EMC TEST REPORT

FCC 47 CFR Part 15B, ISED ICES-003 Issue 6

Report Reference No	G0M-1804-7374-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 Testing Laboratory site: 3470A-2
Applicant	Luke Roberts GmbH
Address	Phorusgasse 8/2 1040 Vienna AUSTRIA
Test Specification	Full compliance test
Standard	47 CFR Part 15 Subpart B ISED ICES-003 Issue 6 ANSI C63.4:2014
Non-Standard Test Method	None
Equipment under Test (EUT):	
Product Description	LED Pendant Luminaire with Bluetooth Low Energy Radio
Model(s)	LRF
Additional Model(s)	None
Brand Name(s)	None
Hardware Version(s)	LR-F01-v5
Software Version(s)	RF: Nordic Semiconductor S132 v.3.0.0
FCC-ID	2AP5D01LR
IC	23941-01LR
Test Result	**PASSED**

Possibe test case verdicts:		
required by standard but not tested	N/T	
not required by standard	N/R	
required by standard but not appl. 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	2018-05-09	
Report:		
Compiled by	Matthias Handrik	
Tested by (+ signature) (Responsible for Test)	Matthias Handrik	
Approved by (+ signature) (Deputy Head of Lab)	Jens Marquardt	
Date of Issue	2018-07-05	
Total number of pages	30	
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:		

ABBREVIATIONS AND ACRONYMS

Acronyms	
Acronym	Description
EUT	Equipment Under Test
FCC	Federal Communications Commission
ISED	Innovation, Science and Economic Development Canada
T_{NOM}	Nominal operating temperature
V_{NOM}	Nominal supply voltage

VERSION HISTORY

Version History			
Version	Issue Date	Remarks	Revised By
01	2018-05-07	Initial Release	

REPORT INDEX

1 Equipment (Test Item) Under Test

Description	LED Pendant Luminaire with Bluetooth Low Energy Radio	
Model	LRF	
Additional Model(s)	None	
Brand Name(s)	None	
Serial Number(s)	unspecified	
Hardware Version(s)	LR-F01-v5	
Software Version(s)	RF: Nordic Semiconductor S132 v.3.0.0	
FCC-ID	2AP5D01LR	
IC	23941-01LR	
Class	Class B	
Equipment type	Table top	
Highest internal frequency [MHz]	2480	
Radio Module	Type	Bluetooth Low Energy module
	Model	unspecified
	Manufacturer	unspecified
	FCC-ID	unspecified
	IC	unspecified
Supply Voltage	V_{NOM}	120V AC
AC/DC-Adaptor	None	
Manufacturer	Luke Roberts GmbH Phorusgasse 8/2 1040 Vienna AUSTRIA	

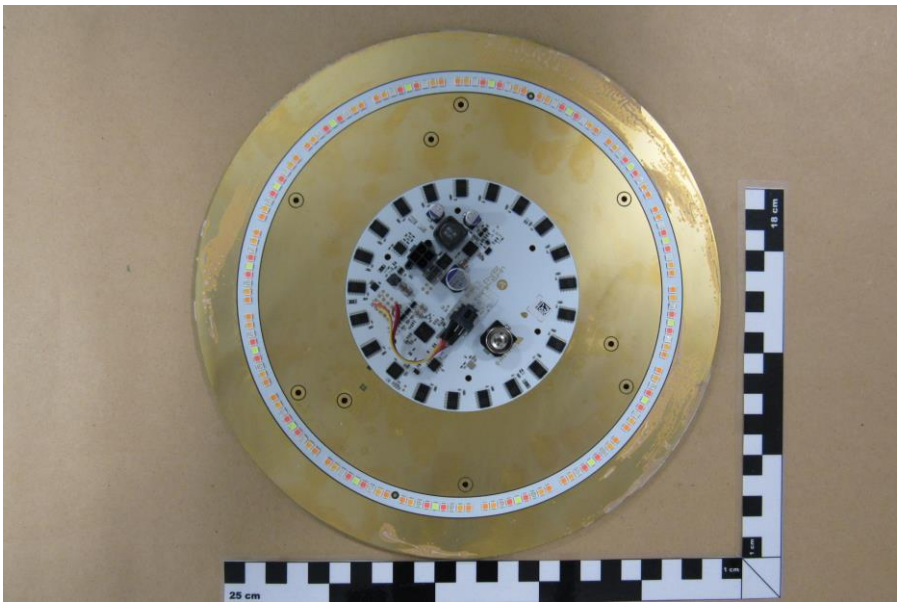
1.1 Equipment Ports

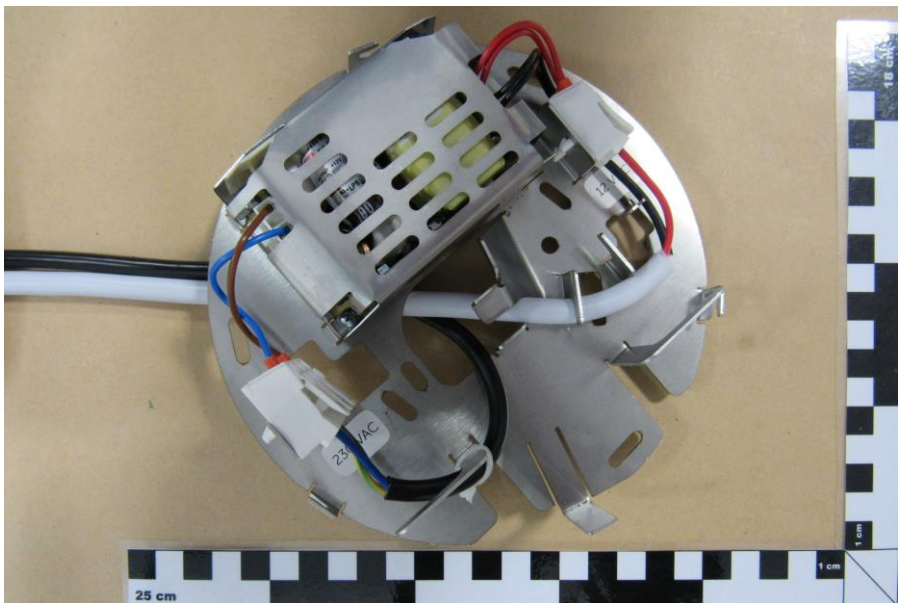
Name	Type	Attributes		Comment
Power	AC	Count: Direction: Service only:	1 In No	
Description:				
AC	AC mains power input/output port			
DC	DC power input/output port			
IO	Input/Output port			
TP	Telecommunication port			
NE	Non-electrical port			

