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EMC TEST REPORT

FCC 47 CFR Part 15B
Industry Canada ICES-003

Electromagnetic compatibility - Unintentional radiators

Report Reference No. ..... :	G0M-1611-6034-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-Antennenmodul
Model No.	4K-WISY-Antennenmodul
Additional Models	None
Hardware version	A00447C
Firmware / Software version	41.2.3.3
Contains	FCC-ID: 2AKIJ-4KANTMOD IC: 22197-4KANTMOD
Test result	**Passed**

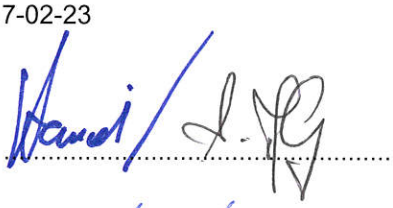
Possible test case verdicts:

- 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 ..... : 2017-02-02

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) ..... : Deputy Head of Lab	Jens Marquardt	
Date of issue ..... :	2017-03-01	
Total number of pages ..... :	28	

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.

Additional comments:

Version History

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

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

REPORT INDEX

1 Equipment (Test item) Description

Description	4K-WISY-Antennenmodul
Model	4K-WISY-Antennenmodul
Additional Models	None
Serial number	None
Hardware version	A00447C
Software / Firmware version	41.2.3.3
Contains FCC-ID	2AKIJ-4KANTMOD
Contains IC	22197-4KANTMOD
Power supply	5 VDC USB
AC/DC-Adaptor	None
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-Rotor	ARTIS GmbH	O3PZ1021101	Companion
AE	AC/DC adaptor	DELL	LA130PM121	
AE	Software	ARTIS GmbH	4K-WiSy-Visu	V45.2.3.7

***Note:** Use the following abbreviations:

AE : Auxiliary/Associated Equipment, or

SIM : Simulator (Not Subjected to Test)

CABL : Connecting cables

1.5 Input / Output Ports

Port #	Name	Type*	Max. Cable Length	Cable Shielded	Comments (e.g. Cat. of Cable)
1	Power	DC / I/O	2m	-	USB
2	Digital Input	I/O	2m	-	

***Note:** Use the following abbreviations:

AC : AC power port

DC : DC power port

N/E : Non electrical

I/O : Signal input or output port

TP : Telecommunication port

1.6 Operating Modes and Configurations

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

Configuration #	EUT Configuration
Continues measurement	EUT direct connect via USB to Laptop. Software 4K-WiSy-Visu runs on Laptop and visualized the measurement data of torque, force, bending from 4K-Wisy-Rotor. The connection between EUT and 4K-Wisy-Rotor is a continuous radio (TX/RX) connection on 2402 MHz.

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	Keysight	N9038A-526	EF01070	2016-08	2017-08
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
AMN	Schwarzbeck	NSLK 8128	EF00975	2015-12	2017-12
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 dBµV. 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:

Reading on Analyzer (dBµV) + A.F. (dB) = Net field strength (dBµV/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 dBµV/m). The FCC limits are given in units of µV/m. The following formula is used to convert the units of µV/m to dBµV/m:

Limit (dBµV/m) = 20*log (µV/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:

Reading	+	AF	=	Net Reading	:	Net reading - FCC limit	= Margin
21.5 dBµV	+	26 dB	=	47.5 dBµV/m	:	47.5 dBµV/m - 57.0 dBµV/m	= -9.5 dB

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		21°C			
Relative Humidity	30 to 60 %		37%			
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-1611-6034

