

EMC TEST REPORT

FCC 47 CFR Part 15B
Industry Canada ICES-003

Electromagnetic compatibility - Unintentional radiators

Report Reference No. : G0M-1611-6094-EF0215B-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 : Fabmatics GmbH

Address : Zur Steinhöhe 1
01099 Dresden
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	LF RFID reader
Model No.	LF-134-SER-P-V4.0
Additional Models	None
Hardware version	4.0
Firmware / Software version	3.0.0
	FCC-ID: YTV-LF-134-SER-4 IC: N/A
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)

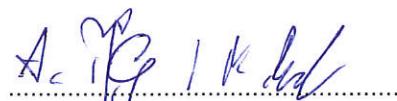
Testing:

Date of receipt of test item: 2016-12-22

Date (s) of performance of tests: 2017-01-02 – 2017-02-09

Compiled by : Marco Belz

Tested by (+ signature)..... : Andreas Pflug/Marco Belz



Approved by (+ signature) : Jens Marquardt

Deputy Head of Lab



Date of issue : 2017-03-09

Total number of pages : 25

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	2017-03-09	Initial Release	

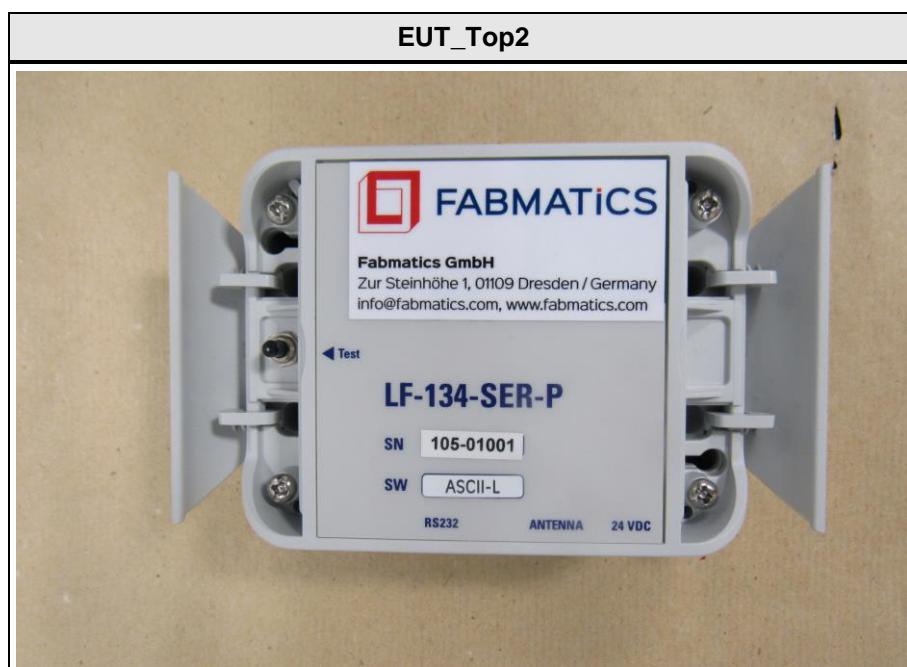
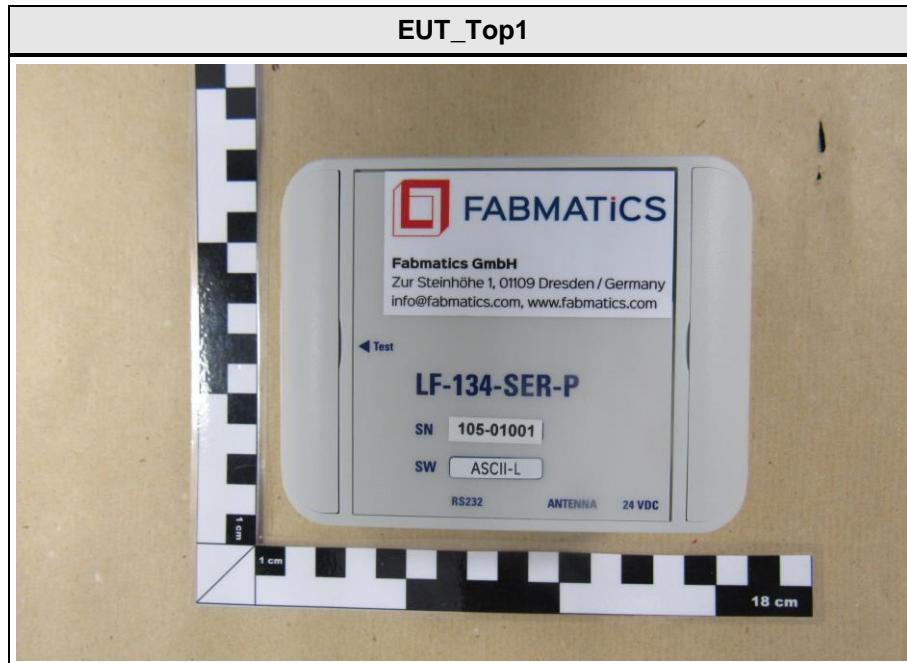
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1 Equipment (Test item) Description