1.2 Equipment Photos - Internal

EUT PCB TOP

EUT PCB BOTTOM



EUT power supply


1.3 Equipment Photos - External

EUT TOP


EUT BOTTOM


1.4 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
AE	Smartphone	Samsung	SM-G03F	
AE	Software application	Luke Roberts GmbH	Ver.: 1.0.15 (88)	
Description:				
AE	Auxillary Equipment			
SIM	Simulator			
CBL	Connecting Cable			
Comment:				

1.5 Operational Modes

Mode #	Description
1	EUT powered via mains power supply. Bluetooth Low Energy connection to smartphone. Software “Max Power” (worst case)
Comment:	

1.6 EUT Configuration

Configuration #	Description
1	EUT placed inside the measurement chamber. Powered up. Smartphone controls the EUT via software application.
Comment:	

1.7 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, ISED ICES-003 Issue 6				
Reference	**Requirement**	**Reference Method**	**Result**	**Remarks**
Emission				
FCC 15.109 ICES-003, 8, 6.1	Radiated emissions	ANSI C63.4:2014	PASS	
FCC 15.107 ICES-003, 8, 6.2	AC power line conducted emissions	ANSI C63.4:2014	PASS	
Comment:				

Possible Test Case Verdicts	
PASS	Test object does meet the requirements
FAIL	Test object does not meet the requirements
N/T	Required by standard but not tested
N/R	Not required by standard for the test object

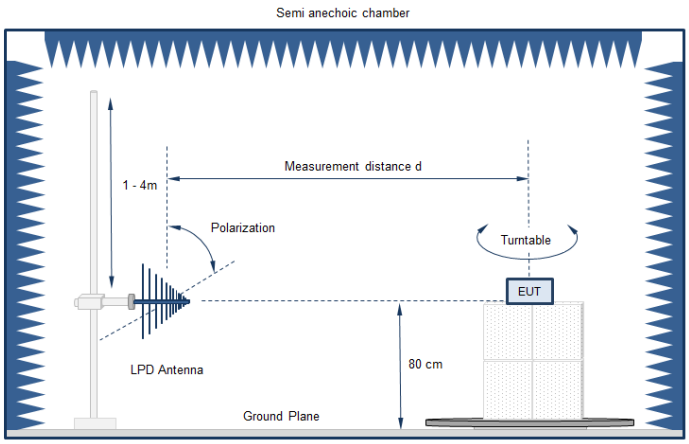
2.1 Test Conditions and Results - Radiated emissions acc. to ANSI C63.4

2.1.1 Information

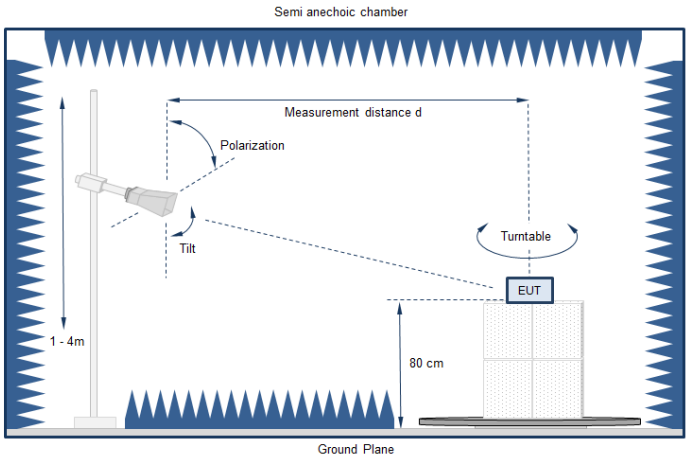
Test Information	
Reference	FCC 15.109, ICES-003, 8, 6.1
Reference method	ANSI C63.4:2014 Section 8
Equipment class	Class B
Equipment type	Table top
Highest internal frequency [MHz]	2480
Measurement range	10 MHz to 12400 MHz
Temperature [°C]	22 C°
Humidity [%]	51 %
Operator	Matthias Handrik
Date	2018-06-01

2.1.2 Setup

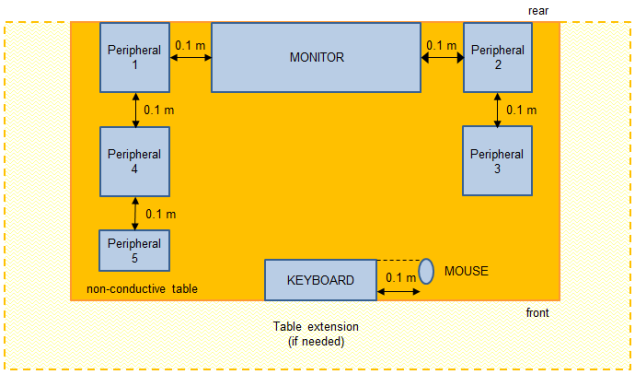
Measurement up to 1 GHz



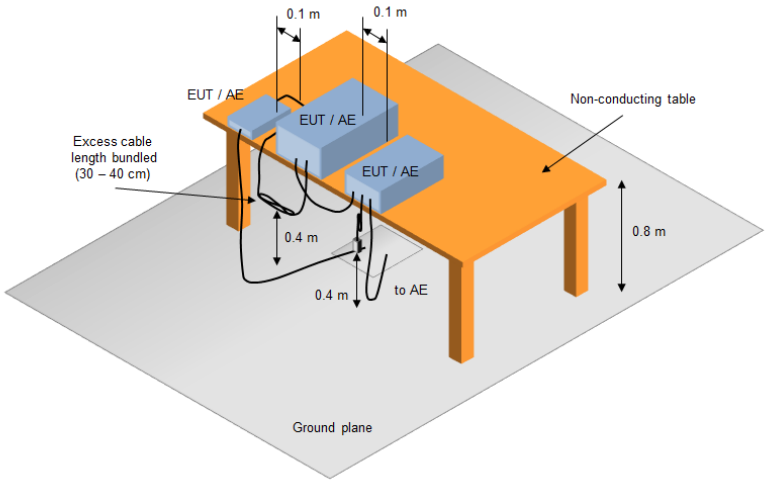
Measurement above 1 GHz



Equipment placement - Table top



Test Setup



2.1.3 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic chamber	Frankonia	AC1	EF00200	functional test	functional test
Keysight	EMI Test Receiver	N9038A-526/WXP	EF01070	2017-08	2018-08
Biconical antenna	Rohde & Schwarz Vertriebs GmbH	HK116	EF00186	2018-03	2020-03
R&S	LPD Antenna	HL 223	EF00187	2016-05	2019-05
ETS-Lindgren	Horn Antenna	3117	EF01256	2017-07	2018-07

