

EMC TEST REPORT FCC 47 CFR Part 15B, ISED ICES-003 Issue 6	
Report Reference No	G0M-1910-8555-EF0115B-V01
Testing Laboratory	Eurofins Product Service GmbH
Address	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation	    DAKKS - Registration number : D-PL-12092-01-03 (ISED) ISED Testing Laboratory site: 3470A-2 DAKKS - Registration number : D-PL-12092-01-04 (FCC) FCC Filed Test Laboratory, Reg.-No.: 96970
Applicant	dresden elektronik ingenieurtechnik gmbh
Address	Enno-Heidebroek-Straße 12 01237 Dresden GERMANY
Test Specification Standard(s)	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	Zigbee Radio Module for Raspberry Pi
Model(s)	RaspBee II
Additional Model(s)	None
Brand Name(s)	None
Hardware Version(s)	5 770 19 00.150.00
Software Version(s)	0
FCC-ID	XVV-RASPBEE2
IC	8720A-RASPBEE2
Test Result	PASSED

Possible 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	2019-11-08	
Report:		
Compiled by	Stephan Liebich	
Tested by (+ signature) (Responsible for Test)	Stephan Liebich	
	Matthias Handrik	
Approved by (+ signature) (Head of Lab)	Christian Weber	
Date of Issue	2020-02-26	
Total number of pages	29	
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	2020-02-26	Initial Release	

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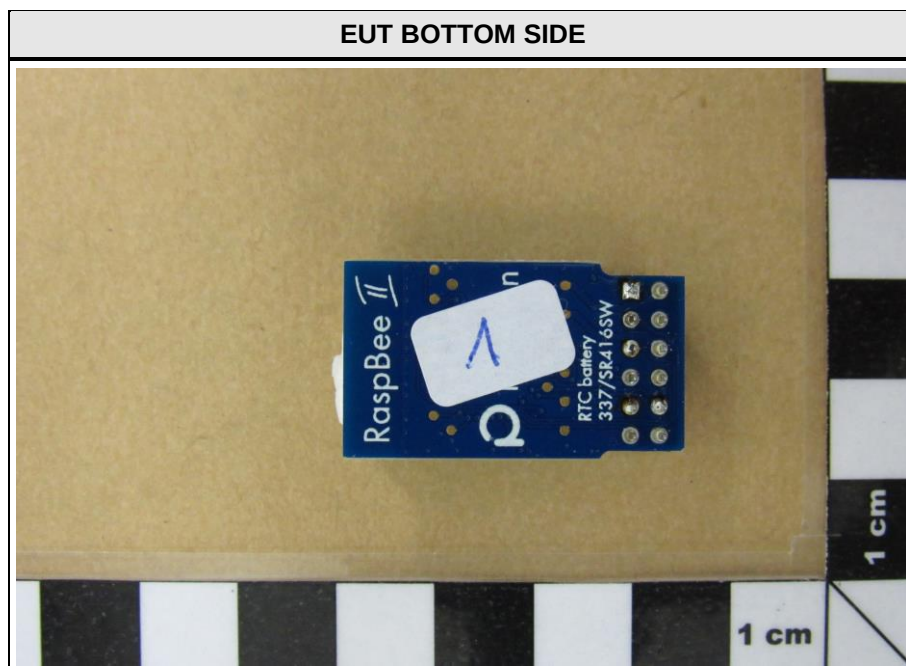
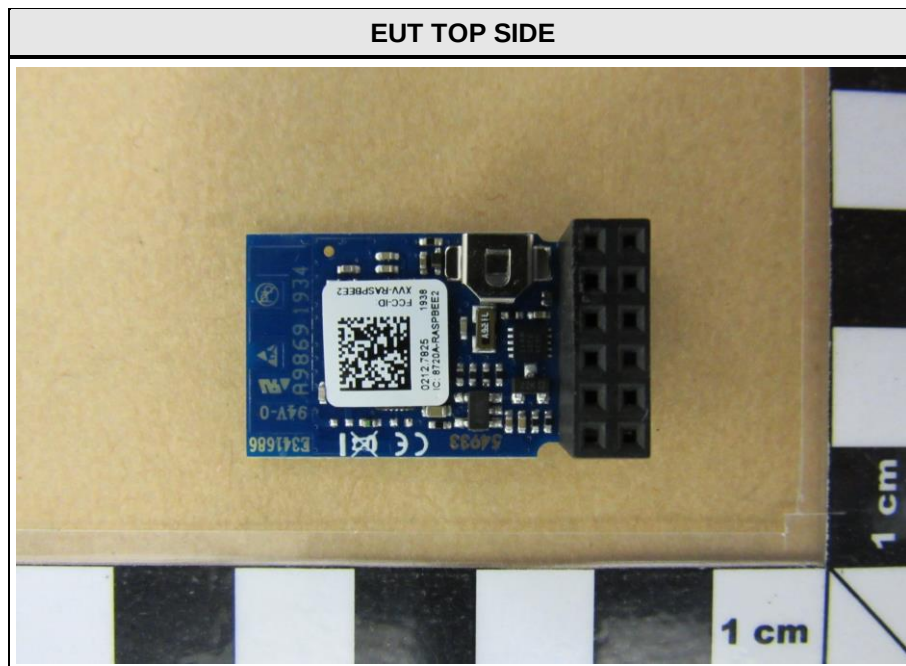
1 Equipment (Test Item) Under Test

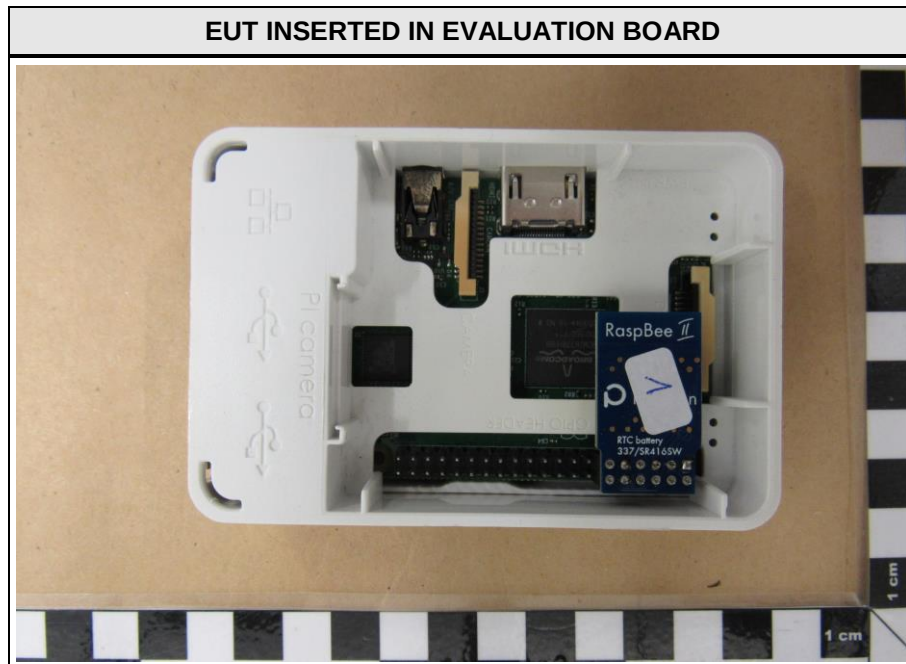
Description	Zigbee Radio Module for Raspberry Pi	
Model	RaspBee II	
Additional Model(s)	None	
Brand Name(s)	None	
Serial Number(s)	unspecified	
Hardware Version(s)	5 770 19 00.150.00	
Software Version(s)	0	
FCC-ID	XVV-RASPBEE2	
IC	8720A-RASPBEE2	
Class	Class B	
Equipment type	Table top	
Highest internal frequency [MHz]	2483.5	
Supply Voltage	V _{NOM}	5 V DC (external power supply)
AC/DC-Adaptor	None	
Manufacturer	dresden elektronik ingenieurtechnik gmbh Enno-Heidebroek-Straße 12 01237 Dresden GERMANY	

