

EMC TEST REPORT

FCC 47 CFR Part 15B
Industry Canada ICES-003

Electromagnetic compatibility - Unintentional radiators

Report Reference No. : G0M-1802-7219-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 Test Firm Designation Number: DE0008
IC Testing Laboratory site: 3470A-2

Applicant's name : Humotion GmbH

Address : Heerdestraße 23
48149 Münster
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	embedded Sensor System / Data Logger	
Model No.	DX 3.5	
Additional Models	None	
Hardware version	DX 3.5 Rev 01	
Firmware / Software version	1.0.518.13580	
	FCC-ID: 2AO4RDX3520FQ	IC: N/A

Test result **Passed**

Test Report No.: G0M-1802-7219-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: 2018-02-27

Date (s) of performance of tests: 2018-04-09

Compiled by: Manuel Engel / Matthias Handrik

Tested by (+ signature).....: Manuel Engel / Matthias Handrik

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

Date of issue: 2018-04-13

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.

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	2018-04-13	Initial Release	

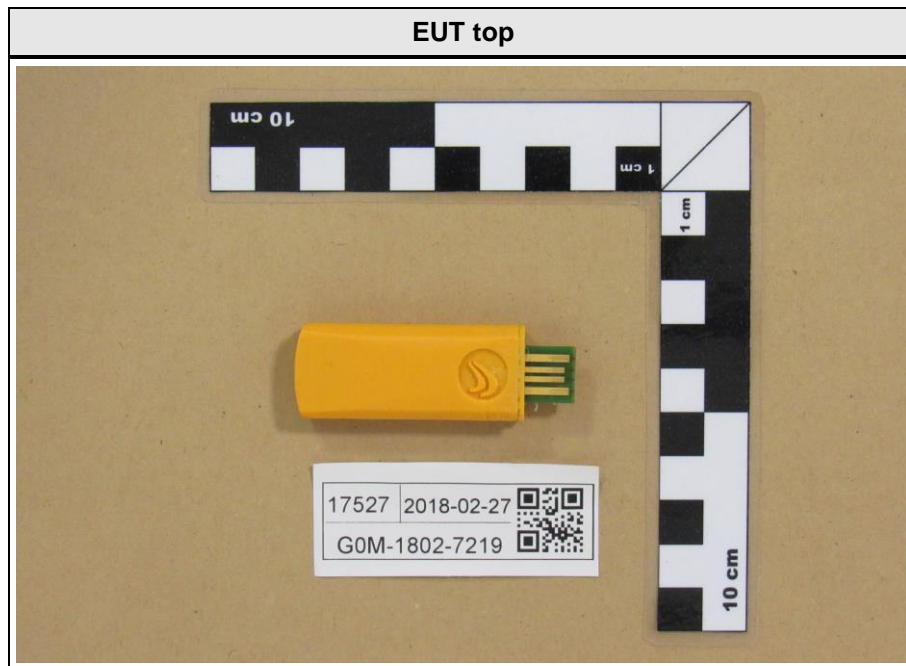
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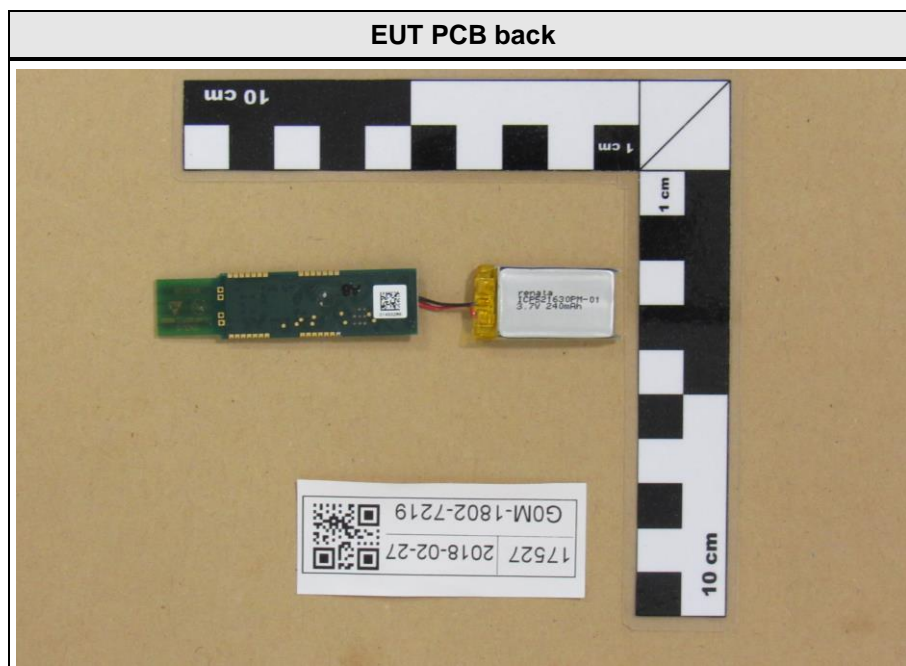
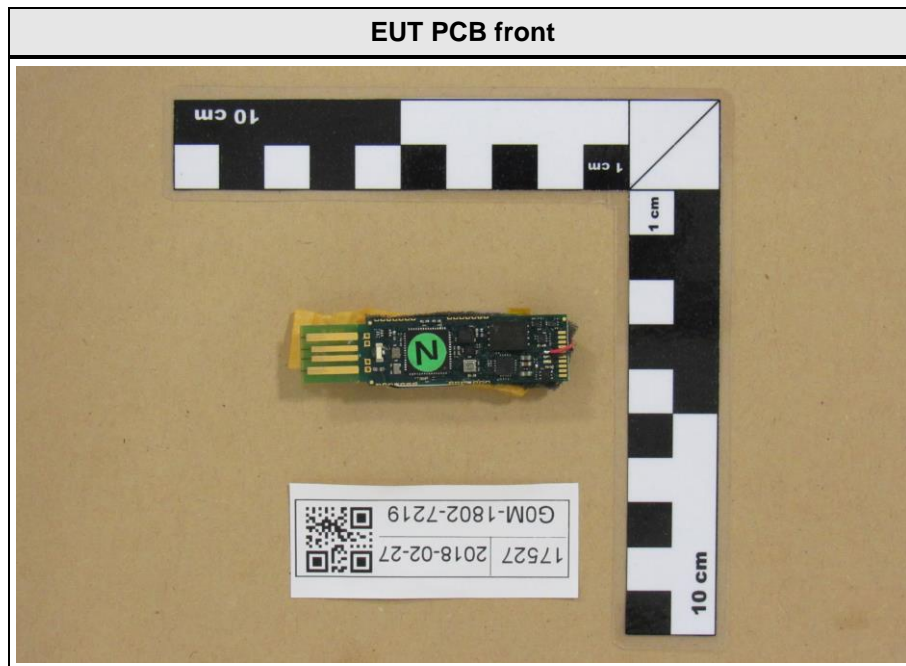
1 Equipment (Test item) Description