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

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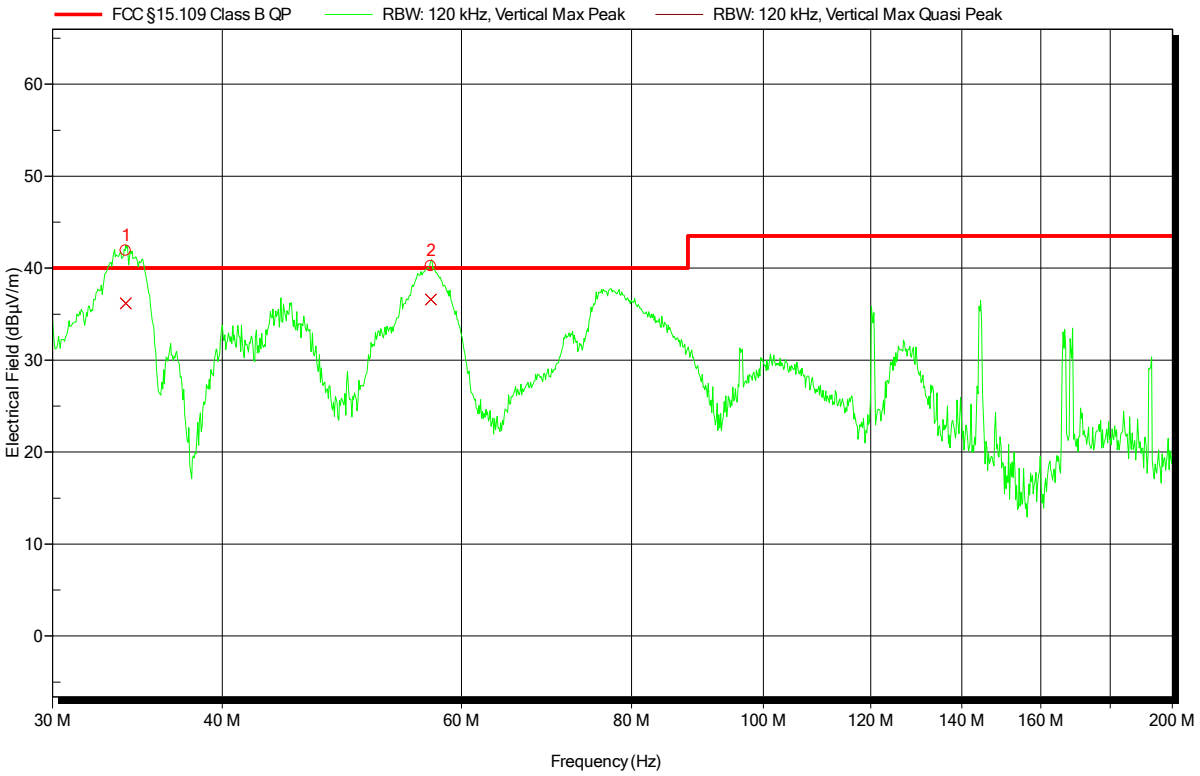

Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	33.963 MHz	36.19 dBµV/m	40 dBµV/m	-3.81 dB	Pass	271 Degree	1 m
2	56.962 MHz	36.58 dBµV/m	40 dBµV/m	-3.42 dB	Pass	271 Degree	1 m

Spurious emissions under normal conditions according to FCC Part 15b

Project number: G0M-1611-6034

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

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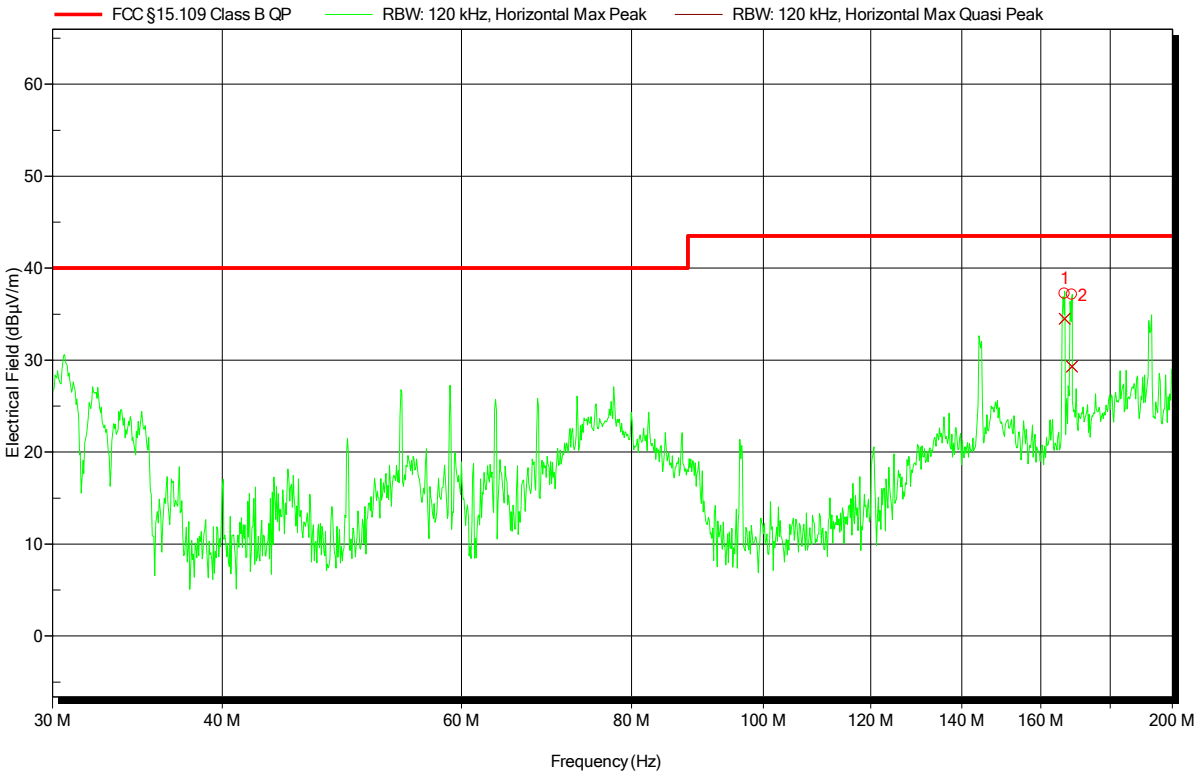

Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	166.588 MHz	34.5 dBµV/m	43.52 dBµV/m	-9.02 dB	Pass	323 Degree	1.43 m
2	168.665 MHz	29.31 dBµV/m	43.52 dBµV/m	-14.21 dB	Pass	323 Degree	1.43 m

Spurious emissions under normal conditions according to FCC Part 15b

Project number: G0M-1611-6034

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

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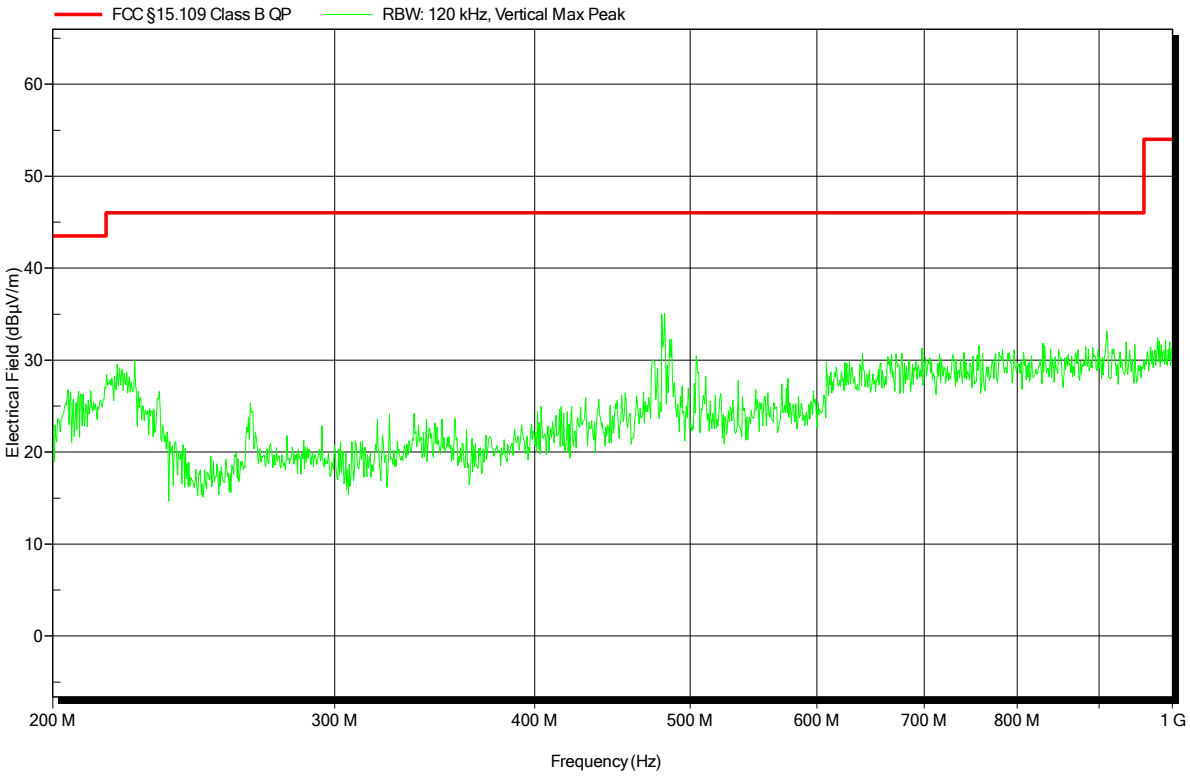