1.1 Equipment Ports

Name	Type	Attributes	Comment
POWER	DC	Count: 1 Direction: In Service only: No	-
UART	IO	Count: 1 Direction: IO Service only: No	-
I2C	IO	Count: 1 Direction: IO Service only: No	-
Description:			
AC	AC mains power input/output port		
DC	DC power input/output port		
BAT	DC power input port connected to external battery		
IO	Input/Output port		
TP	Telecommunication port		
NE	Non-electrical port		

1.2 Equipment Photos





1.3 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
AE	Raspberry Pi	Raspberry Pi Foundation	Raspberry Pi 3	Host for EUT
AE	Conbee	De	-	Companion device, ZigBee USB dongle
MON	Laptop	Lenovo	T450	-
AE	AC/DC-Adaptor 1	Lenovo	ADLX45NDC3A	-
AE	AC/DC-Adaptor 2	SAMSUNG	ETA-U90EWE	-
Description:				
AE	Auxiliary Equipment			
SIM	Simulator			
MON	Monitoring Equipment			
CBL	Connecting Cable			
Comment:				

1.4 Operational Modes

Mode #	Description
1	ZigBee Tx (EUT sends/receives permanent data packages to/from companion device via ZigBee connection)
Comment:	

1.5 EUT Configuration

Configuration #	Description
1	EUT is inserted in Raspberry Pi. EUT get power from Raspberry Pi. Raspberry Pi is powered up and powered with 5 V DC via USB connection from Laptop. Laptop is powered via AC/DC-Adaptor 1 with 120 V / 60 Hz external power supply. Conbee is connected with Laptop EUT sends permanent data packages to Conbee via ZigBee connection. Laptop is used for monitoring the sends and receives data packages.
2	EUT is inserted in Raspberry Pi. EUT get power from Raspberry Pi. Raspberry Pi is powered up and powered with 5 V DC via USB connection from AC/DC-Adaptor 2. AC/DC-Adaptor 2 is powered with 120 V / 60 Hz external power supply. Conbee is connected with Laptop EUT sends permanent data packages to Conbee via ZigBee connection. Laptop is used for monitoring the sends and receives data packages.
Comment:	

1.6 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 analyser in dBµV. Any external preamplifiers used are taken into account through internal analyser 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 analyser. 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:

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

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:

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

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/m	= 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:				

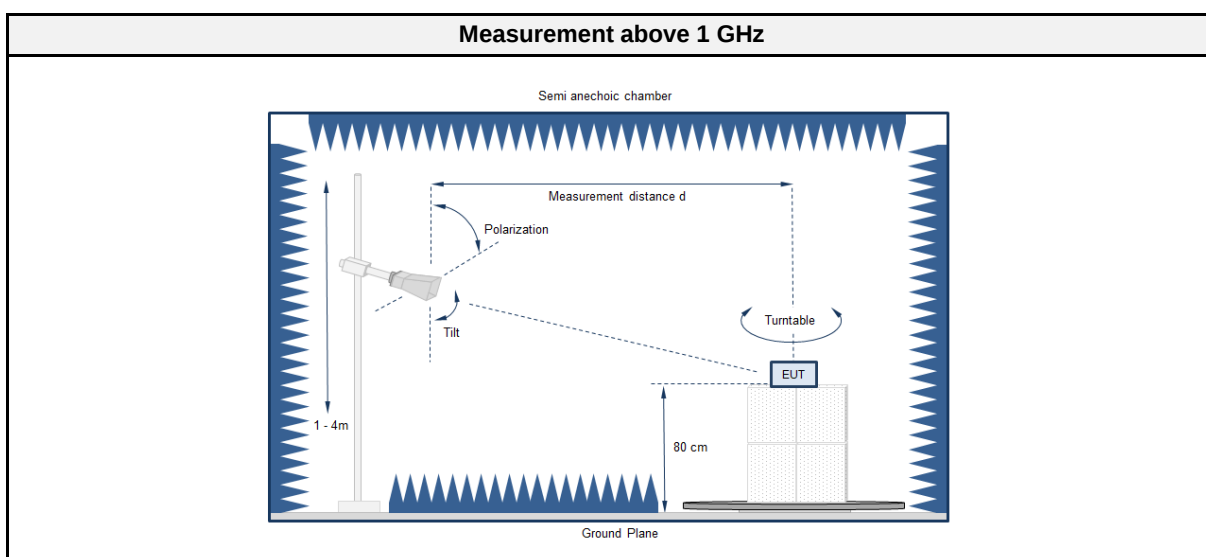
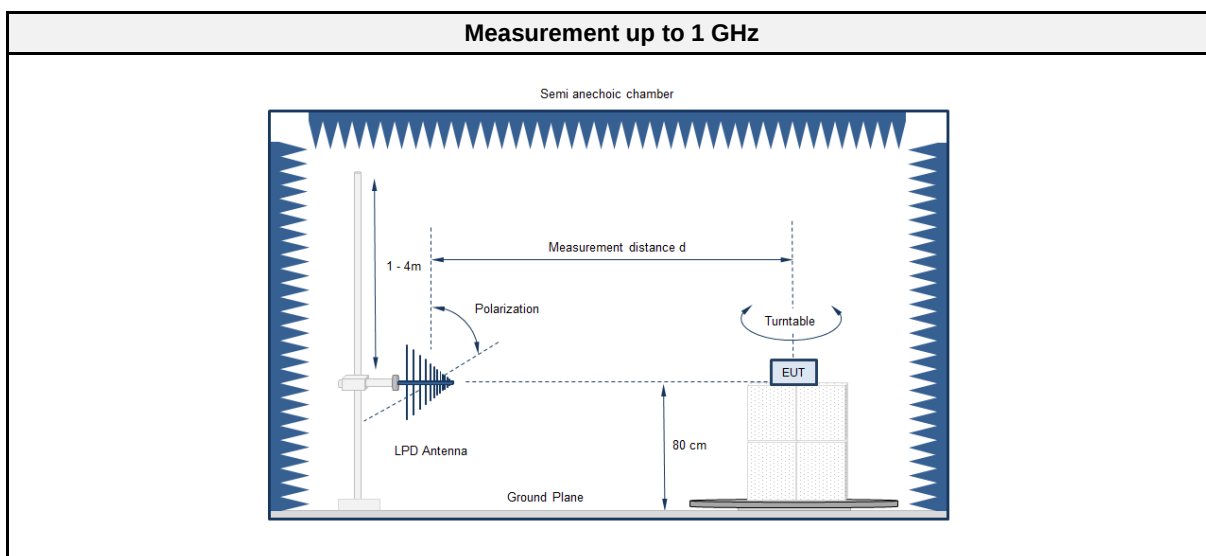
Possible Test Case Verdicts	
PASS	Test object does meet the requirements
FAIL	Test object does not meet the requirements
N/T	Required by standard but not tested
N/R	Not required by standard for the test object