Description	embedded Sensor System / Data Logger
Model	DX 3.5
Additional Models	None
Serial number	None
Hardware version	DX 3.5 Rev 01
Software / Firmware version	1.0.518.13580
FCC-ID	2AO4RDX3520FQ
Contains IC	N/A
Power supply	5 VDC (USB) / 3.7 VDC Battery
AC/DC-Adaptor	None
Manufacturer	Humotion GmbH Heerdestraße 23 48149 Münster Germany
Highest internal frequency	Fmax [MHz] = 96
Device classification	Class B
Equipment type	Tabletop
Number of tested samples	1

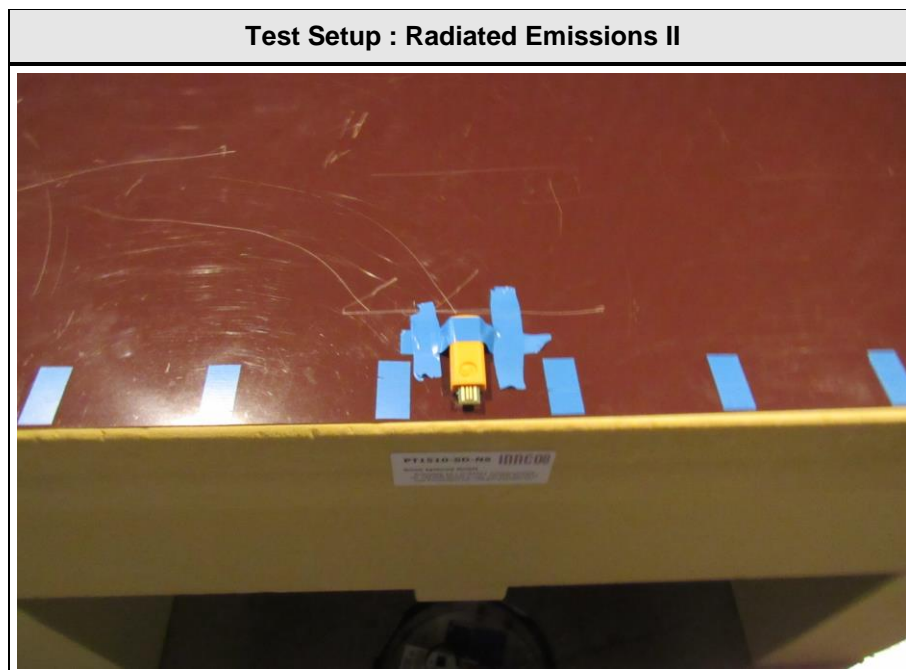
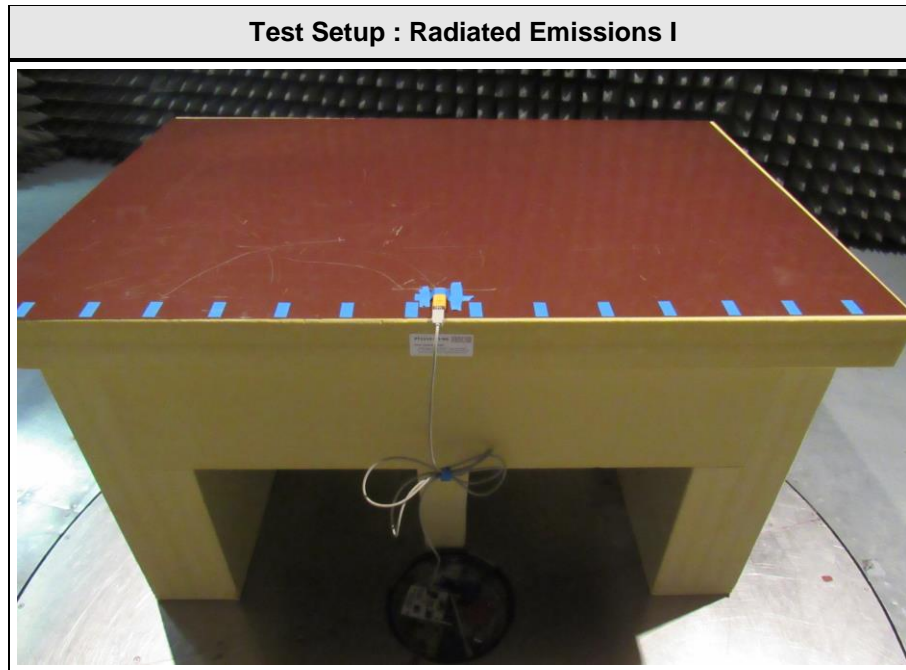
1.1 Photos – Equipment external



1.2 Photos – Equipment internal



1.3 Photos – Test setup



Test Setup : Conducted Emissions



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 CXJ43R1
<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	USB	I/O / DC	2 m	Yes	
<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	Data transfer and charging operation (USB)
2	Measurement operation (battery)

Configuration #	EUT Configuration
1	EUT connected to Laptop via USB.
2	EUT operate stand-alone without Laptop.

1.7 Test Equipment Used During Testing

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

Conducted emissions SR1					
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	2017-07	2018-07
Cable	-	RG223/U	-	System Cal.	System Cal.