Spurious emissions under normal conditions according to FCC Part 15b

Project number: G0M-1611-6034

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

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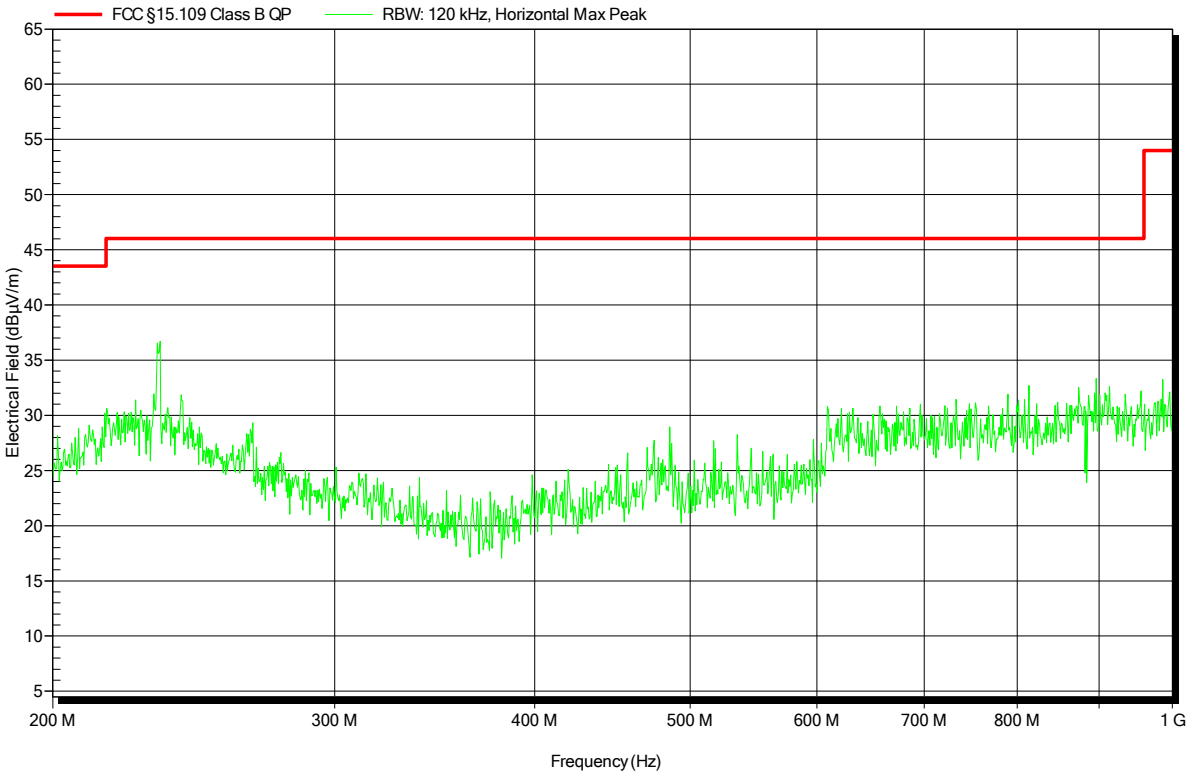

Spurious emissions under normal conditions according to FCC Part 15b

Project number: G0M-1611-6034

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

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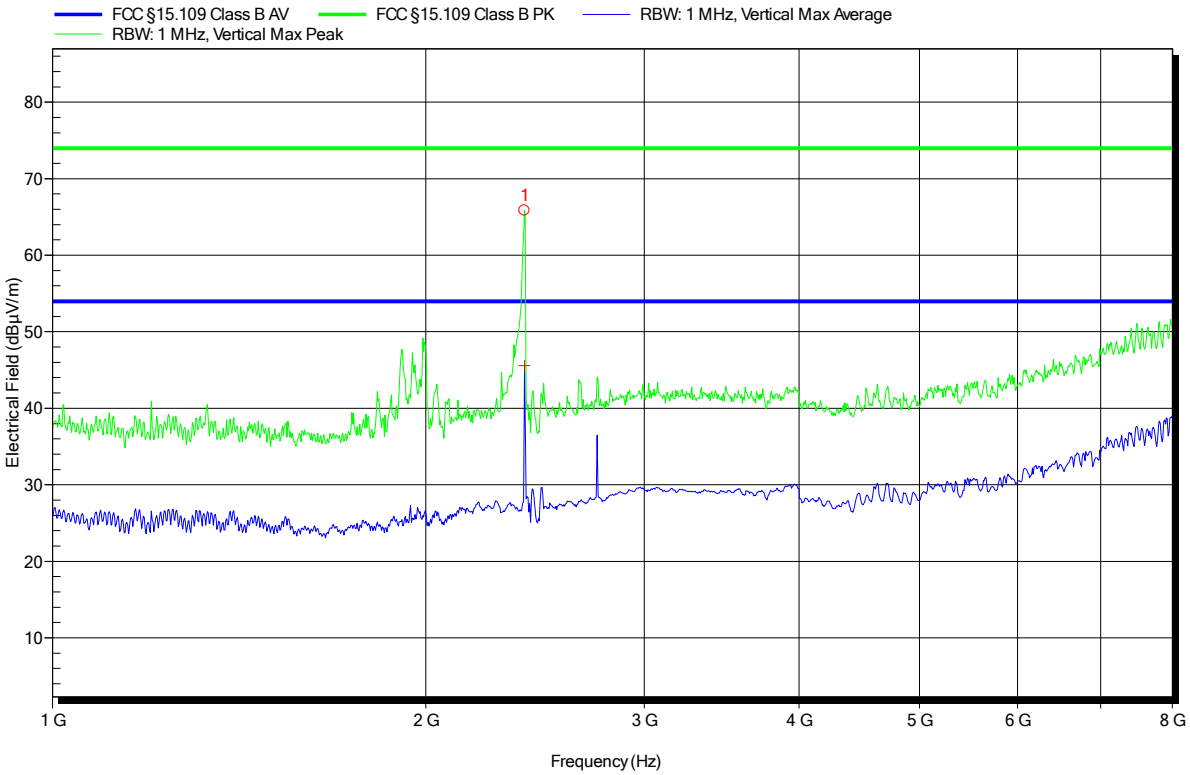