Description	LF RFID reader
Model	LF-134-SER-P-V4.0
Additional Models	None
Serial number	None
Hardware version	4.0
Software / Firmware version	3.0.0
FCC-ID	YTV-LF-134-SER-4
IC	N/A
Power supply	24 VDC via AC/DC Adapter
AC/DC-Adaptor	Model : SYS1308-2424-W2E Manufacturer : Sunny COMPUTER TECHNOLOGY EUROPE Input : 100-240VAC / 50-60Hz Output : 24VDC / 1.0 A
Manufacturer	Fabmatics GmbH Zur Steinhöhe 1 01099 Dresden GERMANY
Highest emission frequency	Fmax [MHz] = 17.1776
Device classification	Class B
Equipment type	Tabletop
Number of tested samples	1

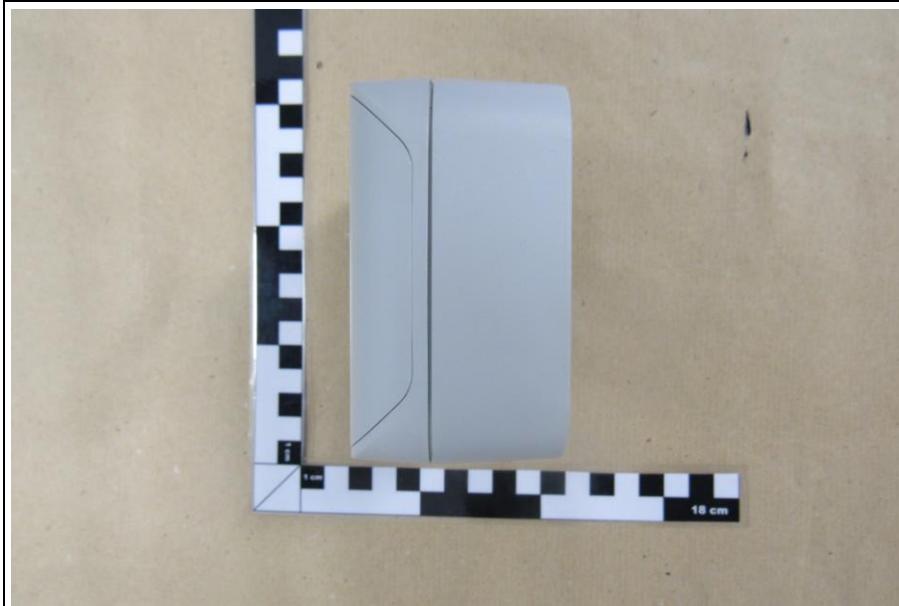
1.1 Photos – Equipment external



EUT_Bottom