Radiated emissions AC1					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Biconical antenna	Rohde & Schwarz Vertriebs GmbH	HK116	EF00186	2018-02	2020-02
LPD Antenna	R&S	HL 223	EF00187	2016-05	2019-05
Horn antenna	Schwarzbeck	BBHA 9120D	EF00018	2016-09	2019-09
MXE EMI Receiver	Keysight Technologies	N9038A- 526/WXP	EF01070	2017-08	2018-08
RF Cable			-	System Cal.	System Cal
RF Cable			-	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:

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

Net:

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

Limit:

This is the FCC Class B radiated emission limit (in units of 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:

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

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:

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			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					
		Fmax [MHz] = 96					
Fully configured sample scanned over the following frequency range		Frequency range					
		30 MHz to 1 GHz					
Operating mode		1 / 2					
Configuration		1 / 2					
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	-		-	-	
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:

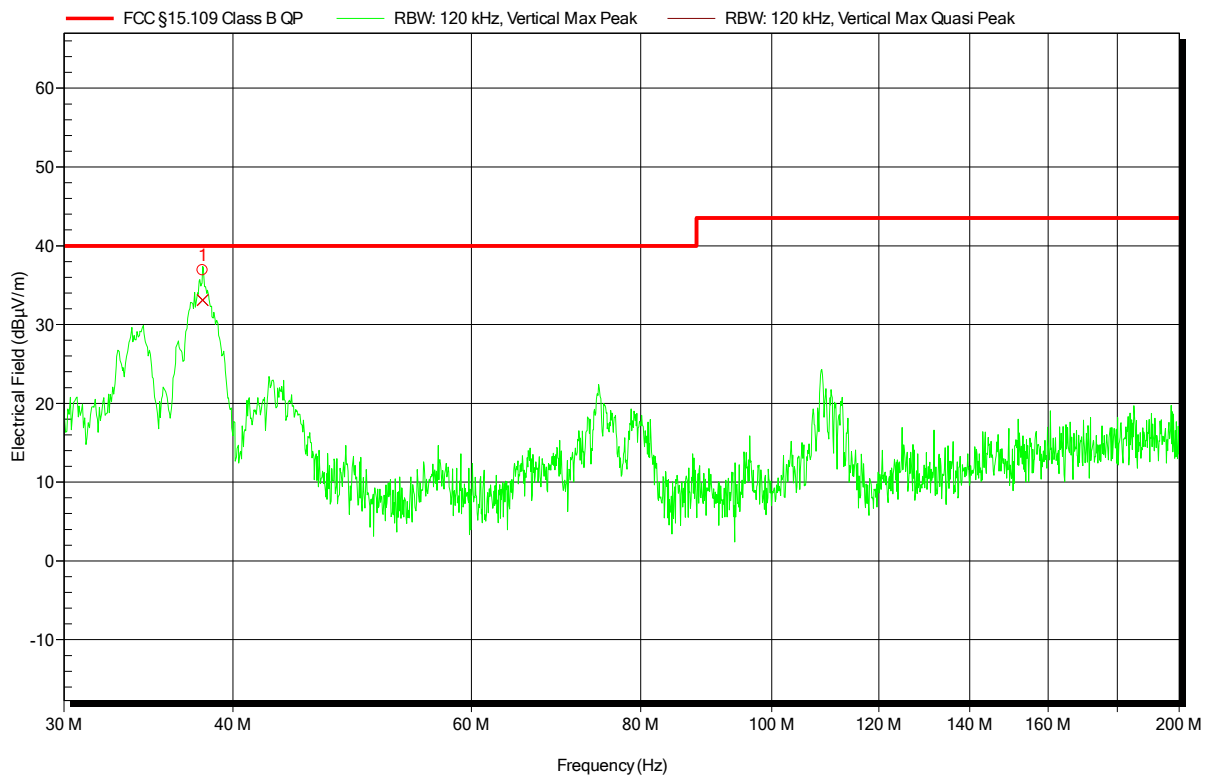
- The EUT was placed on a 0.8 m non-conductive table at a 3 m distance from the receive antenna. The antenna output was connected to the measurement receiver
- A biconical antenna was used for the frequency range 30 – 200 MHz, a logarithmic periodical antenna was used for the frequency range from 200 – 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.

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1802-7219

Applicant: Humotion GmbH
 EUT Name: embedded Sensor System / Data Logger
 Model: DX 3.5
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Engel
 Test Conditions: Tnom: 22°C, Unom: 5 VDC
 Antenna: Rohde & Schwarz HK 116, Vertical
 Measurement distance: 3m
 Mode: Mode 1, DC power supply
 Test Date: 2018-04-09
 Note:

Index 2



Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	37.999 MHz	33.11 dBµV/m	40 dBµV/m	-6.89 dB	Pass	0 Degree	1 m

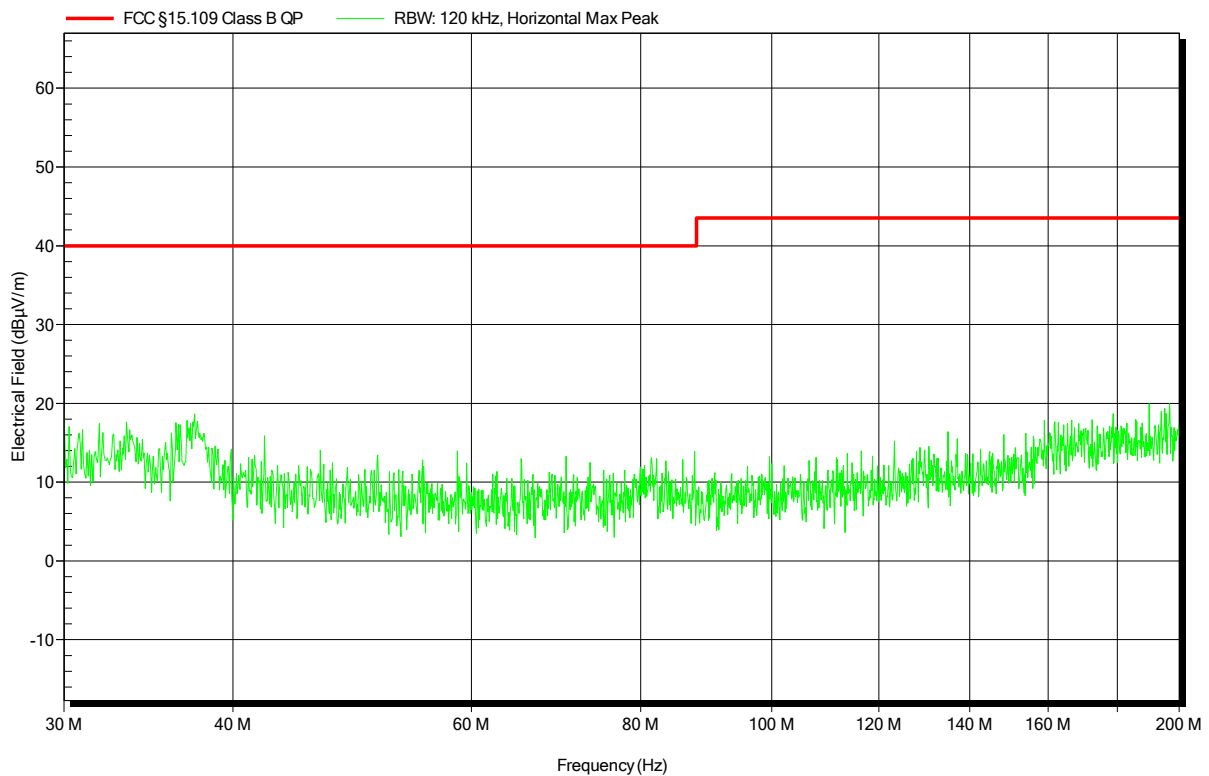
Test Report No.: G0M-1802-7219-EF0115B-V01