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height
1	2.402 GHz	carrier					

Spurious emissions under normal conditions according to FCC Part 15b

Project number: G0M-1611-6034

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

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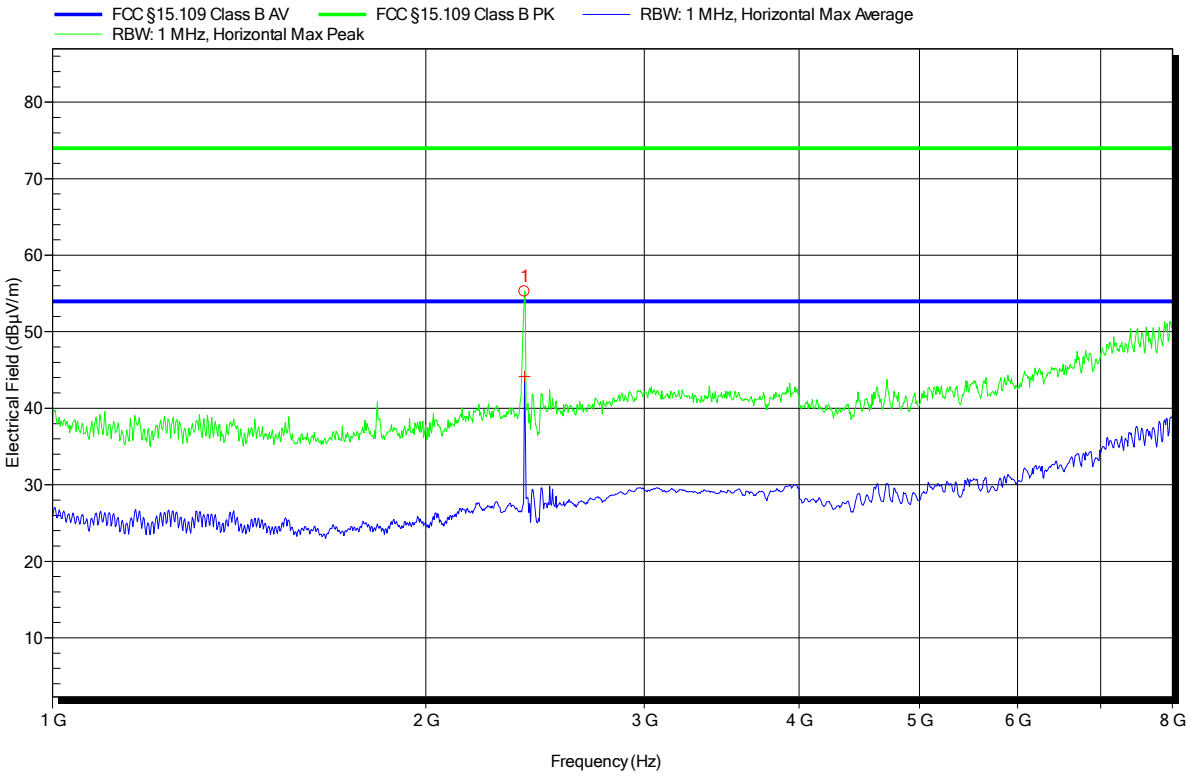