EUT_Side



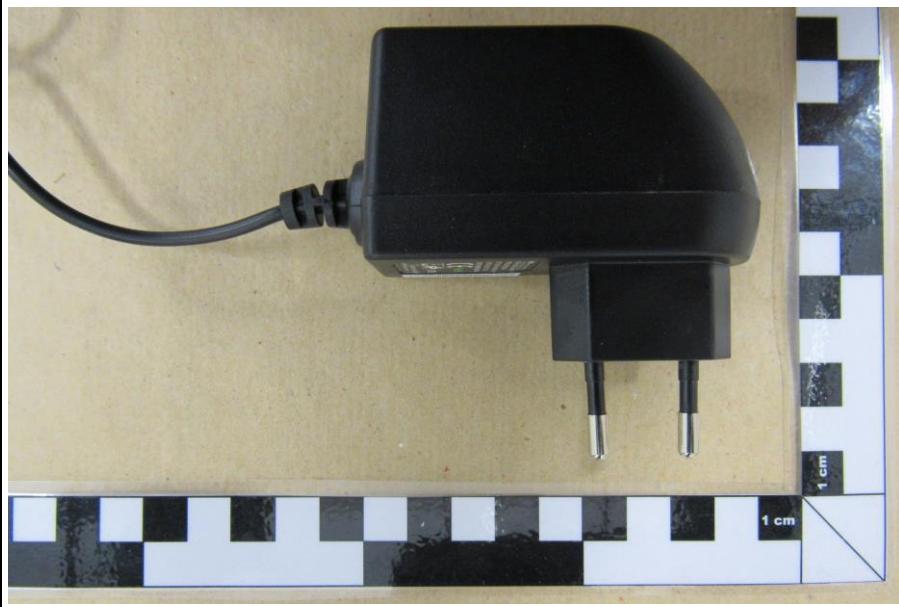
EUT_Port



EUT_Label

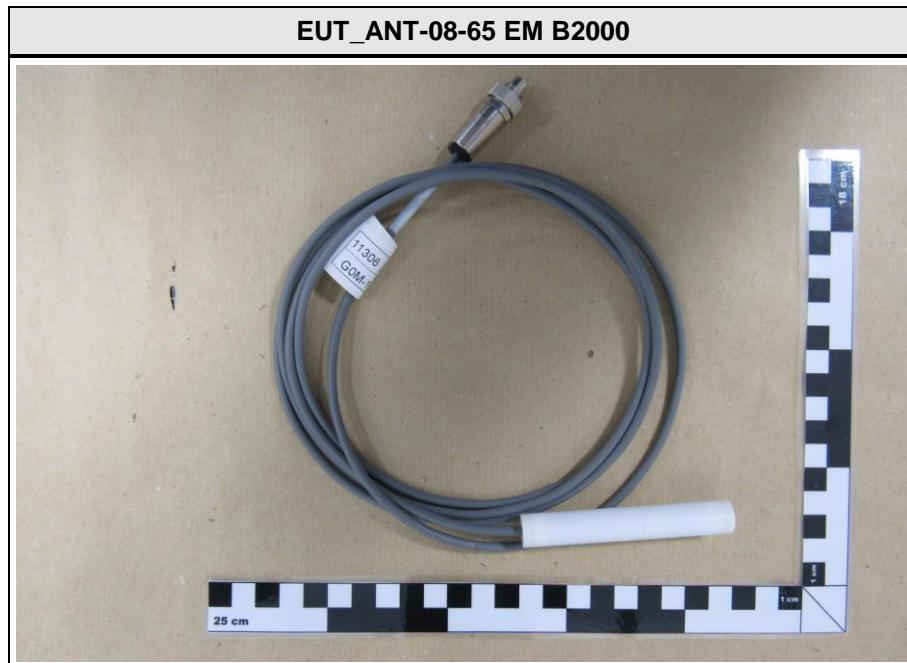


EUT_AC/DC-Adapter



EUT_AC/DC-Adapter_Label





1.2 Photos – Equipment internal

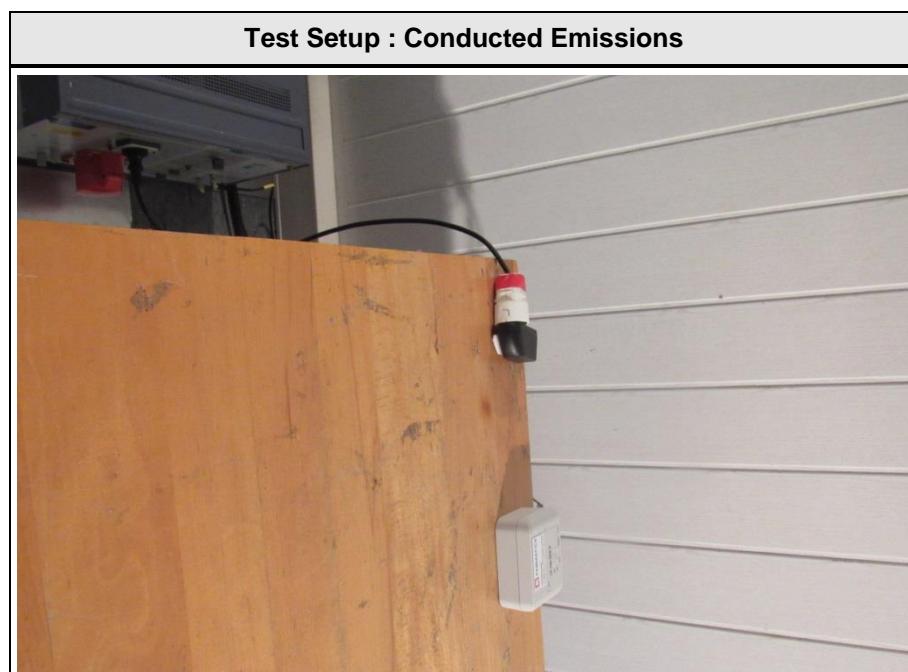
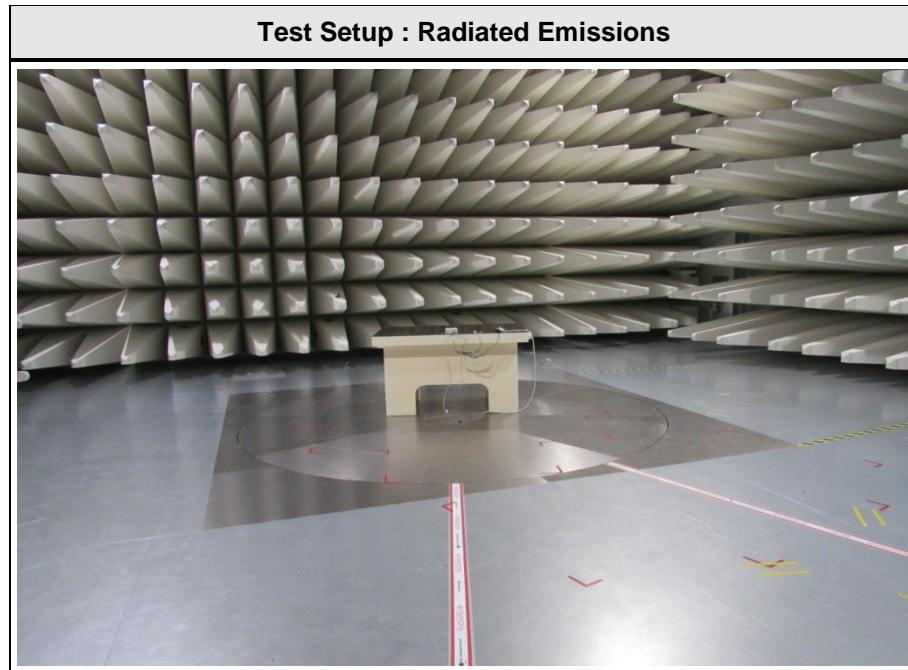
PCB_Top



PCB_Bottom



1.3 Photos – Test setup



1.4 Supporting Equipment Used During Testing

Product Type*	Device	Manufacturer	Model No.	Comments (e.g. serial no.)
AE	Laptop	DELL	Latitude E6420	4250209
AE	Serial/USB Adapter	Assmann	Digitus 2.0	

***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	AC	> 3 m	No	AC/DC Adapter
2	Antenna	I/O	2 m	Yes	
3	RS232	I/O	3 m	Yes	

***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	Continuous RFID-Tag

Configuration #	EUT Configuration
1	EUT was connected via Serial/USB port to Laptop; Ortner Test Suite was used for Read Test; RFID Tag was placed near antenna

1.7 Test Equipment Used During Testing

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

Conducted emissions AC6					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
LISN	Schwarzbeck	NSLK 8128	EF00975	2015-12	2017-12
EMI Test Receiver	Rohde & Schwarz Vertriebs GmbH	ESU26	EF00887	2017-01	2018-01
Pulse Limiter	R&S	ESH3-Z2	EF01063	2016-06	2017-06
Cable	-	RG223/U	-	System Cal.	System Cal.