2.1.4 Procedure

Exploratory measurement
1. The EUT was placed on a non-conductive table at a height of 0.8m. 2. The EUT and support equipment, if needed, were set up to simulate typical usage. 3. 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. 4. The antenna was placed at a distance of 3 or 10 m. 5. The received signal was monitored at the measurement receiver. 6. This procedure has to be performed in both antenna polarizations, horizontal and vertical. 7. The arrangement of the equipment with the maximum emission level is shown on the setup picture at item 1.3

Final measurement
1. 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. 2. 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. 3. The EUT and cable arrangement were based on the exploratory measurement results. 4. Emissions were maximized at each frequency by rotating the EUT and adjusting the receive antenna height and polarization. The maximum values were recorded. 5. The test data of the worst-case conditions were recorded and shown on the next pages.

2.1.5 Limits

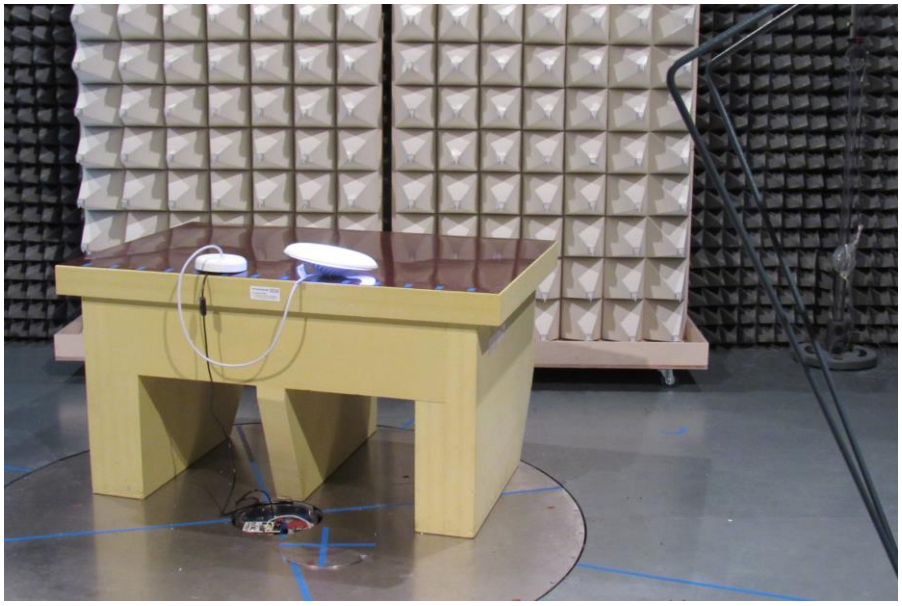
Class B @ 3 m		
Frequency [MHz]	Detector	Limit [dBµV/m]
30 - 88	Quasi-peak	40
88 - 216	Quasi-peak	43.5
216 - 960	Quasi-peak	46
960 - 1000	Quasi-peak	54
> 1000	Peak Average	74 54

Class A @ 10 m		
Frequency [MHz]	Detector	Limit [dBµV/m]
30 - 88	Quasi-peak	39
88 - 216	Quasi-peak	43.5
216 - 960	Quasi-peak	46.5
960 - 1000	Quasi-peak	49.5
> 1000	Peak Average	69.5 49.5

2.1.6 Results

Test Results			
Operational mode	EUT Configuration	Verdict	Remark
1	1	PASS	

2.1.7 Setup Photos

Test setup


2.1.8 Records

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1804-7374

Applicant:	Luke Roberts GmbH
EUT Name:	LED Pendant Luminaire with Bluetooth Low Energy Radio
Model:	LRF
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 22°C, Unom: 120 V AC
Antenna:	Rohde & Schwarz HK 116, Vertical
Measurement distance:	3m
Mode:	Mode# 1
Test Date:	2018-06-01
Note:	

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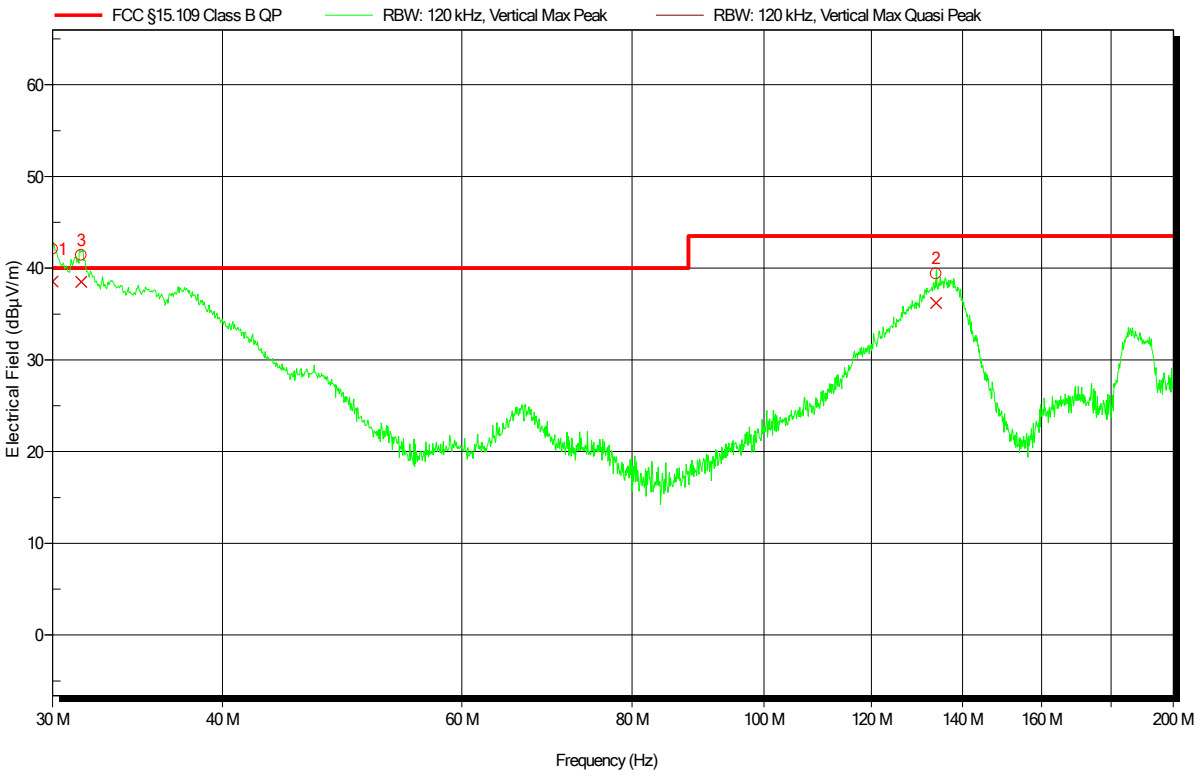

Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	30 MHz	38.56 dBµV/m	40 dBµV/m	-1.44 dB	Pass	0 Degree	1 m
2	133.832 MHz	36.19 dBµV/m	43.52 dBµV/m	-7.33 dB	Pass	0 Degree	1 m
3	31.501 MHz	38.52 dBµV/m	40 dBµV/m	-1.48 dB	Pass	0 Degree	1 m

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1804-7374

Applicant:	Luke Roberts GmbH
EUT Name:	LED Pendant Luminaire with Bluetooth Low Energy Radio
Model:	LRF
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 22°C, Unom: 120 V AC
Antenna:	Rohde & Schwarz HK 116, Horizontal
Measurement distance:	3m
Mode:	Mode# 1
Test Date:	2018-06-01
Note:	

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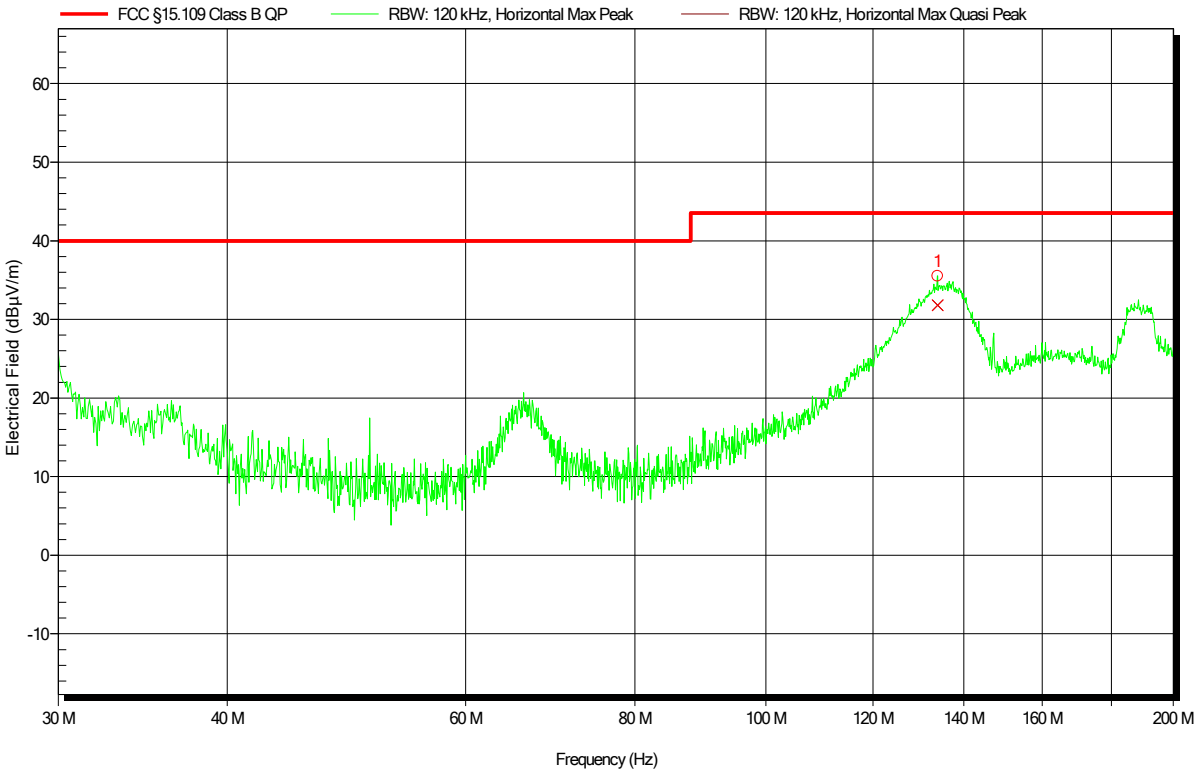

Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	133.903 MHz	31.79 dBµV/m	43.52 dBµV/m	-11.73 dB	Pass	50 Degree	1.30 m

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1804-7374

Applicant:	Luke Roberts GmbH
EUT Name:	LED Pendant Luminaire with Bluetooth Low Energy Radio
Model:	LRF
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 22°C, Unom: 120 V AC
Antenna:	Rohde & Schwarz HL 223, Vertical
Measurement distance:	3m
Mode:	Mode# 1
Test Date:	2018-06-01
Note:	