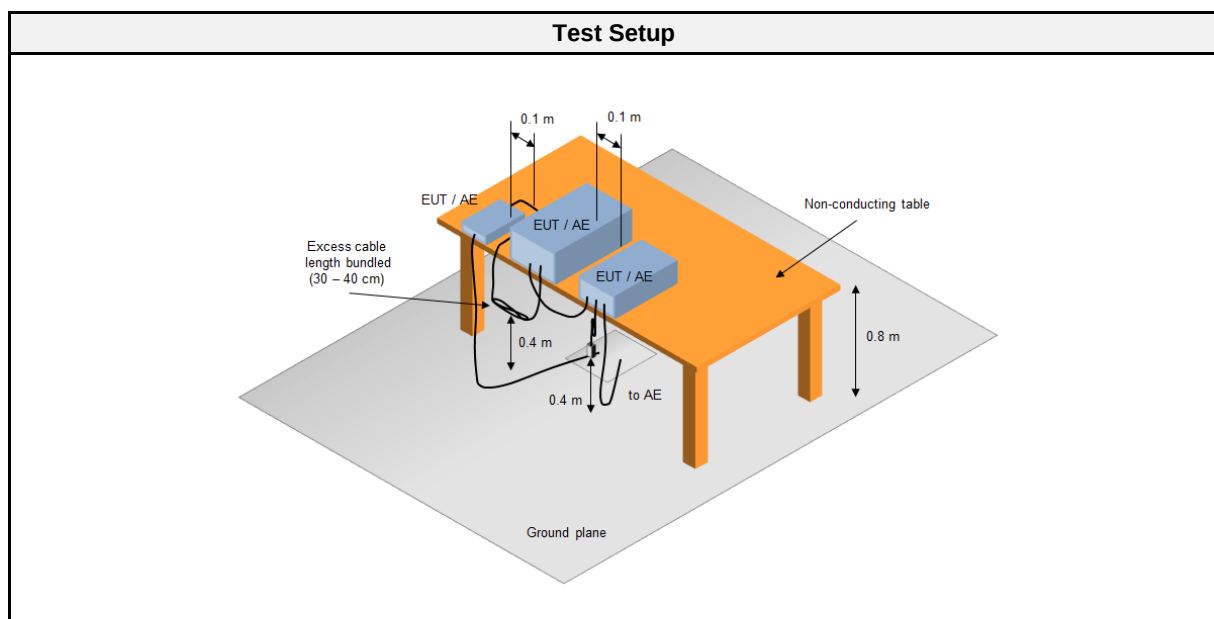
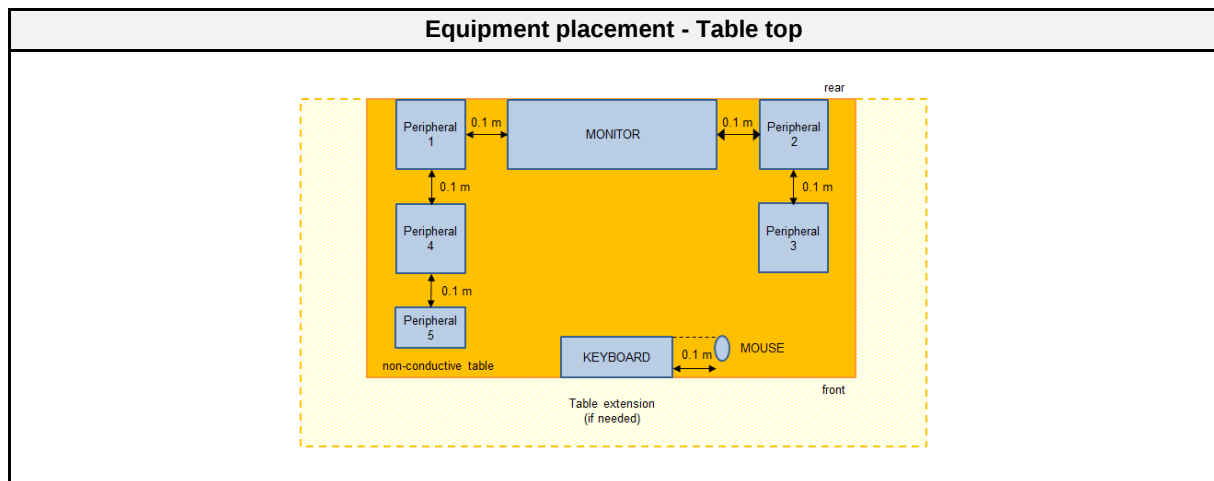
2.1 Test Conditions and Results - Radiated emissions acc. to ANSI C63.4

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]	2483.5
Measurement range	30 MHz to 13000 MHz
Temperature [°C]	24
Humidity [%]	29
Operator	Stephan Liebich
Date	2019-12-16

2.1.2 Setup





2.1.3 Equipment

Test Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	Radimation	2016.1.10

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic chamber	Frankonia	AC1	EF00062	2018-07	2021-07
EMI Test Receiver	Keysight	N9038A-526/WXP	EF01070	2019-09	2020-09
Biconical Antenna	R&S	HK 116	EF00030	2019-04	2022-04
LPD Antenna	R&S	HL 223	EF00187	2019-05	2022-05
Horn antenna	Schwarzbeck	BBHA 9120D (1-18GHz)	EF00018	2017-09	2020-09
Climatic Sensor	Embedded Data Systems, LLC.	2800100000254 17E	EF01054	2019-05	2020-05