Radiated emissions AC6					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
TRILOG Broadband Antenna	Schwarzbeck	VULB 9162	EF00978	2016-11	2017-11
Double-Ridged Guide Antenna	ETS-Lindgren	3117	EF00976	2016-03	2017-03
EMI Test Receiver	R&S	ESU26	EF00887	2017-01	2018-01
RF Cable	Huber & Suhner	Sucoflex 106	-	System Cal.	System Cal
RF Cable	Huber & Suhner	Multiflex 141	-	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:

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

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		23 °C			
Relative Humidity	30 to 60 %		32 %			
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] = 17.1776					
Fully configured sample scanned over the following frequency range	Frequency range					
	30 MHz to 1 GHz					
Operating mode	1					
Configuration	1					
Limits and results Class B						
Frequency [MHz]	Quasi-Peak [dB μ V/m]	Result	Average [dB μ V/m]	Result	Peak [dB μ V/m]	Result
30 – 88	40	PASS	-		-	-
88 – 216	43.5	PASS	-		-	-
216 – 960	46	PASS	-		-	-
960 – 1000	54	PASS	-		-	-
Comments: modified by customer						

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:

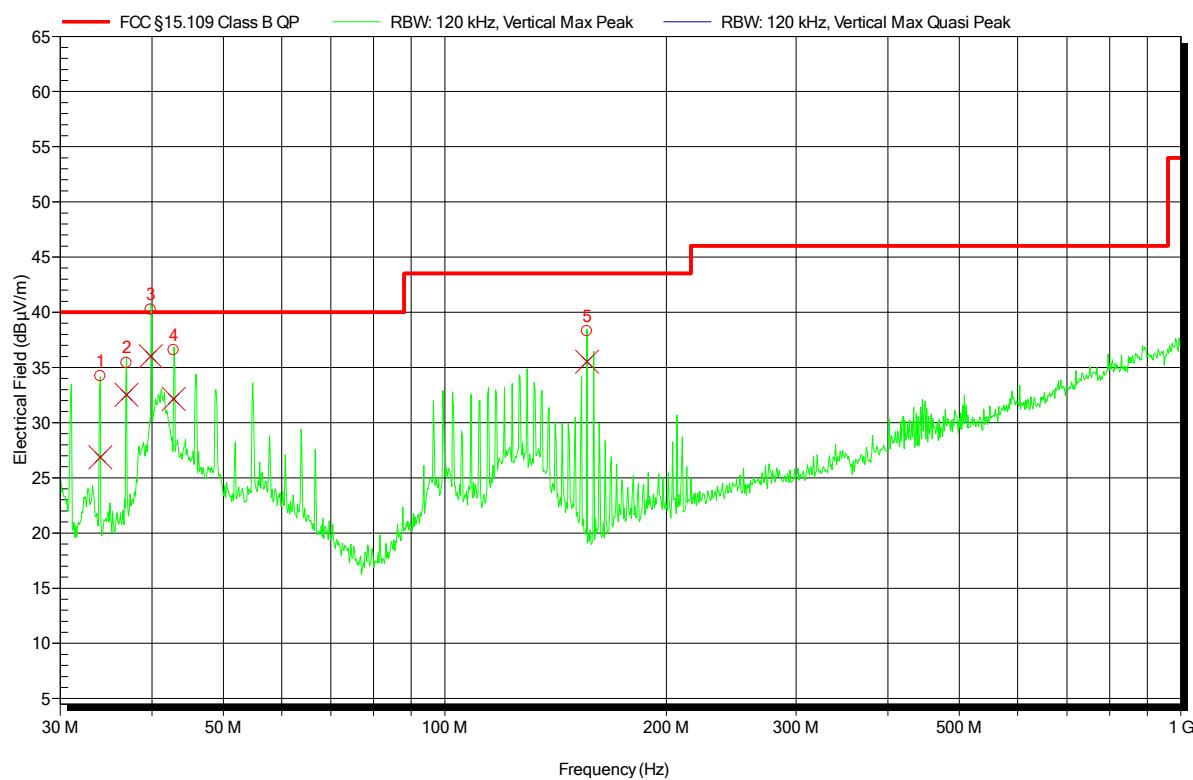
- The EUT was placed on a 0.8 m non-conductive table at a 3 m distance from the receive antenna. The antenna output was connected to the measurement receiver
- A biconical antenna was used for the frequency range 30 – 200 MHz, a logarithmic periodical antenna was used for the frequency range from 200 – 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 according to FCC 15B

Project number: G0M-1611-6094

Applicant: Fabmatics GmbH
 EUT Name: LF RFID-Reader
 Model: LF-134-SER-P-V4.0
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Belz
 Test Conditions: $T_{nom}: 23^{\circ}\text{C}$, $U_{nom}: 24\text{VDC}$ via AC/DC Adapter
 Antenna: Schwarzbeck VULB 9162, Vertical
 Measurement distance: 10 m converted to 3 m
 Mode: cont. RFID-Tag
 Test Date: 2017-02-09
 Note:

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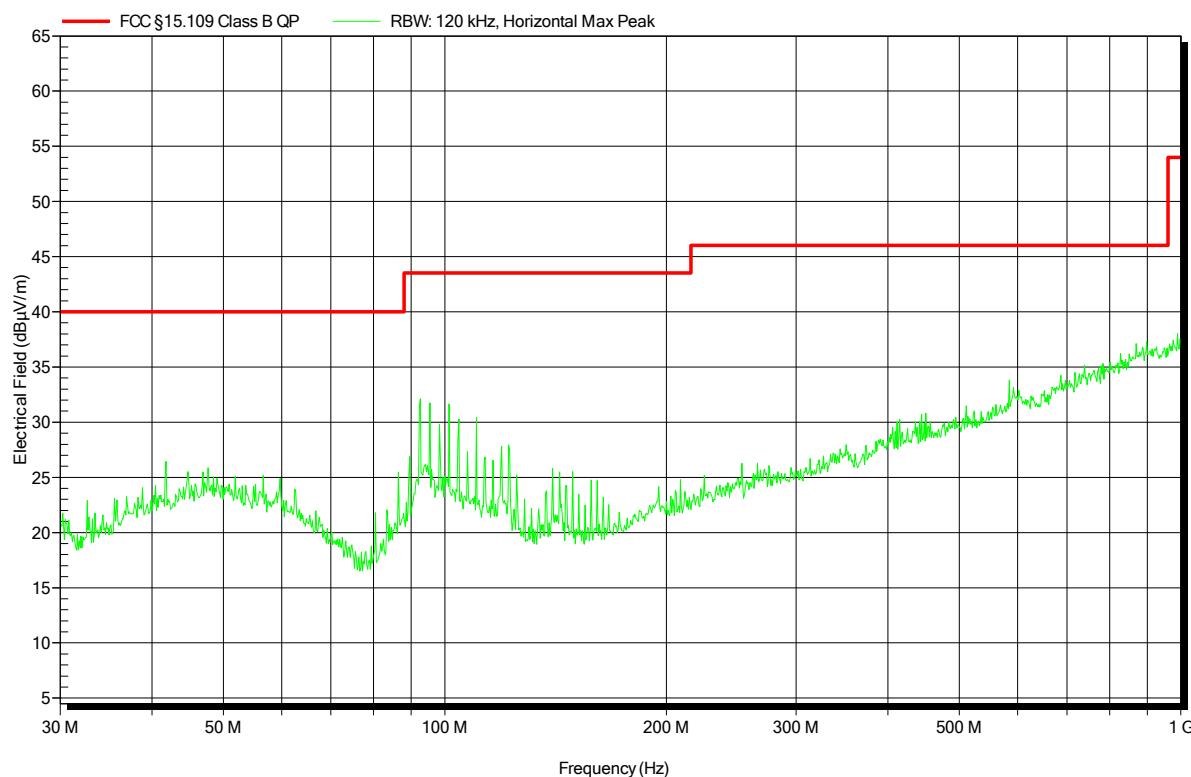
Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	34.02 MHz	26.8 dB μ V/m	40 dB μ V/m	-13.2 dB	Pass	180 Degree	1 m
2	36.936 MHz	32.5 dB μ V/m	40 dB μ V/m	-7.5 dB	Pass	180 Degree	1 m
3	39.822 MHz	36 dB μ V/m	40 dB μ V/m	-4.0 dB	Pass	180 Degree	1 m
4	42.798 MHz	32.2 dB μ V/m	40 dB μ V/m	-7.8 dB	Pass	180 Degree	1 m
5	155.934 MHz	35.5 dB μ V/m	43.5 dB μ V/m	-8.0 dB	Pass	180 Degree	1 m

Radiated emissions according to FCC 15B

Project number: G0M-1611-6094

Applicant: Fabmatics GmbH
EUT Name: LF RFID-Reader
Model: LF-134-SER-P-V4.0
Test Site: Eurofins Product Service GmbH
Operator: Mr. Belz
Test Conditions: Tnom: 23°C, Unom: 24VDC via AC/DC Adapter
Antenna: Schwarzbeck VULB 9162, Horizontal
Measurement distance: 10 m converted to 3 m
Mode: cont. RFID-Tag
Test Date: 2017-02-09
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	23 °C		
Relative Humidity	30 to 60 %	32 %		
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 [dB μ V]	Result	Average [dB μ V]	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:

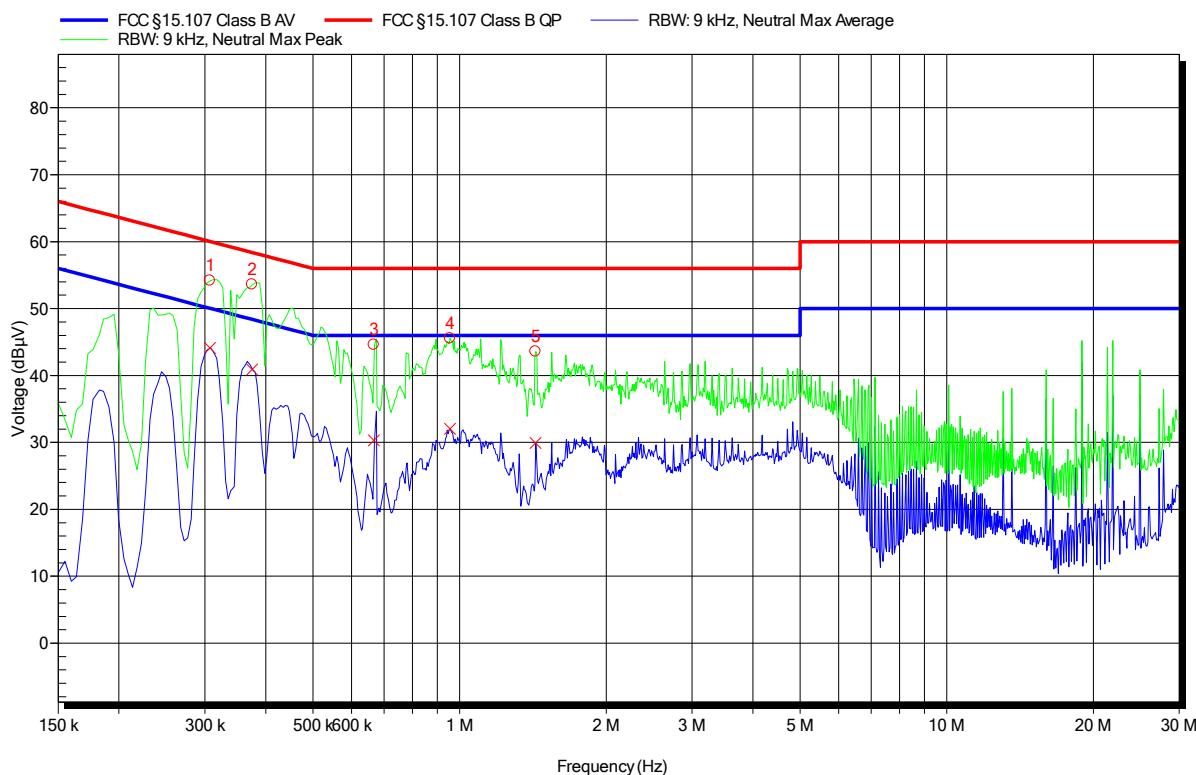
- The EUT was placed on a non conductive table 0.8 m above the reference ground plane and 0.4 m away from the vertical conducting plane (ANSI C63.4: 2014 item 7.3.1)
- The power cord that is normally supplied or recommended by the manufacturer was connected to the LISN.
- The distance between the outer 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-1611-6094

Applicant: Fabmatics GmbH
 EUT Name: LF RFID-Reader
 Model: LF-134-SER-P-V4.0
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Belz
 Test Conditions: $T_{nom}: 23^{\circ}\text{C}$, $U_{nom}: 24\text{VDC}$ via AC/DC Adapter
 LISN: ESH2-Z5 N
 Mode: cont. RFID-Tag
 Test Date: 2017-02-09
 Note:

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Peak Number	Frequency
1	307.5 kHz
2	375 kHz
3	667.5 kHz
4	955.5 kHz
5	1.432 MHz