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

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1802-7219
 Applicant: Humotion GmbH
 EUT Name: embedded Sensor System / Data Logger
 Model: DX 3.5
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Engel
 Test Conditions: Tnom: 22°C, Unom: 5 VDC
 Antenna: Rohde & Schwarz HK 116, Horizontal
 Measurement distance: 3m
 Mode: Mode 1, DC power supply
 Test Date: 2018-04-09
 Note:

Index 1

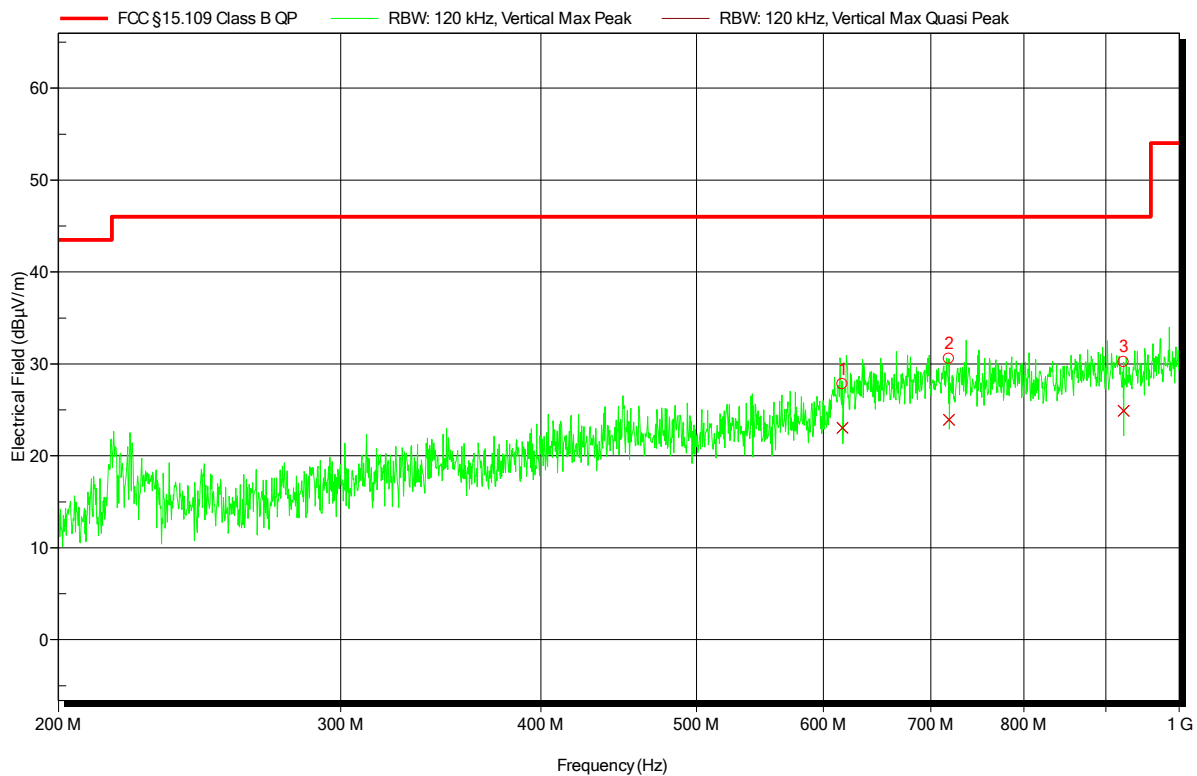


Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1802-7219

Applicant: Humotion GmbH
EUT Name: embedded Sensor System / Data Logger
Model: DX 3.5
Test Site: Eurofins Product Service GmbH
Operator: Mr. Engel
Test Conditions: Tnom: 22°C, Unom: 5 VDC
Antenna: Rohde & Schwarz HL 223, Vertical
Measurement distance: 3m
Mode: Mode 1, DC power supply
Test Date: 2018-04-09
Note:

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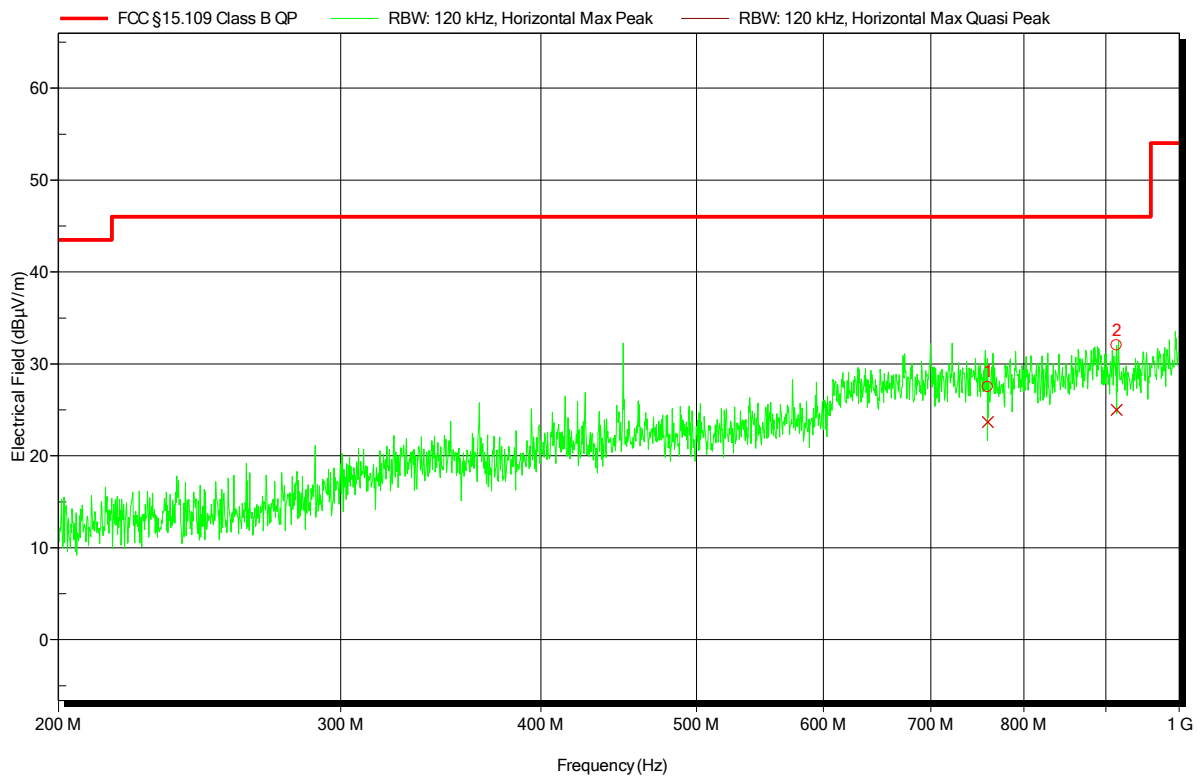
Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	616.518 MHz	23.04 dBµV/m	46.02 dBµV/m	-22.98 dB	Pass	0 Degree	1 m
2	718.523 MHz	23.93 dBµV/m	46.02 dBµV/m	-22.1 dB	Pass	0 Degree	1 m
3	923.152 MHz	24.9 dBµV/m	46.02 dBµV/m	-21.13 dB	Pass	0 Degree	1 m

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1802-7219

Applicant: Humotion GmbH
EUT Name: embedded Sensor System / Data Logger
Model: DX 3.5
Test Site: Eurofins Product Service GmbH
Operator: Mr. Engel
Test Conditions: Tnom: 22°C, Unom: 5 VDC
Antenna: Rohde & Schwarz HL 223, Horizontal
Measurement distance: 3m
Mode: Mode 1, DC power supply
Test Date: 2018-04-09
Note:

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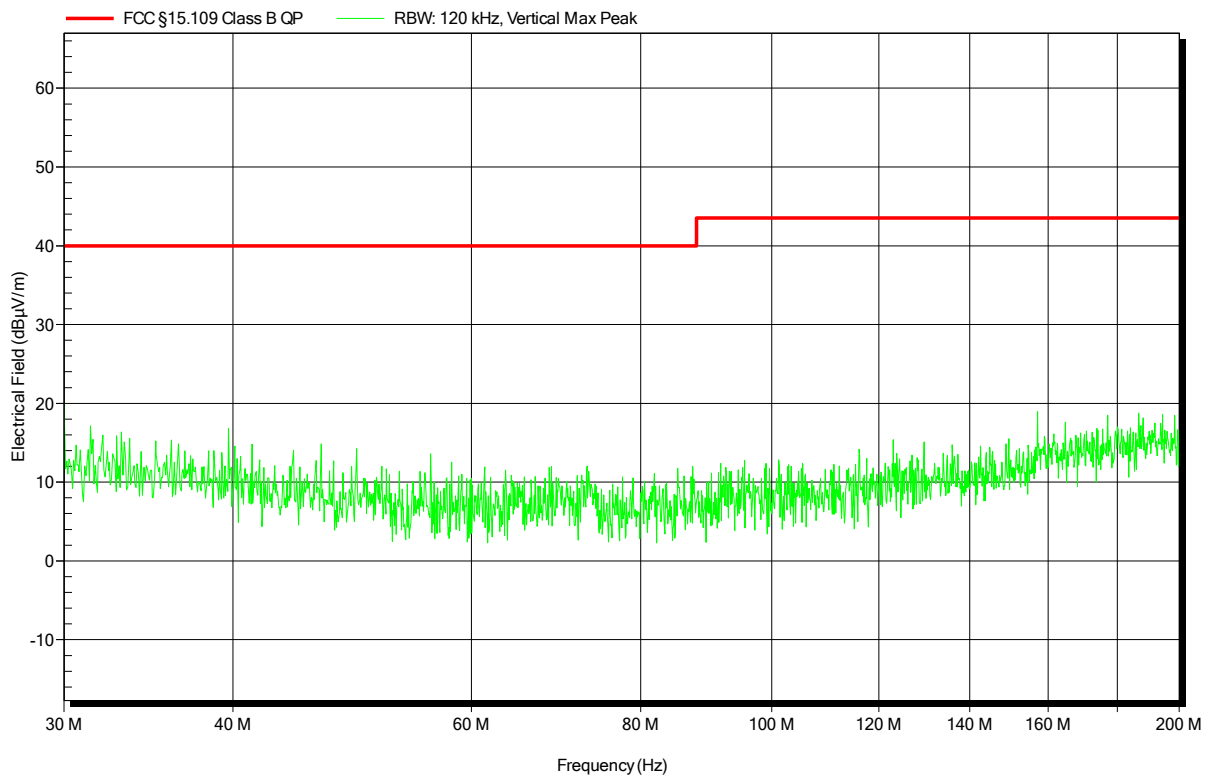


Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	759.568 MHz	23.67 dBµV/m	46.02 dBµV/m	-22.35 dB	Pass	0 Degree	1 m
2	913.954 MHz	24.99 dBµV/m	46.02 dBµV/m	-21.03 dB	Pass	0 Degree	1 m

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1802-7219
 Applicant: Humotion GmbH
 EUT Name: embedded Sensor System / Data Logger
 Model: DX 3.5
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Engel
 Test Conditions: Tnom: 22°C, Unom: 3.7 VDC
 Antenna: Rohde & Schwarz HK 116, Vertical
 Measurement distance: 3m
 Mode: Mode 2, battery
 Test Date: 2018-04-09
 Note:

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 Test Report No.: G0M-1802-7219-EF0115B-V01

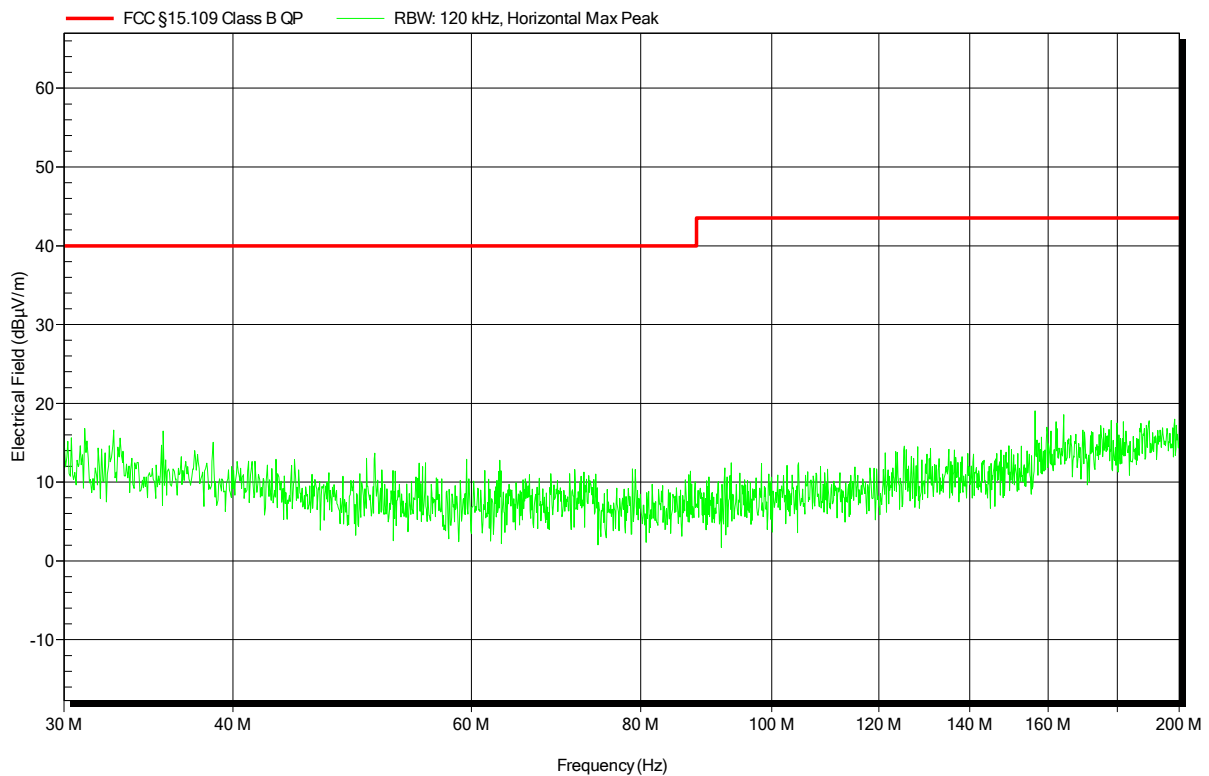
 Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1802-7219

Applicant: Humotion GmbH
 EUT Name: embedded Sensor System / Data Logger
 Model: DX 3.5
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Engel
 Test Conditions: Tnom: 22°C, Unom: 3.7 VDC
 Antenna: Rohde & Schwarz HK 116, Horizontal
 Measurement distance: 3m
 Mode: Mode 2, battery
 Test Date: 2018-04-09
 Note:

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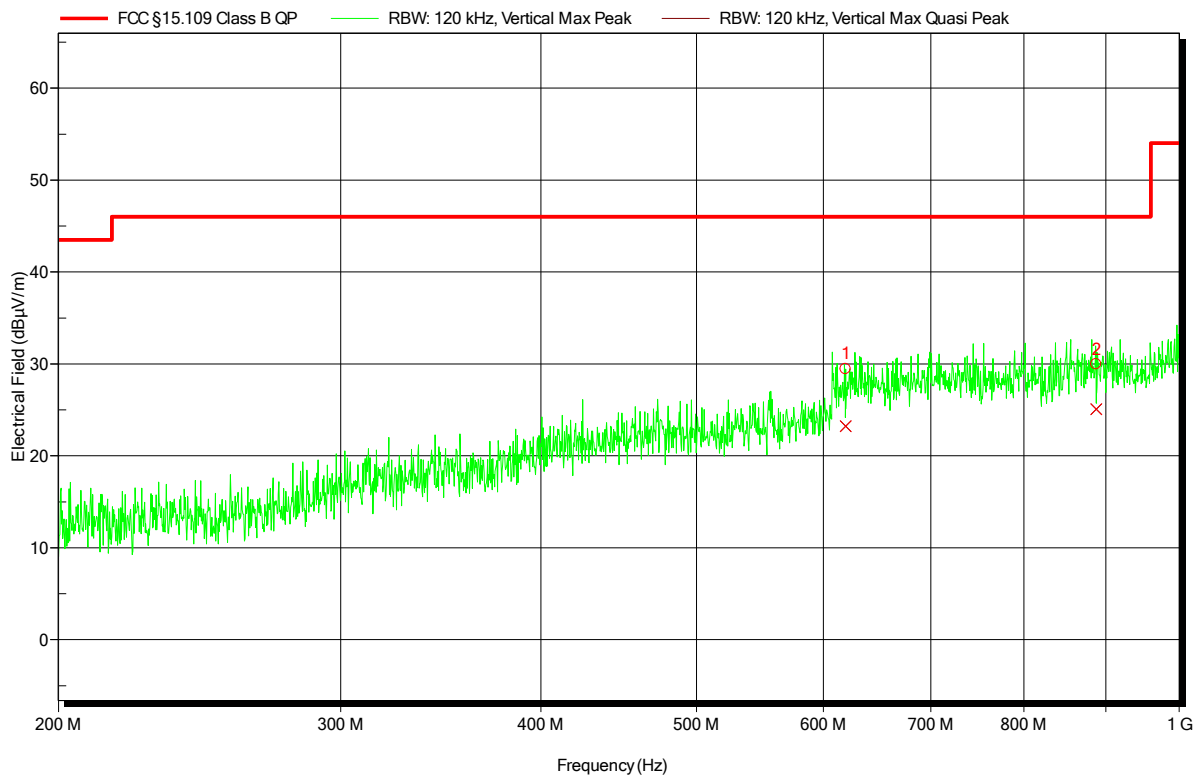


Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1802-7219

Applicant: Humotion GmbH
 EUT Name: embedded Sensor System / Data Logger
 Model: DX 3.5
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Engel
 Test Conditions: Tnom: 22°C, Unom: 3.7 VDC
 Antenna: Rohde & Schwarz HL 223, Vertical
 Measurement distance: 3m
 Mode: Mode 2, battery
 Test Date: 2018-04-09
 Note:

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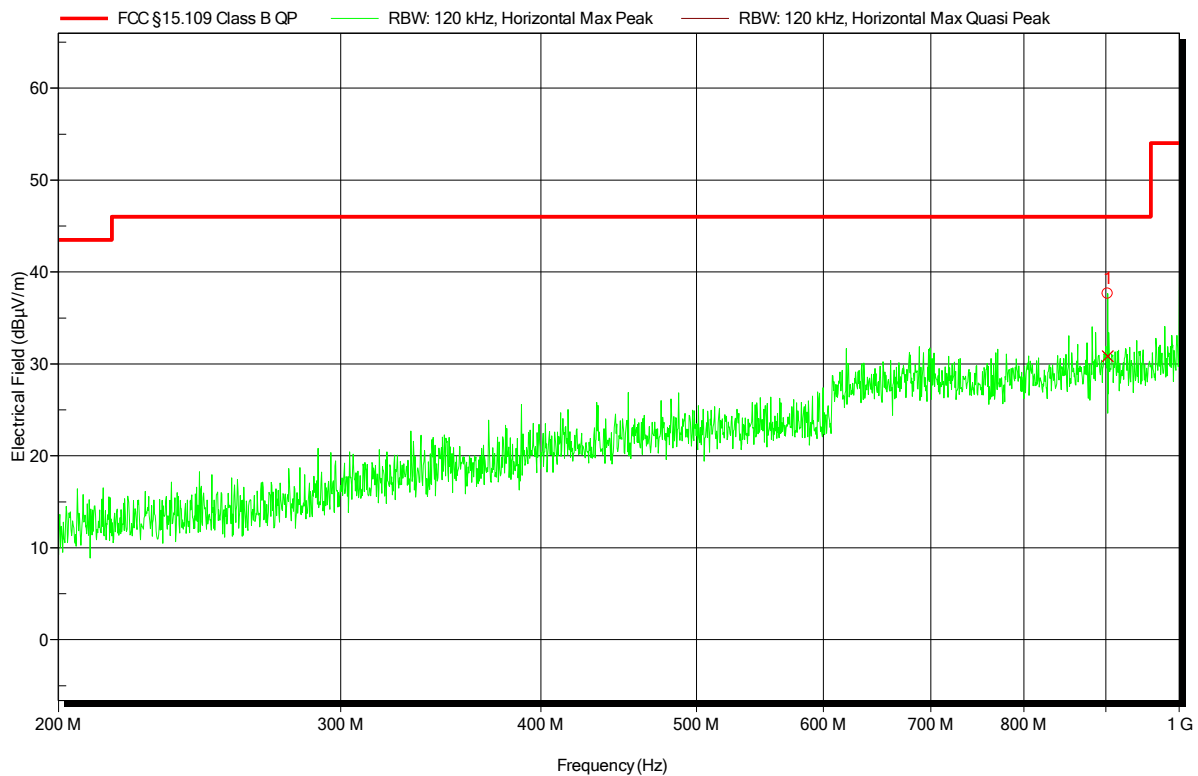
Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	619.441 MHz	23.21 dBµV/m	46.02 dBµV/m	-22.81 dB	Pass	0 Degree	1 m
2	887.619 MHz	25.08 dBµV/m	46.02 dBµV/m	-20.94 dB	Pass	0 Degree	1 m

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1802-7219

Applicant: Humotion GmbH
EUT Name: embedded Sensor System / Data Logger
Model: DX 3.5
Test Site: Eurofins Product Service GmbH
Operator: Mr. Engel
Test Conditions: Tnom: 22°C, Unom: 3.7 VDC
Antenna: Rohde & Schwarz HL 223, Horizontal
Measurement distance: 3m
Mode: Mode 2, battery
Test Date: 2018-04-09
Note:

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Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	902.485 MHz	30.83 dBµV/m	46.02 dBµV/m	-15.19 dB	Pass	0 Degree	1 m

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		1		
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:**