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height
1	2.402 GHz	carrier					

Spurious emissions according to FCC Part 15b

Project number: G0M-1611-6034

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

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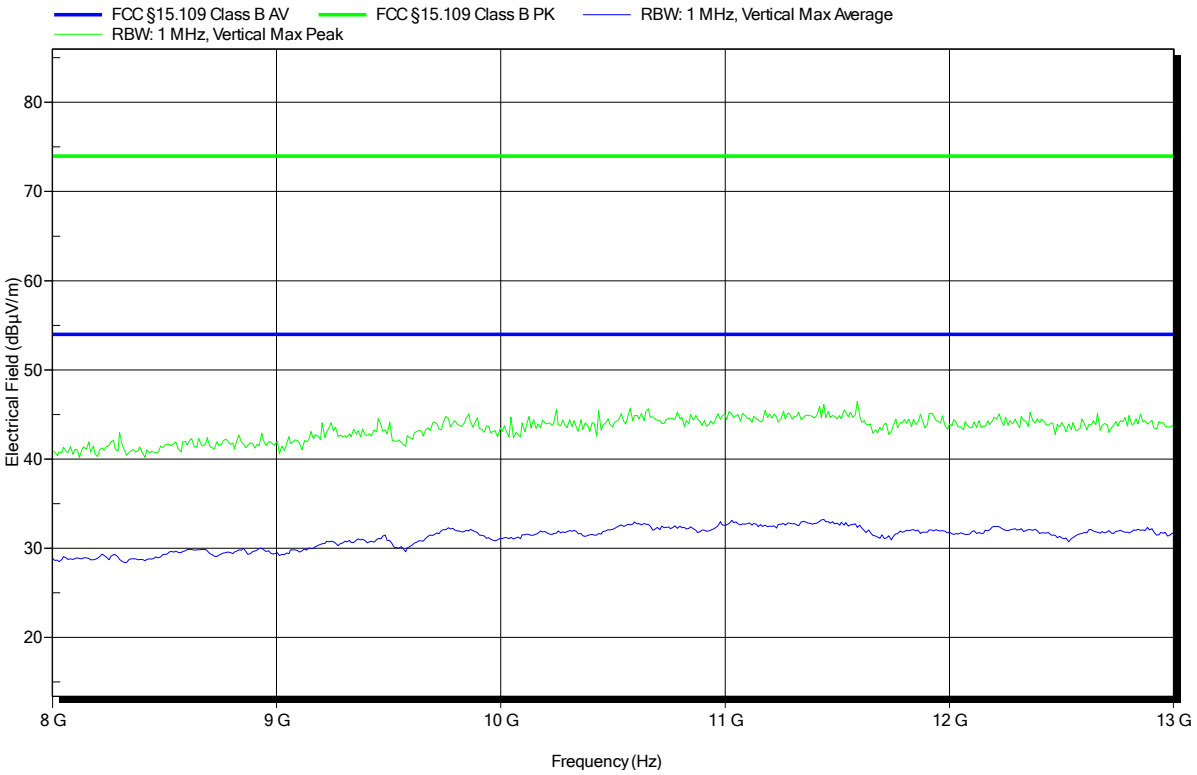

Spurious emissions according to FCC Part 15b

Project number: G0M-1611-6034

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

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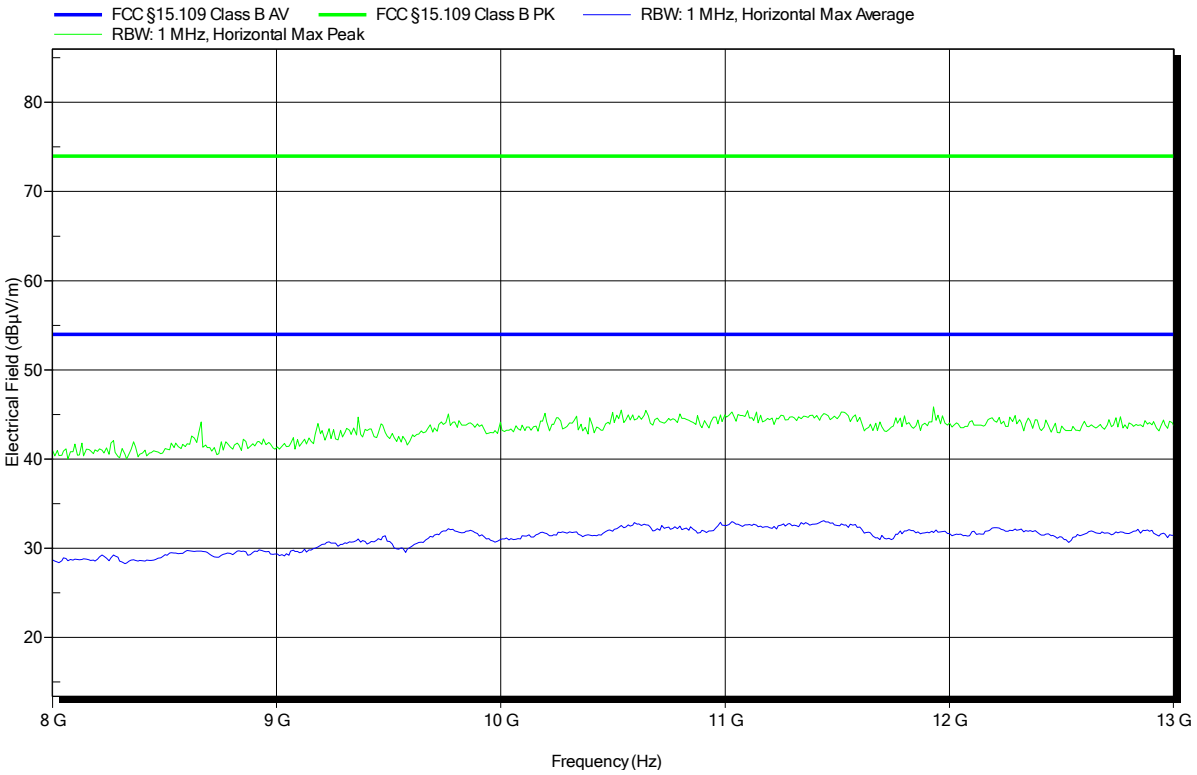