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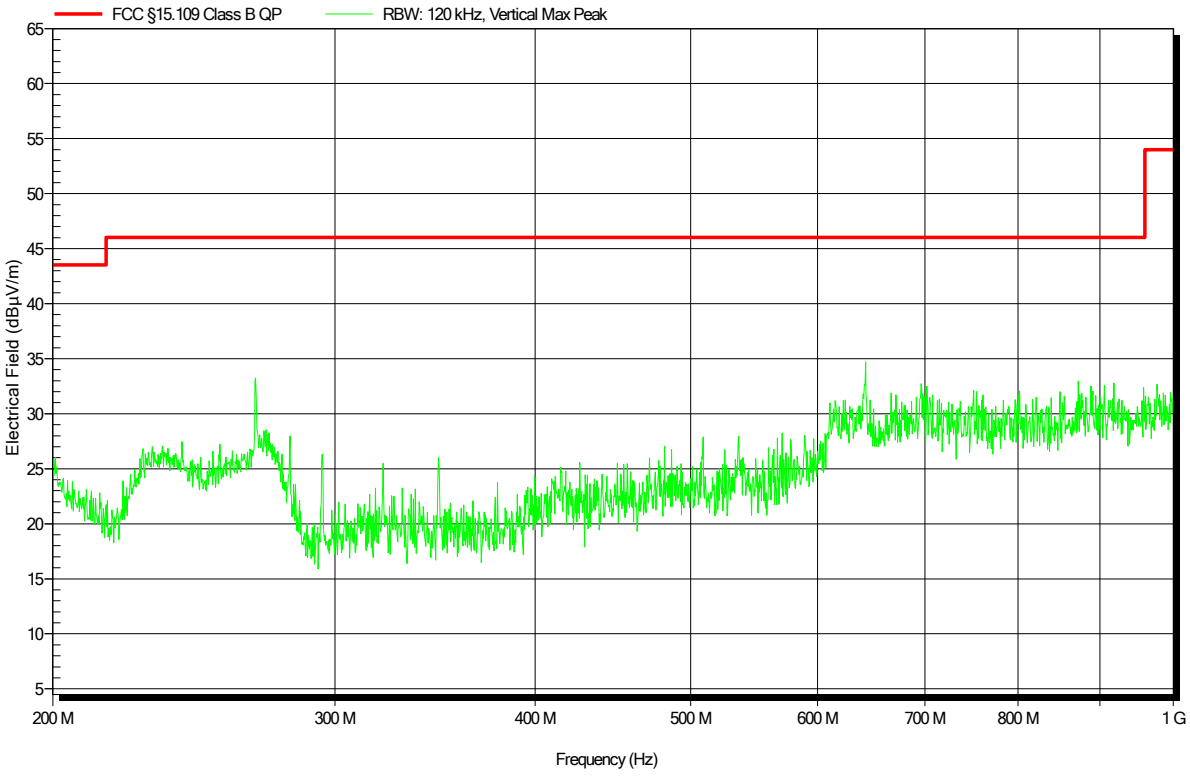

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1804-7374

Applicant:	Luke Roberts GmbH
EUT Name:	LED Pendant Luminaire with Bluetooth Low Energy Radio
Model:	LRF
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 22°C, Unom: 120 V AC
Antenna:	Rohde & Schwarz HL 223, Horizontal
Measurement distance:	3m
Mode:	Mode# 1
Test Date:	2018-06-01
Note:	

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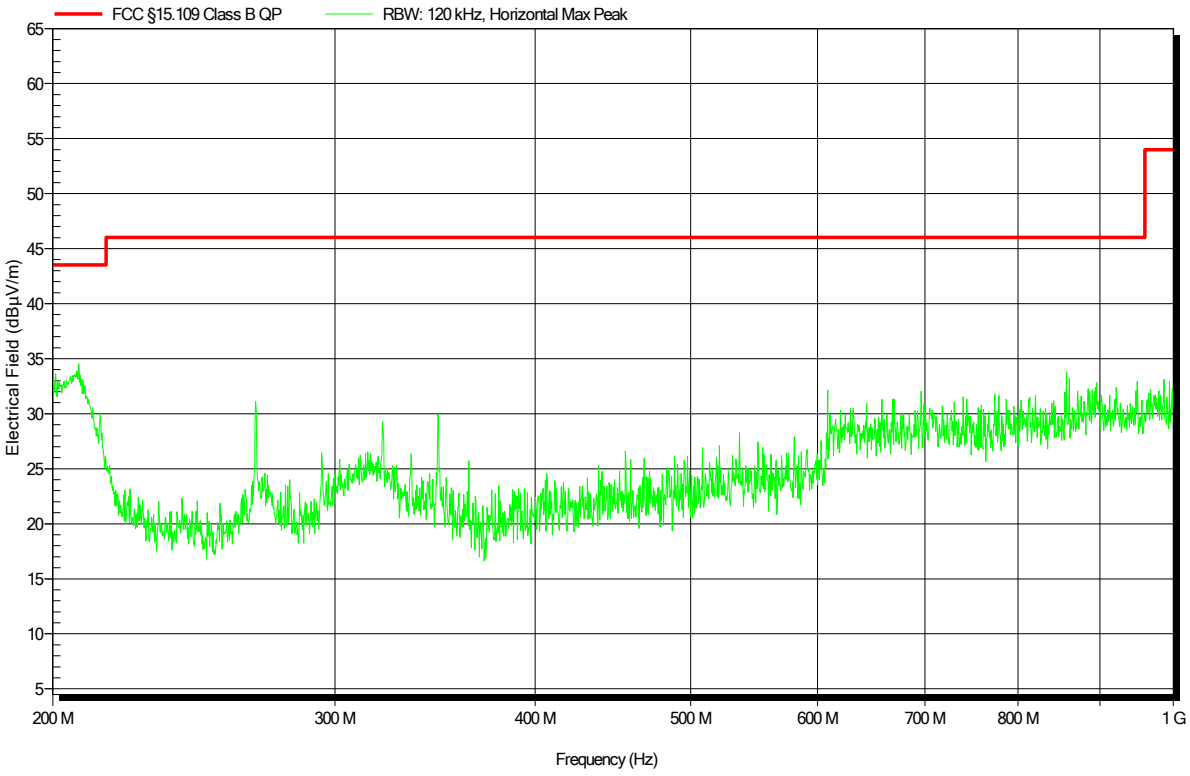

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1804-7374

Applicant:	Luke Roberts GmbH
EUT Name:	LED Pendant Luminaire with Bluetooth Low Energy Radio
Model:	LRF
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 22°C, Unom: 120 V AC
Antenna:	ETS-Lindgren 3117, Vertical
Measurement distance:	3m
Mode:	Mode# 1
Test Date:	2018-06-01
Note:	