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

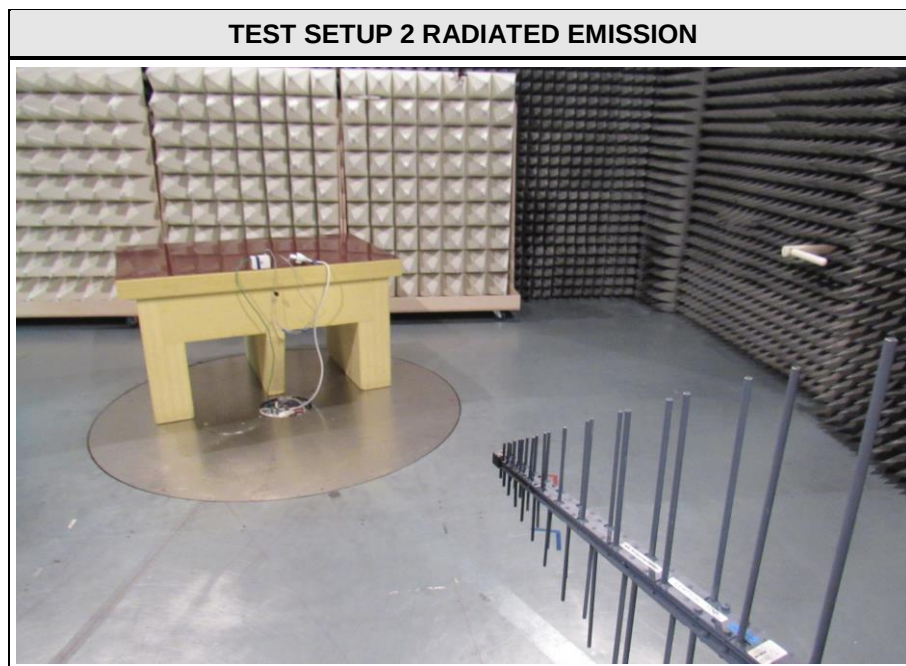
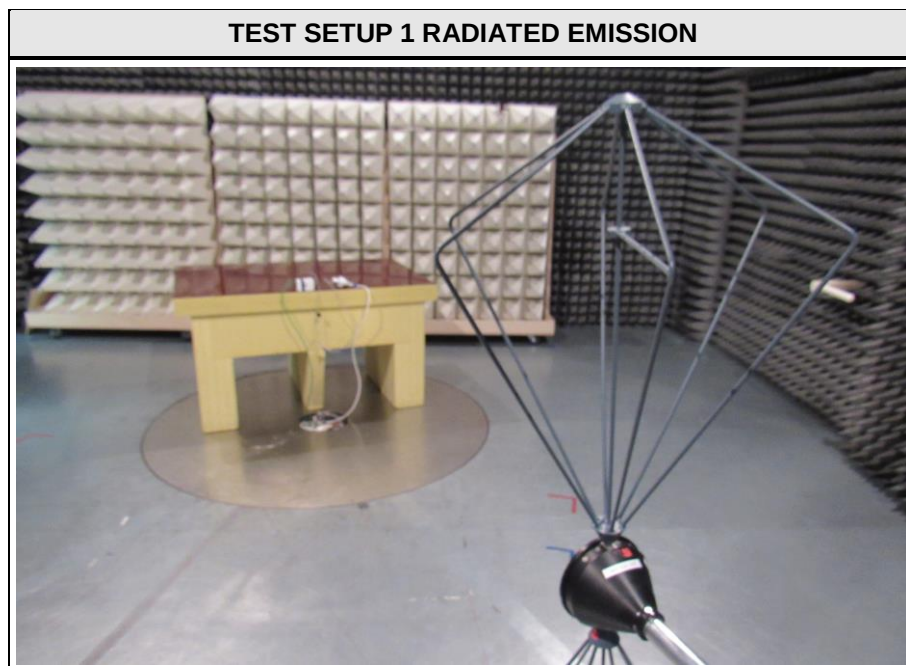
Class B @ 3 m		
Frequency [MHz]	Detector	Limit [dB μ V/m]
30 - 88	Quasi-peak	40
88 - 216	Quasi-peak	43.5
216 - 960	Quasi-peak	46
960 - 1000	Quasi-peak	54
> 1000	Peak	74
	Average	54

Class A @ 10 m		
Frequency [MHz]	Detector	Limit [dB μ V/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	69.5
	Average	49.5