3.2 Test Conditions and Results – AC power line conducted emissions

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 %	36%
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	1	
Configuration	Continues measurement	

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 part 15 Subpart B

Project number: G0M-1611-6034

Applicant:	Artis GmbH
EUT Name:	4K-WISY-Antennenmodul
Model:	4K-WISY-Antennenmodul
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 24°C, Unom: 120V AC
LISN:	ESH2-Z5 N
Mode:	Mode# 1
Test Date:	2017-09-02
Note:	

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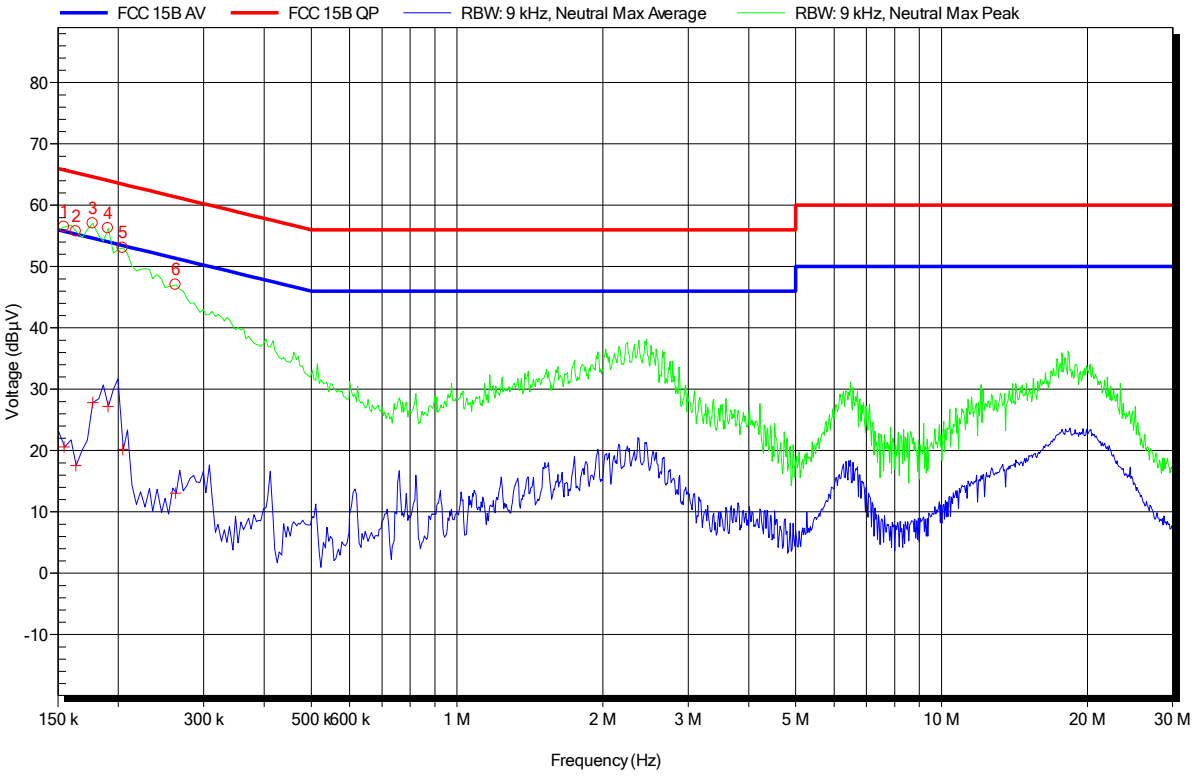