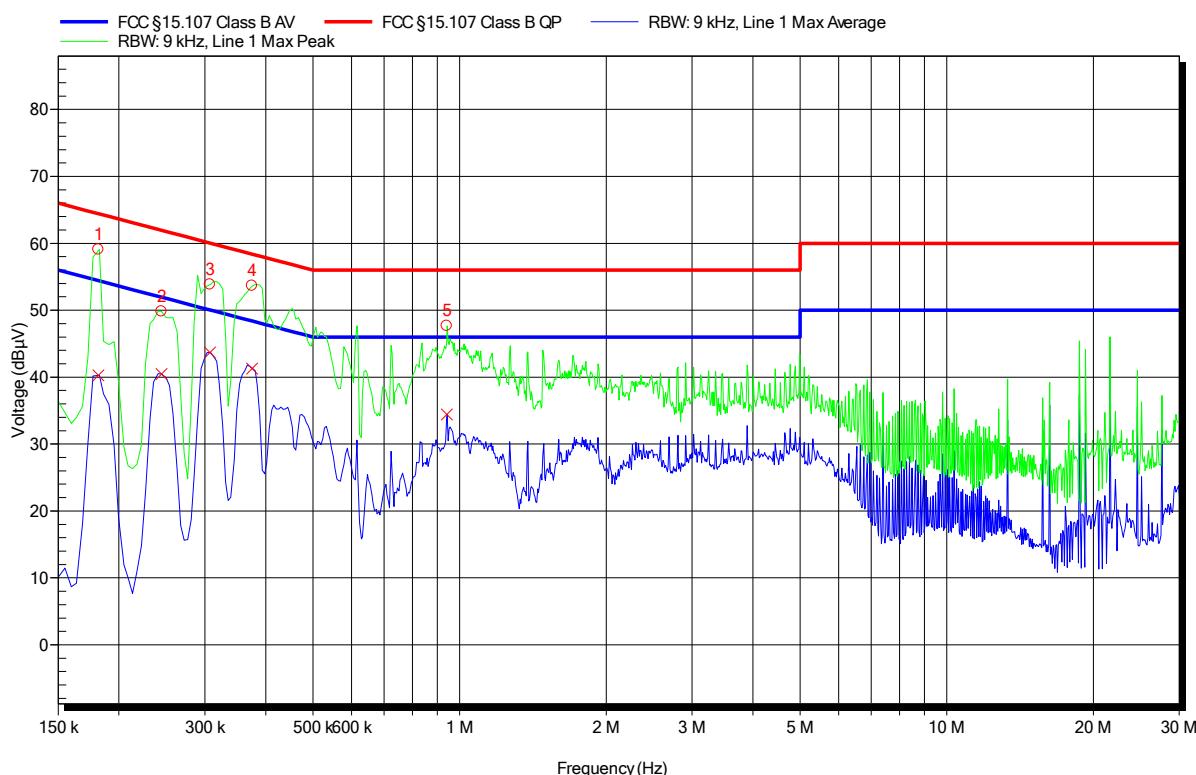
Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status
1	307.5 kHz	44.13 dB μ V	50.04 dB μ V	-5.91 dB	Pass
2	375 kHz	40.91 dB μ V	48.39 dB μ V	-7.48 dB	Pass
3	667.5 kHz	30.29 dB μ V	46 dB μ V	-15.71 dB	Pass
4	955.5 kHz	32 dB μ V	46 dB μ V	-14 dB	Pass
5	1.432 MHz	29.9 dB μ V	46 dB μ V	-16.1 dB	Pass

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

Project number: G0M-1611-6094

Applicant: Fabmatics GmbH
 EUT Name: LF RFID-Reader
 Model: LF-134-SER-P-V4.0
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Belz
 Test Conditions: $T_{nom}: 23^{\circ}\text{C}$, $U_{nom}: 24\text{VDC}$ via AC/DC Adapter
 LISN: ESH2-Z5 L
 Mode: cont. RFID-Tag
 Test Date: 2017-02-09
 Note:

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Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status
1	181.5 kHz	40.25 dB μ V	54.42 dB μ V	-14.17 dB	Pass
2	244.5 kHz	40.44 dB μ V	51.94 dB μ V	-11.5 dB	Pass
3	307.5 kHz	43.69 dB μ V	50.04 dB μ V	-6.35 dB	Pass
4	375 kHz	41.26 dB μ V	48.39 dB μ V	-7.13 dB	Pass
5	942 kHz	34.42 dB μ V	46 dB μ V	-11.58 dB	Pass