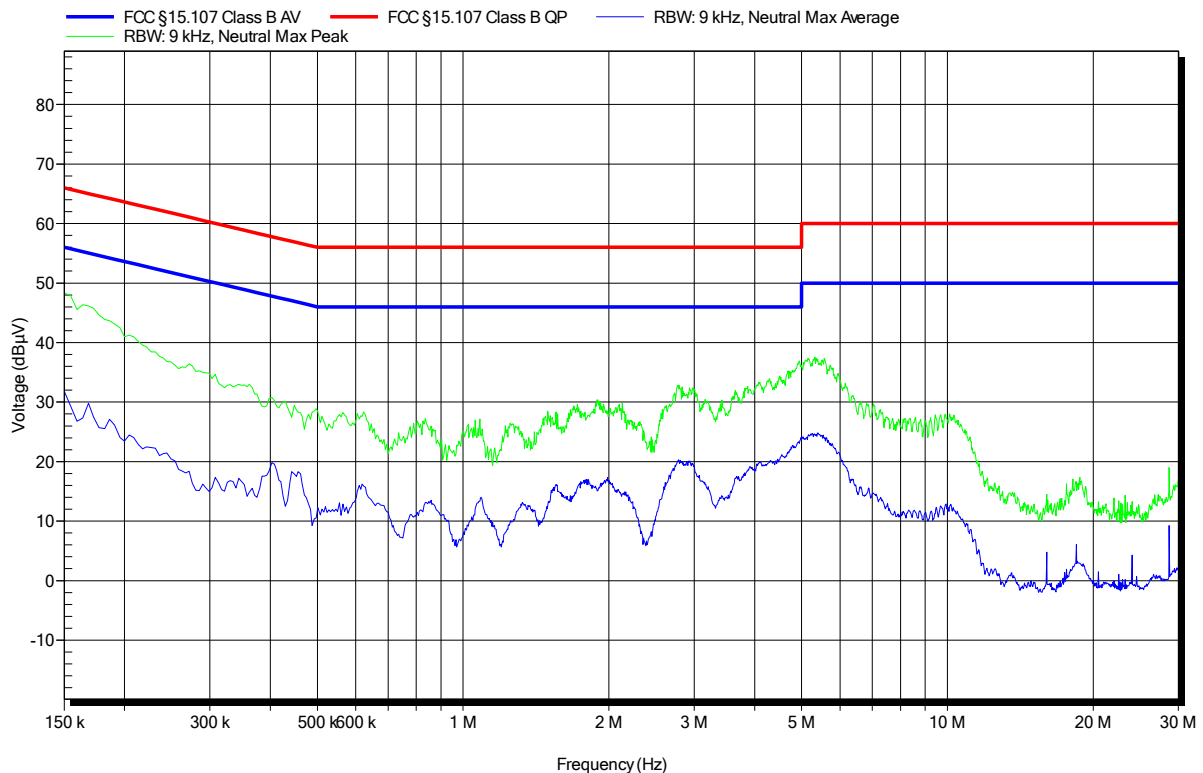
- The EUT was placed on a non conductive table 0.8 m above the reference ground plane and 0.4 m away from the vertical conducting plane (ANSI C63.4: 2014 item 7.3.1)
- The power cord that is normally supplied or recommended by the manufacturer was connected to the LISN.
- The distance between the outer edge of the EUT and the LISN shall be set to 0.8 m. A longer power cord shall be bundled to this length (bundling shall not exceed 40 cm in length).
- The LISN measurement port was connected to a measurement receiver
- The EUT and cable arrangement were based on the exploratory measurement results
- The test data of the worst-case conditions were recorded and shown on the next pages.

EMI voltage test in the ac-mains according to FCC 15B

Project number: G0M-1611-6033

Applicant:	Artis GmbH
EUT Name:	4-K WISY Rotor und Sensorsystem
Model:	4K-WISY-Rotor
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 24°C, Unom: 120V AC (AC/DC adaptor)
LISN:	ESH2-Z5 N
Mode:	Mode# 2
Test Date:	2017-02-20
Note:	

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Eurofins Product Service GmbH
Storkower Str. 38c, D-15526 Reichenwalde, Germany

EMI voltage test in the ac-mains according to FCC 15B

Project number: G0M-1611-6033

Applicant:	Artis GmbH
EUT Name:	4-K WISY Rotor und Sensorsystem
Model:	4K-WISY-Rotor
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 24°C, Unom: 120V AC (AC/DC adaptor)
LISN:	ESH2-Z5 L
Mode:	Mode# 2
Test Date:	2017-02-20
Note:	

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