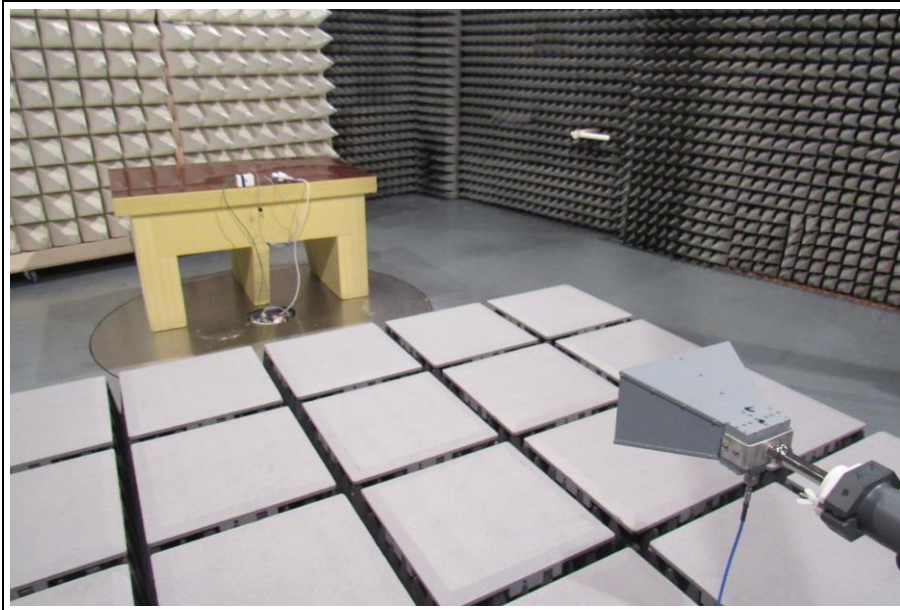
2.1.6 Results

Test Results			
Operational mode	EUT Configuration	Verdict	Remark
1	2	PASS	-

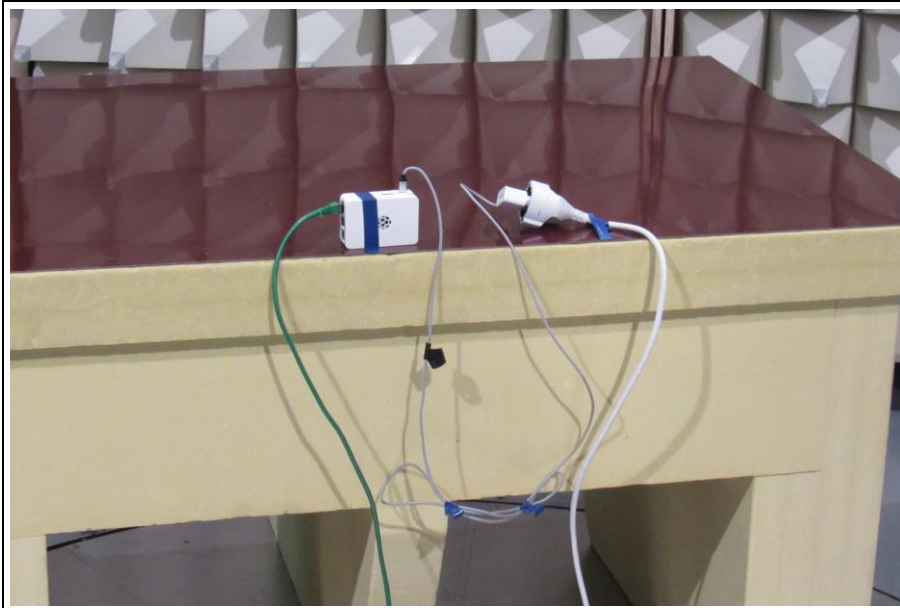
2.1.7 Setup Photos



TEST SETUP 3 RADIATED EMISSION



TEST SETUP FOCUS RADIATED EMISSION

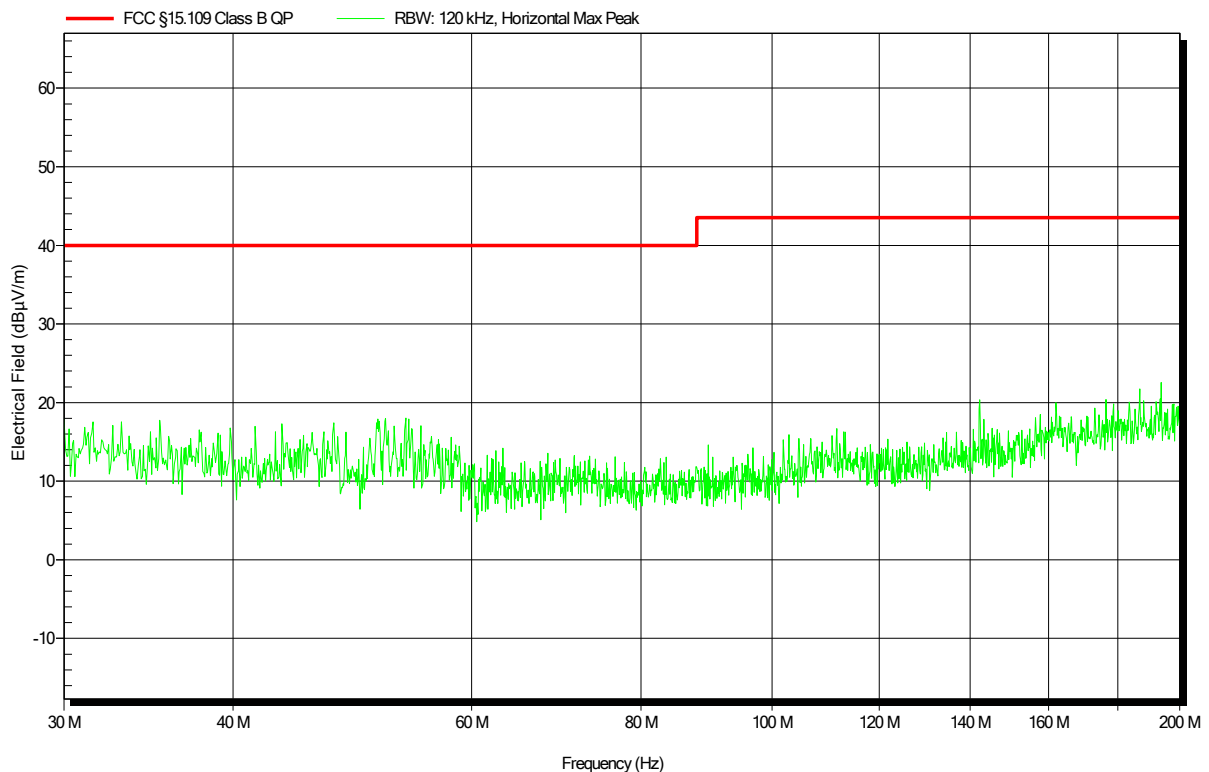


2.1.8 Records

**Radiated emissions
according to FCC part 15B**

Project Number: G0M-1910-8555
 Applicant: dresden elektronik ingenieurtechnik gmbh
 Model Description: Zigbee Radio Module for Raspberry Pi
 Model: RaspBee II
 Test Sample ID: 1
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Liebich
 Test Date: 2019-12-16
 Operating Conditions: ambient temperature: 24 °C
 power input: 120 V / 60 Hz
 Antenna: Rohde & Schwarz HK 116, Horizontal
 Measurement Distance: 3m
 Mode: 1
 Note 1:

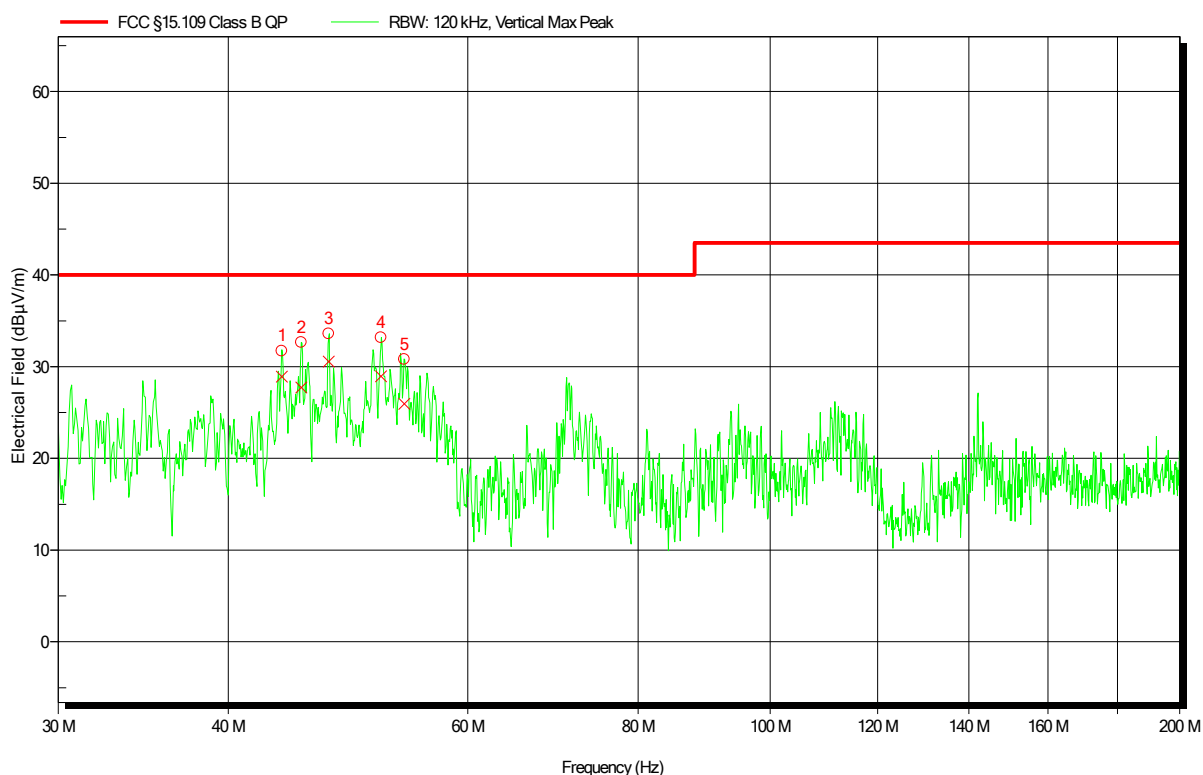
Index 3



Radiated emissions according to FCC part 15B

Project Number: G0M-1910-8555
 Applicant: dresden elektronik ingenieurtechnik gmbh
 Model Description: Zigbee Radio Module for Raspberry Pi
 Model: RaspBee II
 Test Sample ID: 1
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Liebich
 Test Date: 2019-12-16
 Operating Conditions: ambient temperature: 24 °C
 power input: 120 V / 60 Hz
 Antenna: Rohde & Schwarz HK 116, Vertical
 Measurement Distance: 3m
 Mode: 1