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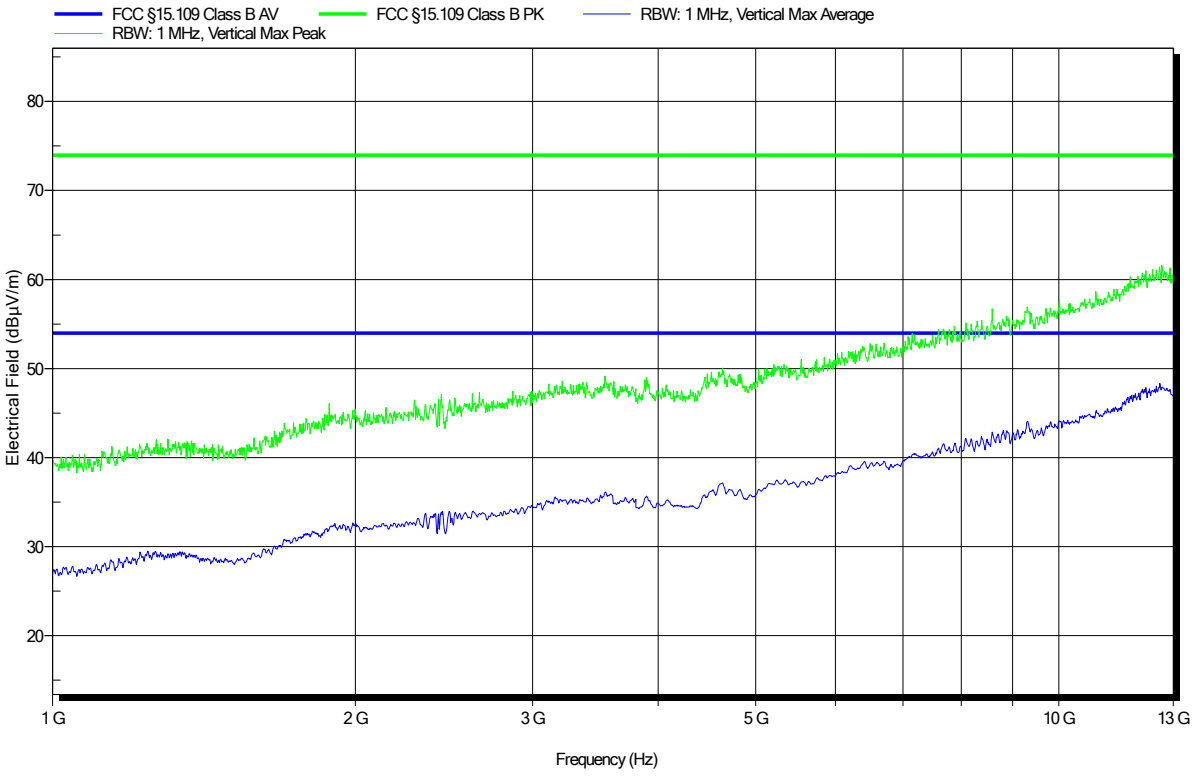

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1804-7374

Applicant:	Luke Roberts GmbH
EUT Name:	LED Pendant Luminaire with Bluetooth Low Energy Radio
Model:	LRF
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 22°C, Unom: 120 V AC
Antenna:	ETS-Lindgren 3117, Horizontal
Measurement distance:	3m
Mode:	Mode# 1
Test Date:	2018-06-01
Note:	

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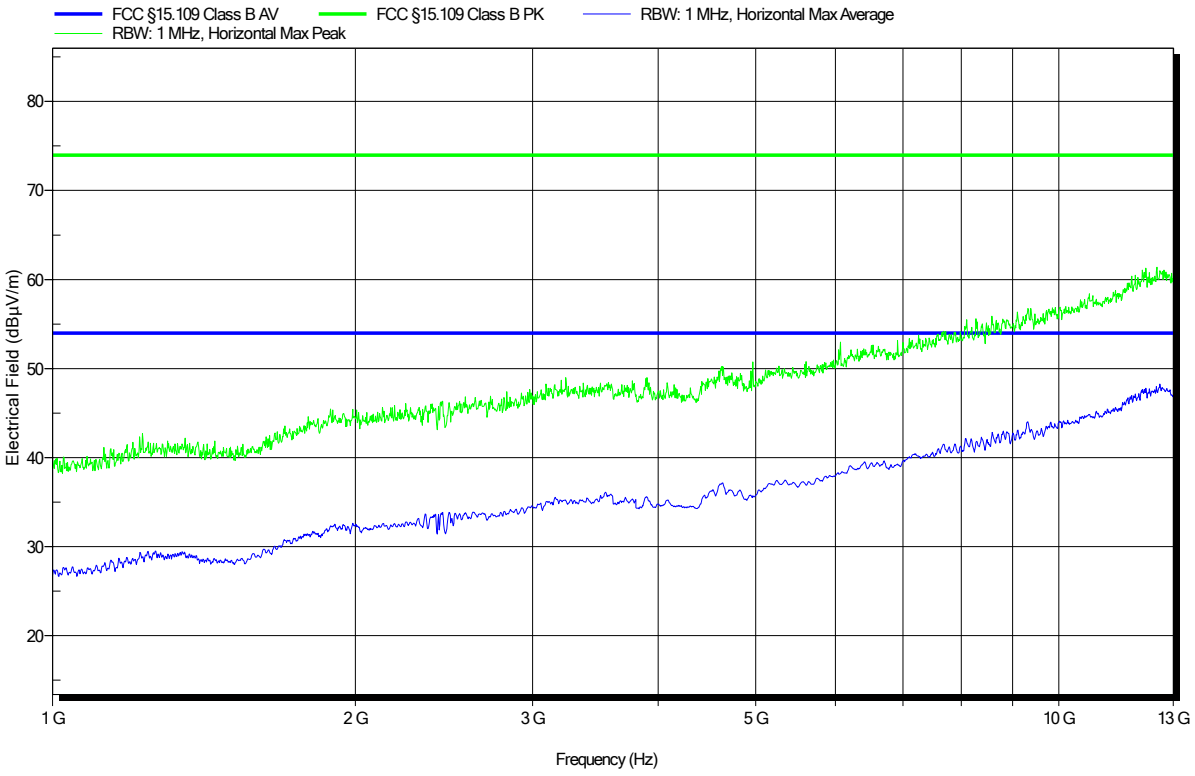


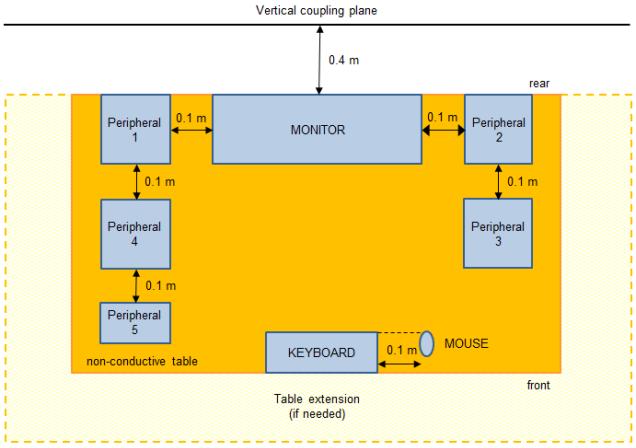
2.2 Test Conditions and Results - Conducted emissions acc. to ANSI C63.4