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status
1	154.5 kHz	20.59 dBµV	55.75 dBµV	-35.17 dB	Pass
2	163.5 kHz	17.57 dBµV	55.28 dBµV	-37.72 dB	Pass
3	177 kHz	27.8 dBµV	54.63 dBµV	-26.83 dB	Pass
4	190.5 kHz	27.2 dBµV	54.01 dBµV	-26.82 dB	Pass
5	204 kHz	20.17 dBµV	53.45 dBµV	-33.28 dB	Pass
6	262.5 kHz	13.04 dBµV	51.35 dBµV	-38.31 dB	Pass

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

Project number: G0M-1611-6034

Applicant:	Artis GmbH
EUT Name:	4K-WISY-Antennenmodul
Model:	4K-WISY-Antennenmodul
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 24°C, Unom: 120 V AC
LISN:	ESH2-Z5 L
Mode:	Mode# 1
Test Date:	2017-09-02
Note:	

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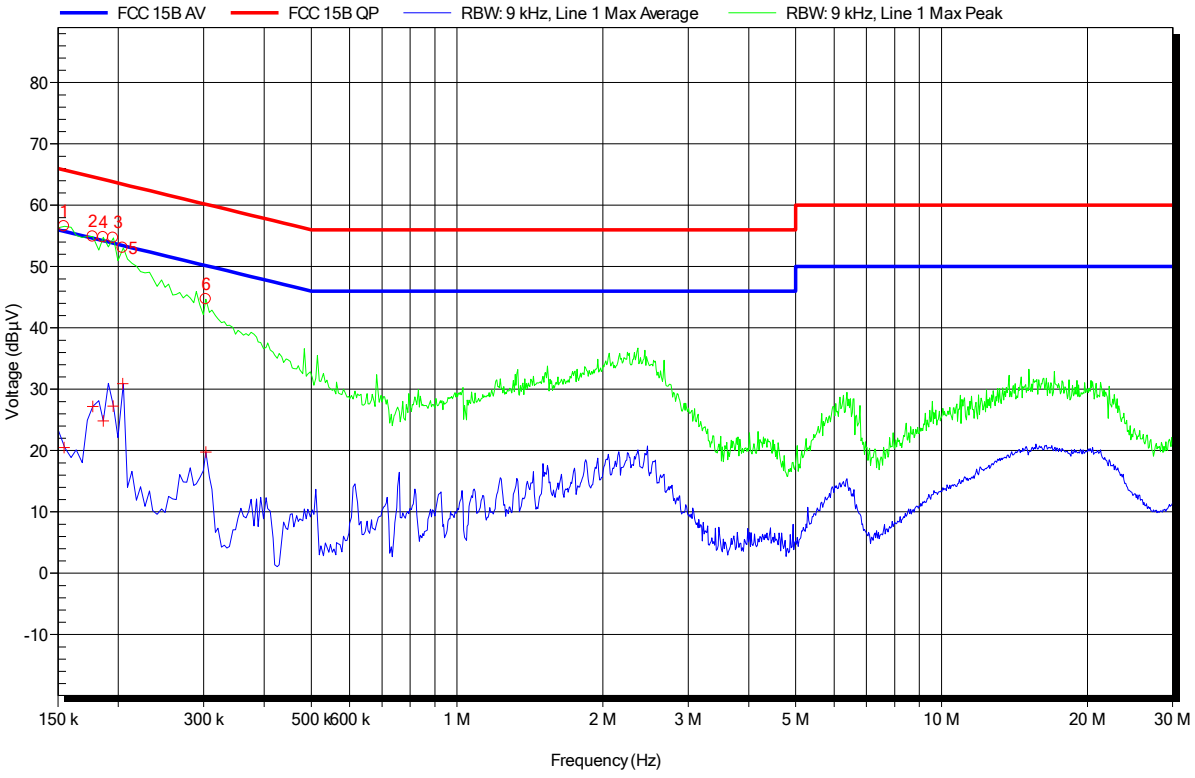

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status
1	154.5 kHz	20.51 dBµV	55.75 dBµV	-35.25 dB	Pass
2	177 kHz	27.21 dBµV	54.63 dBµV	-27.42 dB	Pass
3	195 kHz	27.23 dBµV	53.82 dBµV	-26.59 dB	Pass
4	186 kHz	24.86 dBµV	54.21 dBµV	-29.35 dB	Pass
5	204 kHz	30.93 dBµV	53.45 dBµV	-22.52 dB	Pass
6	303 kHz	19.75 dBµV	50.16 dBµV	-30.41 dB	Pass