Index 2



Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	43.793 MHz	28.92 dBµV/m	40 dBµV/m	-11.08 dB	Pass	0 Degree	1 m
2	45.259 MHz	27.72 dBµV/m	40 dBµV/m	-12.28 dB	Pass	0 Degree	1 m
3	47.414 MHz	30.54 dBµV/m	40 dBµV/m	-9.46 dB	Pass	0 Degree	1 m
4	51.81 MHz	28.95 dBµV/m	40 dBµV/m	-11.05 dB	Pass	0 Degree	1 m
5	53.87 MHz	25.95 dBµV/m	40 dBµV/m	-14.05 dB	Pass	0 Degree	1 m

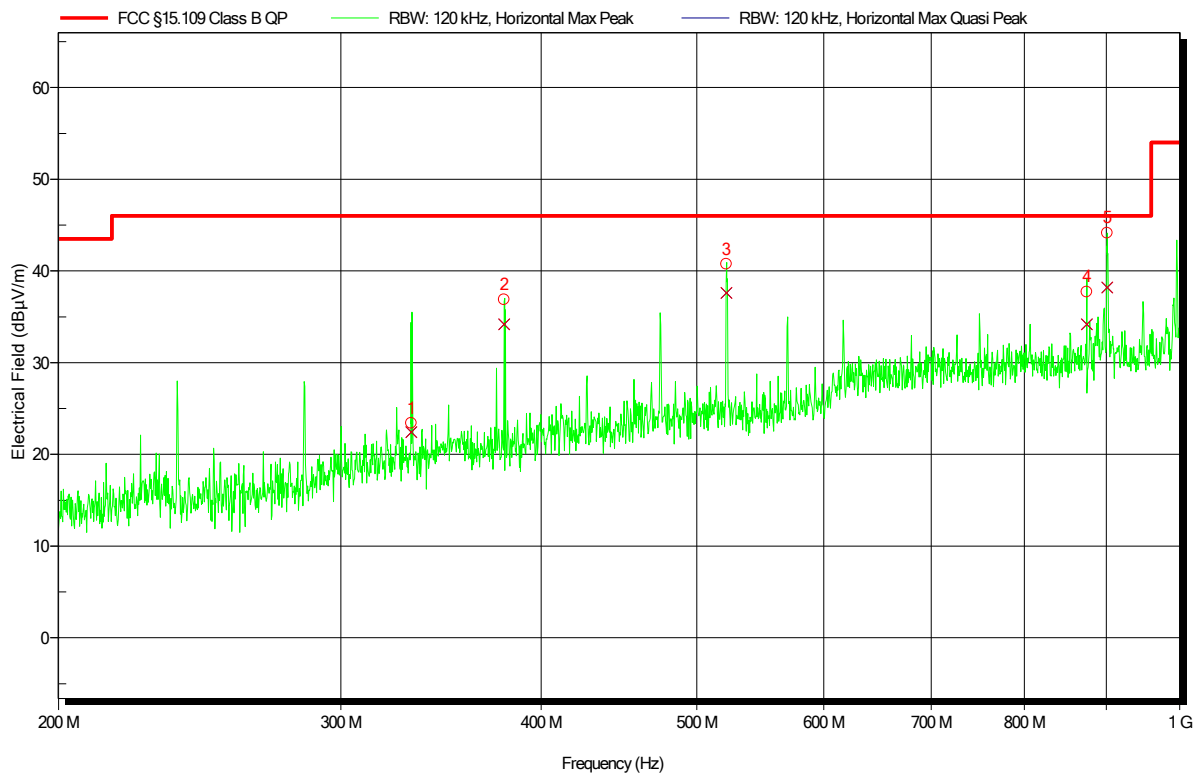
Test Report No.: G0M-1910-8555-EF0115B-V01

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

Radiated emissions according to FCC part 15B

Project Number: G0M-1910-8555
 Applicant: dresden elektronik ingenieurtechnik gmbh
 Model Description: Zigbee Radio Module for Raspberry Pi
 Model: RaspBee II
 Test Sample ID: 1
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Liebich
 Test Date: 2019-12-16
 Operating Conditions: ambient temperature: 24 °C
 power input: 120 V / 60 Hz
 Antenna: Rohde & Schwarz HL 223, Horizontal
 Measurement Distance: 3m
 Mode: 1

Index 5



Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	331.978 MHz	22.41 dBµV/m	46.02 dBµV/m	-23.61 dB	Pass	0 Degree	1 m
2	379.37 MHz	34.19 dBµV/m	46.02 dBµV/m	-11.84 dB	Pass	0 Degree	1 m
3	521.765 MHz	37.61 dBµV/m	46.02 dBµV/m	-8.41 dB	Pass	0 Degree	1 m
4	874.993 MHz	34.18 dBµV/m	46.02 dBµV/m	-11.84 dB	Pass	0 Degree	1 m
5	901.045 MHz	38.2 dBµV/m	46.02 dBµV/m	-7.83 dB	Pass	0 Degree	1 m

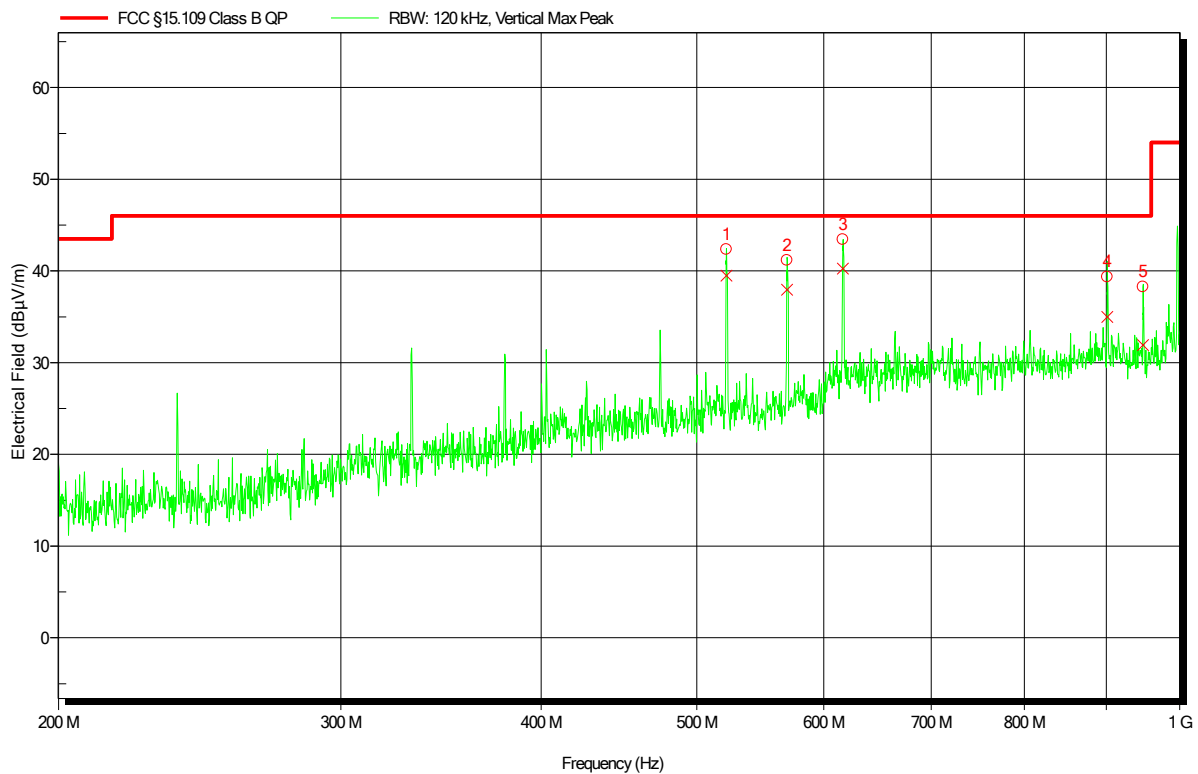
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Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Radiated emissions according to FCC part 15B