2.2.1 Information

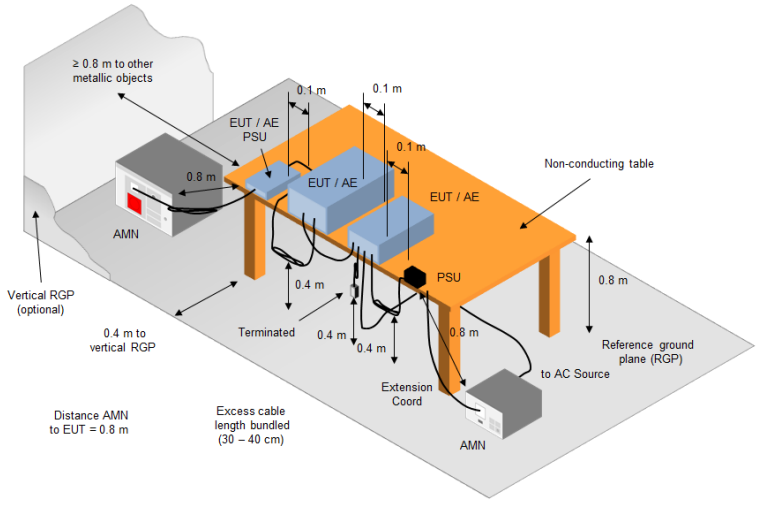
Test Information	
Reference	FCC 15.107, ICES-003, 8, 6.2
Reference method	ANSI C63.4:2014 Section 12
Measurement range	150 kHz to 30 MHz
Equipment class	Class B
Equipment type	Table top
Temperature [°C]	21 C°
Humidity [%]	55 %
Operator	Matthias Handrik
Date	2018-06-04

2.2.2 Setup

Equipment placement



Test Setup



2.2.3 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
R&S	AMN	ESH2-Z5	EF00182	2017-01	2019-01
R&S	Pulse Limiter	ESH3-Z2	EF01063	2017-07	2018-07
R&S	EMI Test Receiver	ESR 7	EF00943	2017-07	2018-07

2.2.4 Procedure

Exploratory measurement
1. 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)
2. The power cord that is normally supplied or recommended by the manufacturer was connected to the LISN.
3. 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).
4. The LISN measurement port was connected to a measurement receiver
5. I/O cables were bundled not longer than 0.4 m
6. Measurement was performed in the frequency range 0.15 – 30MHz on each current-carrying conductor
7. To maximize the emissions the cable positions were manipulated
8. The worst configuration of EUT and cables is shown on a test setup picture at item 1.3

Final measurement
1. 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)
2. The power cord that is normally supplied or recommended by the manufacturer was connected to the LISN.
3. 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).
4. The LISN measurement port was connected to a measurement receiver
5. The EUT and cable arrangement were based on the exploratory measurement results
6. The test data of the worst-case conditions were recorded and shown on the next pages

2.2.5 Limits

Class B		
Frequency [MHz]	Quasi-peak Limit [dBµV]	Average Limit [dBµV]
0.15 - 0.5	66 - 56 *	56 - 46 *
0.5 - 5	56	46
5 - 30	60	50
* Decreases with the logarithm of the frequency		

2.2.6 Results

AC power line conducted emissions					
Port	Coupling	Operational mode	EUT Configuration	Verdict	Remark
Power	AMN	1	1	PASS	

2.2.7 Setup Photos

Test setup


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

2.2.8 Records

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

Project number: G0M-1804-7374

Applicant:	Luke Roberts GmbH
EUT Name:	LED Pendant Luminaire with Bluetooth Low Energy Radio
Model:	LRF
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 21°C, Unom: 120 V AC
LISN:	ESH2-Z5 N
Mode:	Mode# 1
Test Date:	2018-06-04
Note:	

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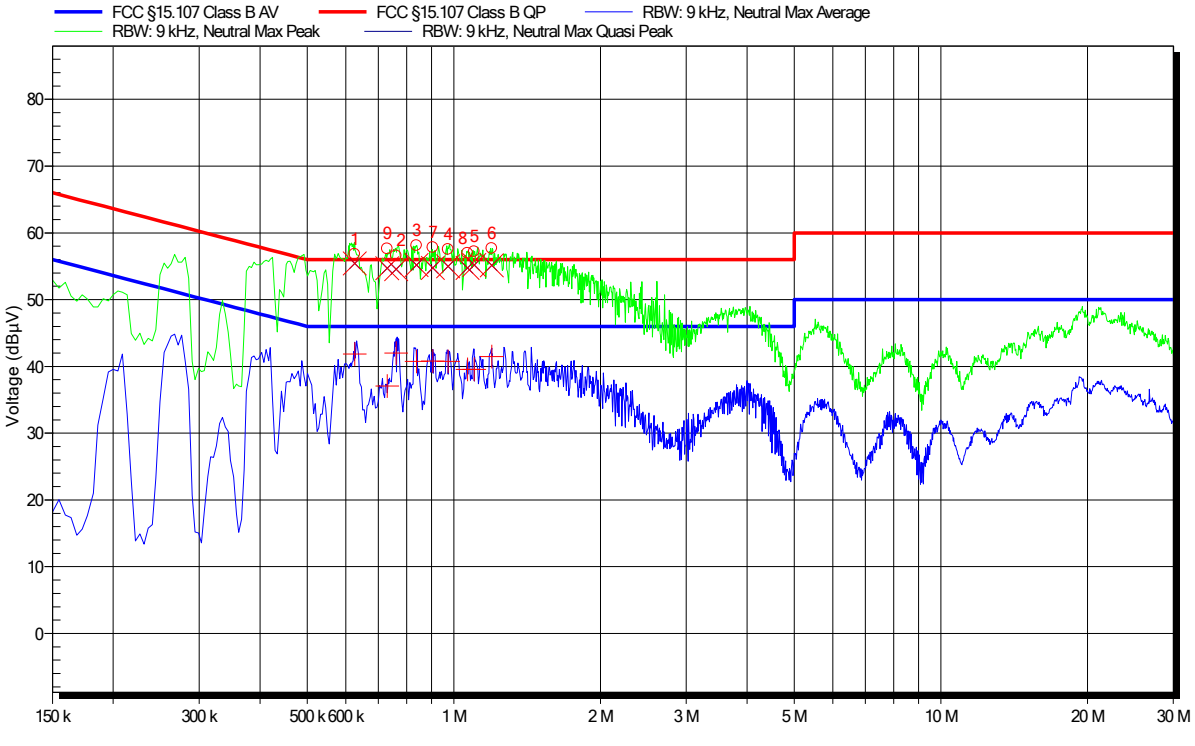

Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status
1	626.1 kHz	55.44 dBµV	56 dBµV	-0.56 dB	Pass
2	762 kHz	54.56 dBµV	56 dBµV	-1.44 dB	Pass
3	838.05 kHz	55.19 dBµV	56 dBµV	-0.81 dB	Pass
4	973.5 kHz	55.01 dBµV	56 dBµV	-0.99 dB	Pass
5	1.102 MHz	55.16 dBµV	56 dBµV	-0.84 dB	Pass
6	1.197 MHz	55.15 dBµV	56 dBµV	-0.85 dB	Pass
7	906 kHz	54.76 dBµV	56 dBµV	-1.24 dB	Pass
8	1.068 MHz	54.75 dBµV	56 dBµV	-1.25 dB	Pass
9	730.5 kHz	54.72 dBµV	56 dBµV	-1.28 dB	Pass

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status
1	626.1 kHz	41.84 dBµV	46 dBµV	-4.16 dB	Pass
2	762 kHz	41.98 dBµV	46 dBµV	-4.02 dB	Pass
3	838.05 kHz	40.73 dBµV	46 dBµV	-5.27 dB	Pass
4	973.5 kHz	40.76 dBµV	46 dBµV	-5.24 dB	Pass
5	1.102 MHz	39.55 dBµV	46 dBµV	-6.45 dB	Pass
6	1.197 MHz	41.48 dBµV	46 dBµV	-4.52 dB	Pass
7	906 kHz	40.78 dBµV	46 dBµV	-5.22 dB	Pass
8	1.068 MHz	39.55 dBµV	46 dBµV	-6.45 dB	Pass
9	730.5 kHz	37.04 dBµV	46 dBµV	-8.96 dB	Pass

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

Project number: G0M-1804-7374

Applicant:	Luke Roberts GmbH
EUT Name:	LED Pendant Luminaire with Bluetooth Low Energy Radio
Model:	LRF
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 21°C, Unom: 120 V AC
LISN:	ESH2-Z5 L
Mode:	Mode# 1
Test Date:	2018-06-04
Note:	

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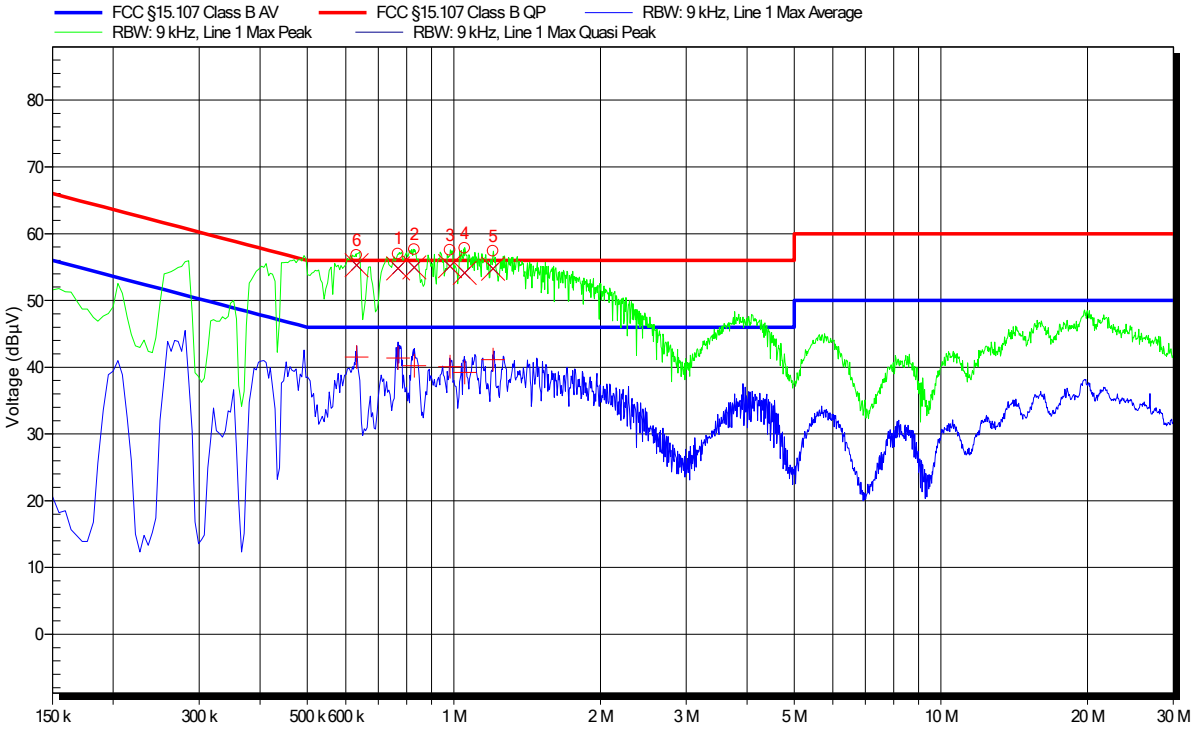

Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status
1	768.75 kHz	54.79 dBµV	56 dBµV	-1.21 dB	Pass
2	829.5 kHz	54.95 dBµV	56 dBµV	-1.05 dB	Pass
3	982.95 kHz	55.12 dBµV	56 dBµV	-0.88 dB	Pass
4	1.053 MHz	54.12 dBµV	56 dBµV	-1.88 dB	Pass
5	1.203 MHz	54.74 dBµV	56 dBµV	-1.26 dB	Pass
6	631.5 kHz	55.29 dBµV	56 dBµV	-0.71 dB	Pass

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status
1	768.75 kHz	41.39 dBµV	46 dBµV	-4.61 dB	Pass
2	829.5 kHz	40.24 dBµV	46 dBµV	-5.76 dB	Pass
3	982.95 kHz	40.07 dBµV	46 dBµV	-5.93 dB	Pass
4	1.053 MHz	39.21 dBµV	46 dBµV	-6.79 dB	Pass
5	1.203 MHz	41.16 dBµV	46 dBµV	-4.84 dB	Pass
6	631.5 kHz	41.53 dBµV	46 dBµV	-4.47 dB	Pass