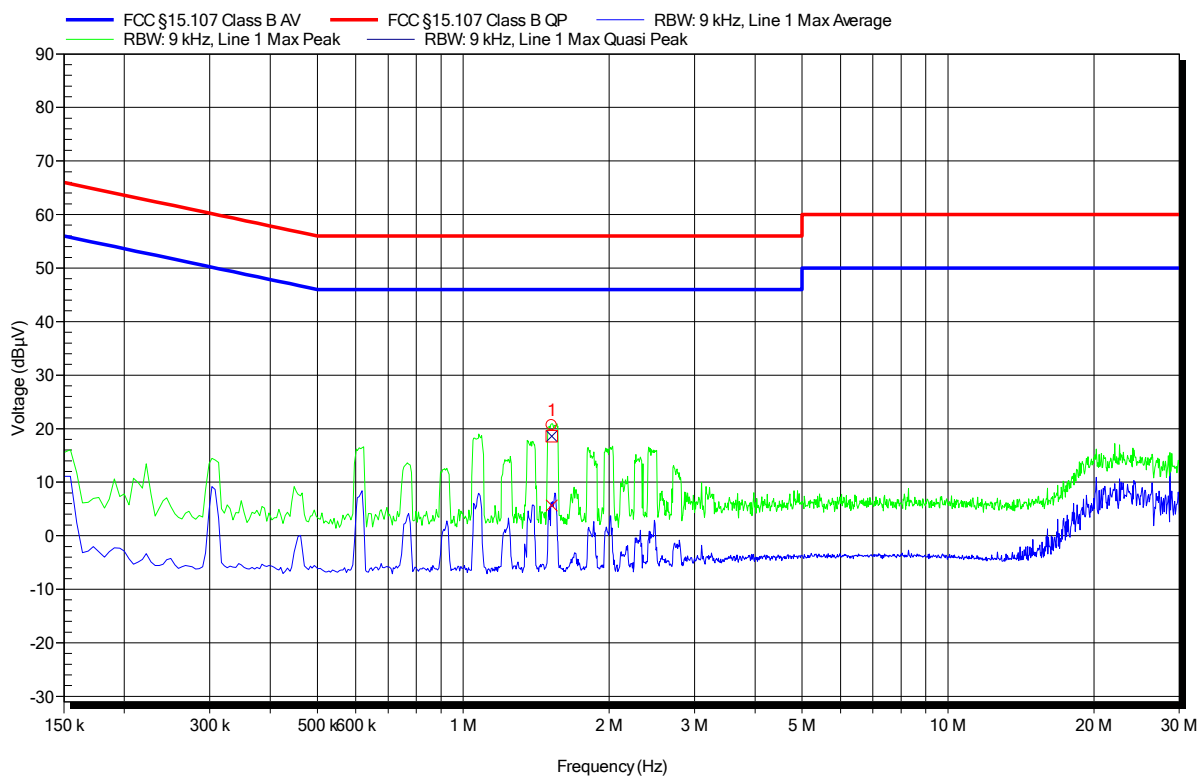
- The EUT was placed on a non conductive table 0.8 m above the reference ground plane and 0.4 m away from the vertical conducting plane (ANSI C63.4: 2014 item 7.3.1)
- The power cord that is normally supplied or recommended by the manufacturer was connected to the LISN.
- The distance between the outer 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 15b

Project number: G0M-1802-7219

Applicant: Humotion GmbH
EUT Name: embedded Sensor System / Data Logger
Model: DX 3.5
Test Site: Eurofins Product Service GmbH
Operator: Mr. Engel
Test Conditions: Tnom: 23°C, Unom: 120 VAC (AC/DC Adaptor)
LISN: ESH2-Z5 L
Mode: mode 1
Test Date: 2018-04-09
Note:

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Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status
1	1.522 MHz	18.57 dBμV	56 dBμV	-37.43 dB	Pass
Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status
1	1.522 MHz	5.66 dBμV	46 dBμV	-40.34 dB	Pass

Test Report No.: G0M-1802-7219-EF0115B-V01

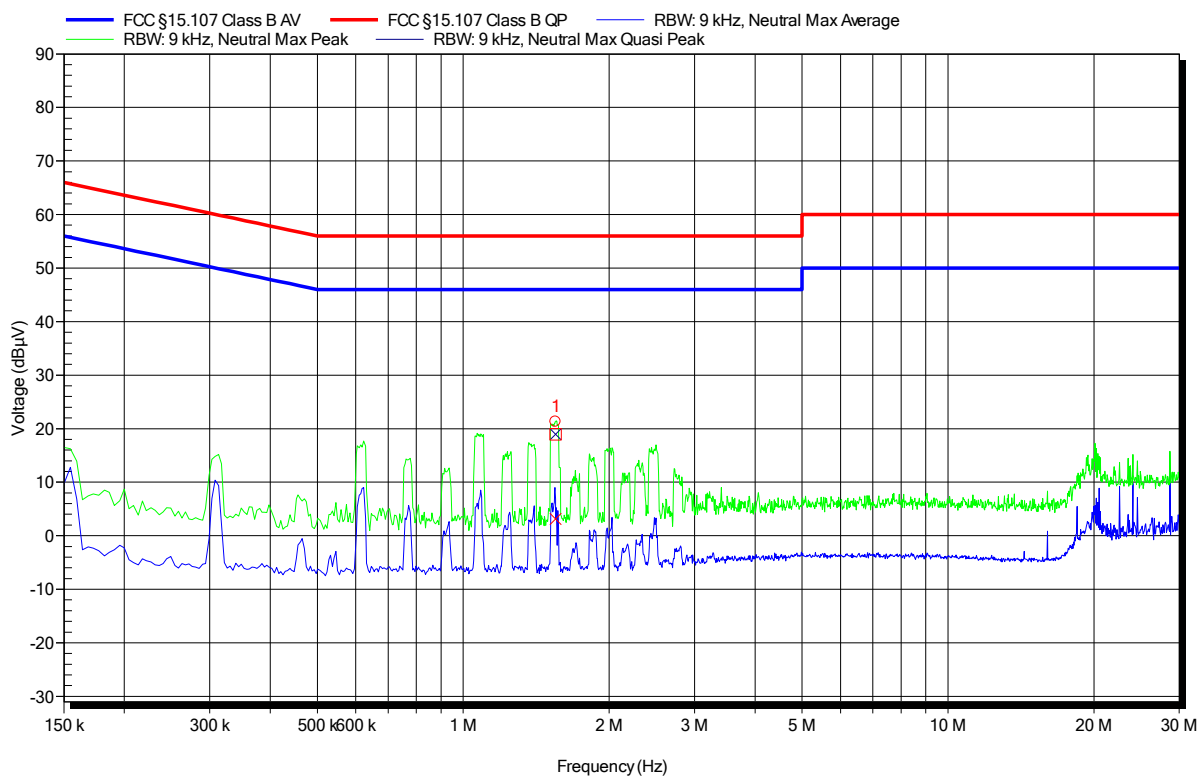
Eurofins Product Service GmbH
Storkower Str. 38c, D-15526 Reichenwalde, Germany

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

Project number: G0M-1802-7219

Applicant: Humotion GmbH
EUT Name: embedded Sensor System / Data Logger
Model: DX 3.5
Test Site: Eurofins Product Service GmbH
Operator: Mr. Engel
Test Conditions: Tnom: 23°C, Unom: 120 VAC (AC/DC Adaptor)
LISN: ESH2-Z5 N
Mode: mode 1
Test Date: 2018-04-09
Note:

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Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status
1	1.55 MHz	18.92 dBµV	56 dBµV	-37.08 dB	Pass

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status
1	1.55 MHz	3.14 dBµV	46 dBµV	-42.86 dB	Pass

Test Report No.: G0M-1802-7219-EF0115B-V01

Eurofins Product Service GmbH
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