Project Number: G0M-1910-8555
 Applicant: dresden elektronik ingenieurtechnik gmbh
 Model Description: Zigbee Radio Module for Raspberry Pi
 Model: RaspBee II
 Test Sample ID: 1
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Liebich
 Test Date: 2019-12-16
 Operating Conditions: ambient temperature: 24 °C
 power input: 120 V / 60 Hz
 Antenna: Rohde & Schwarz HL 223, Vertical
 Measurement Distance: 3m
 Mode: 1

Index 4



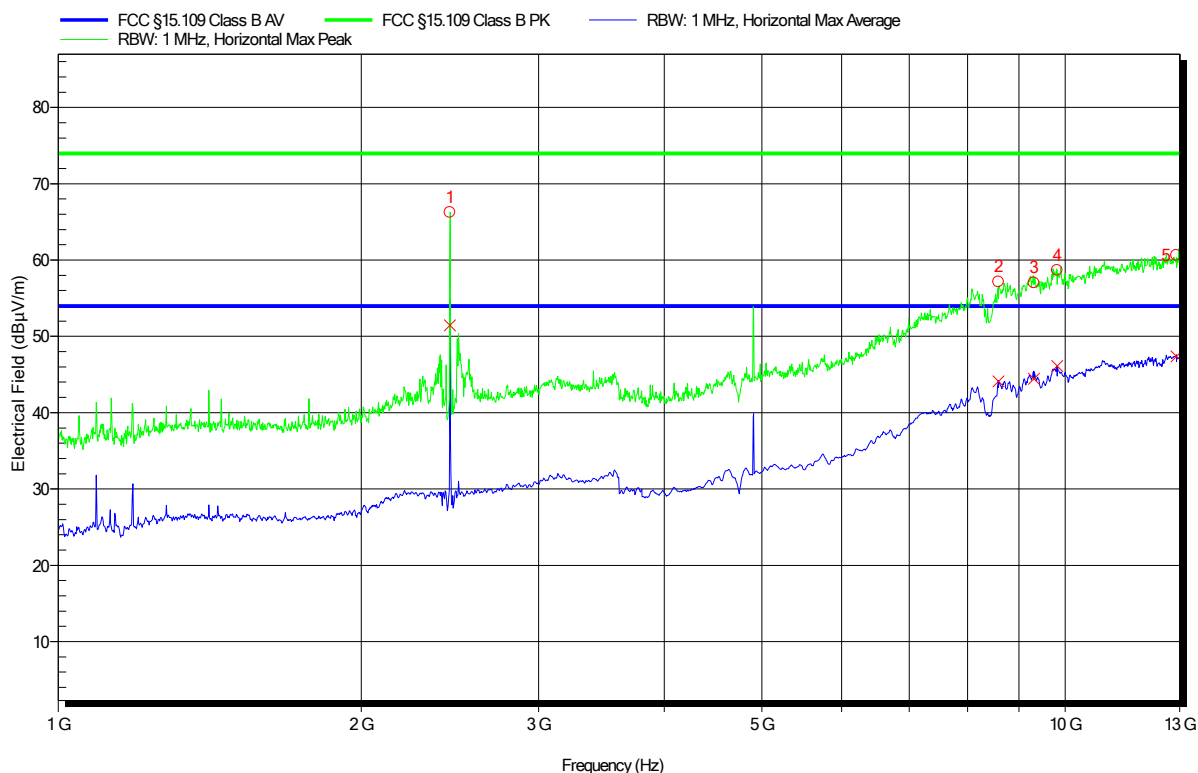
Test Report No.: G0M-1910-8555-EF0115B-V01

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

Radiated emissions according to FCC part 15B

Project Number: G0M-1910-8555
 Applicant: dresden elektronik ingenieurtechnik gmbh
 Model Description: Zigbee Radio Module for Raspberry Pi
 Model: RaspBee II
 Test Sample ID: 1
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Liebich
 Test Date: 2019-12-16
 Operating Conditions: ambient temperature: 24 °C
 power input: 120 V / 60 Hz
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement Distance: 3m
 Mode: 1

Index 7



Peak Number	Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Angle	Height
1	2.451 GHz			ZigBee-Carrier		0 Degree	1 m
2	8.585 GHz	57.14 dBµV/m	73.98 dBµV/m	-16.84 dB	Pass	0 Degree	1 m
3	9.312 GHz	57.03 dBµV/m	73.98 dBµV/m	-16.95 dB	Pass	0 Degree	1 m
4	9.82 GHz	58.65 dBµV/m	73.98 dBµV/m	-15.33 dB	Pass	0 Degree	1 m
5	12.9 GHz	60.64 dBµV/m	73.98 dBµV/m	-13.34 dB	Pass	0 Degree	1 m

Test Report No.: G0M-1910-8555-EF0115B-V01

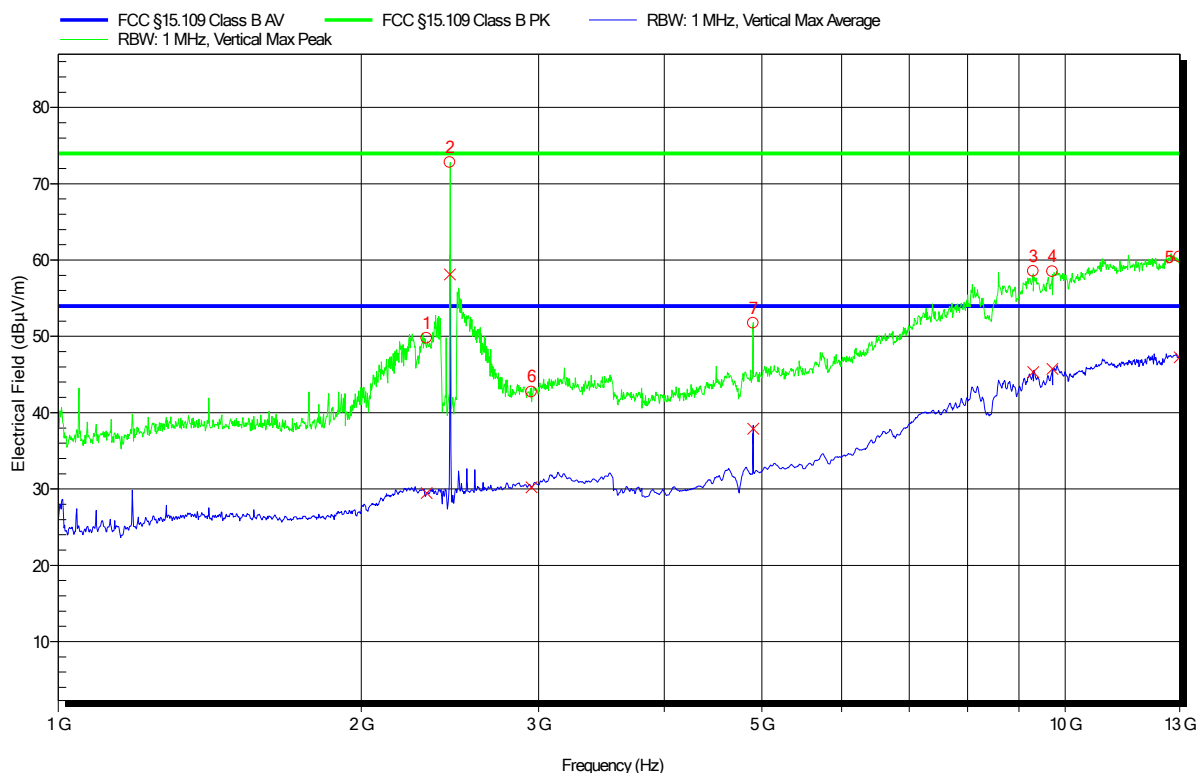
Eurofins Product Service GmbH
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Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height
1	2.451 GHz			ZigBee-Carrier		0 Degree	1 m
2	8.585 GHz	44.1 dBμV/m	53.98 dBμV/m	-9.88 dB	Pass	0 Degree	1 m
3	9.312 GHz	44.44 dBμV/m	53.98 dBμV/m	-9.54 dB	Pass	0 Degree	1 m
4	9.82 GHz	46.11 dBμV/m	53.98 dBμV/m	-7.87 dB	Pass	0 Degree	1 m
5	12.9 GHz	47.37 dBμV/m	53.98 dBμV/m	-6.61 dB	Pass	0 Degree	1 m

Radiated emissions according to FCC part 15B

Project Number: G0M-1910-8555
 Applicant: dresden elektronik ingenieurtechnik gmbh
 Model Description: Zigbee Radio Module for Raspberry Pi
 Model: RaspBee II
 Test Sample ID: 1
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Liebich
 Test Date: 2019-12-16
 Operating Conditions: ambient temperature: 24 °C
 power input: 120 V / 60 Hz
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement Distance: 3m
 Mode: 1

Index 6



Peak Number	Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Angle	Height
1	2.323 GHz	49.77 dBµV/m	73.98 dBµV/m	-24.21 dB	Pass	0 Degree	1 m
2	2.451 GHz						
3	9.302 GHz	58.52 dBµV/m	73.98 dBµV/m	-15.46 dB	Pass	0 Degree	1 m
4	9.717 GHz	58.51 dBµV/m	73.98 dBµV/m	-15.47 dB	Pass	0 Degree	1 m
5	12.998 GHz	60.41 dBµV/m	73.98 dBµV/m	-13.57 dB	Pass	0 Degree	1 m

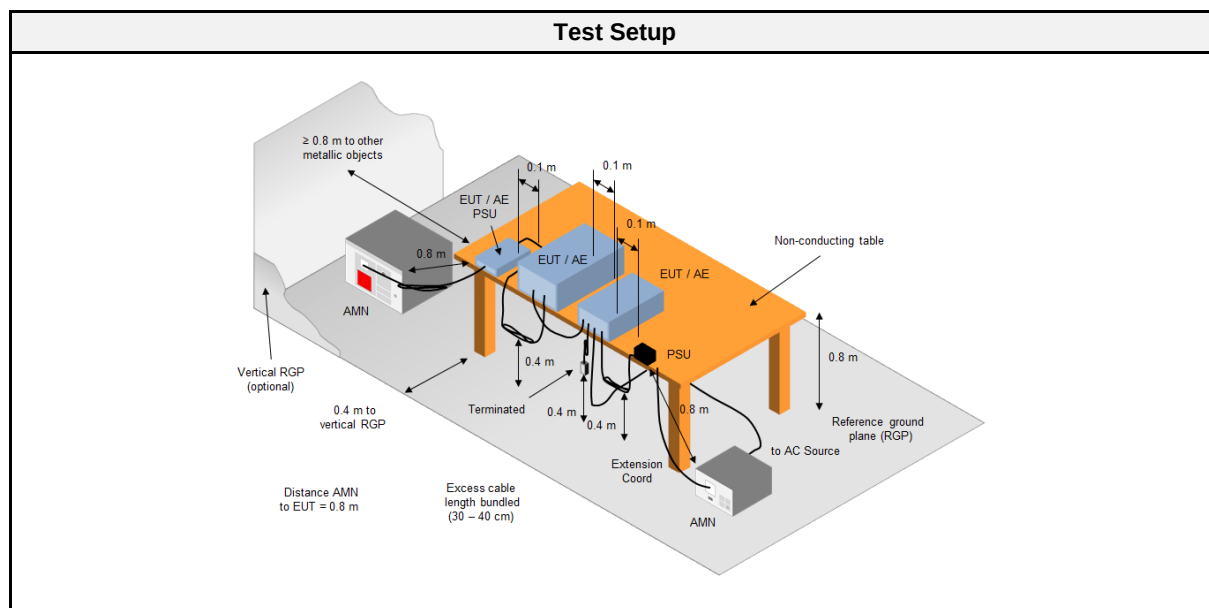
Test Report No.: G0M-1910-8555-EF0115B-V01

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

6	2.952 GHz	42.71 dBμV/m	73.98 dBμV/m	-31.27 dB	Pass	0 Degree	1 m
7	4.901 GHz	51.76 dBμV/m	73.98 dBμV/m	-22.22 dB	Pass	0 Degree	1 m
Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height
1	2.323 GHz	29.47 dBμV/m	53.98 dBμV/m	-24.51 dB	Pass	0 Degree	1 m
2	2.451 GHz		ZigBee-Carrier 53.98 dBμV/m			0 Degree	1 m
3	9.302 GHz	45.3 dBμV/m		-8.68 dB	Pass	0 Degree	1 m
4	9.717 GHz	45.72 dBμV/m	53.98 dBμV/m	-8.26 dB	Pass	0 Degree	1 m
5	12.998 GHz	47.26 dBμV/m	53.98 dBμV/m	-6.72 dB	Pass	0 Degree	1 m
6	2.952 GHz	30.24 dBμV/m	53.98 dBμV/m	-23.74 dB	Pass	0 Degree	1 m
7	4.901 GHz	37.91 dBμV/m	53.98 dBμV/m	-16.07 dB	Pass	0 Degree	1 m

2.2.1 Information

2.2.2 Setup



2.2.3 Equipment

Test Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	Radimation	2016.1.10

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
AMN	R&S	ESH3-Z5	EF00036	2019-07	2021-07
Pulse Limiter	R&S	ESH3-Z2	EF01063	2019-07	2020-07
EMI Test Receiver	R&S	ESR 7	EF00943	2019-10	2020-10
Climatic Sensor	Embedded Data Systems, LLC.	2800100000254 17E	EF01054	2019-05	2020-05

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

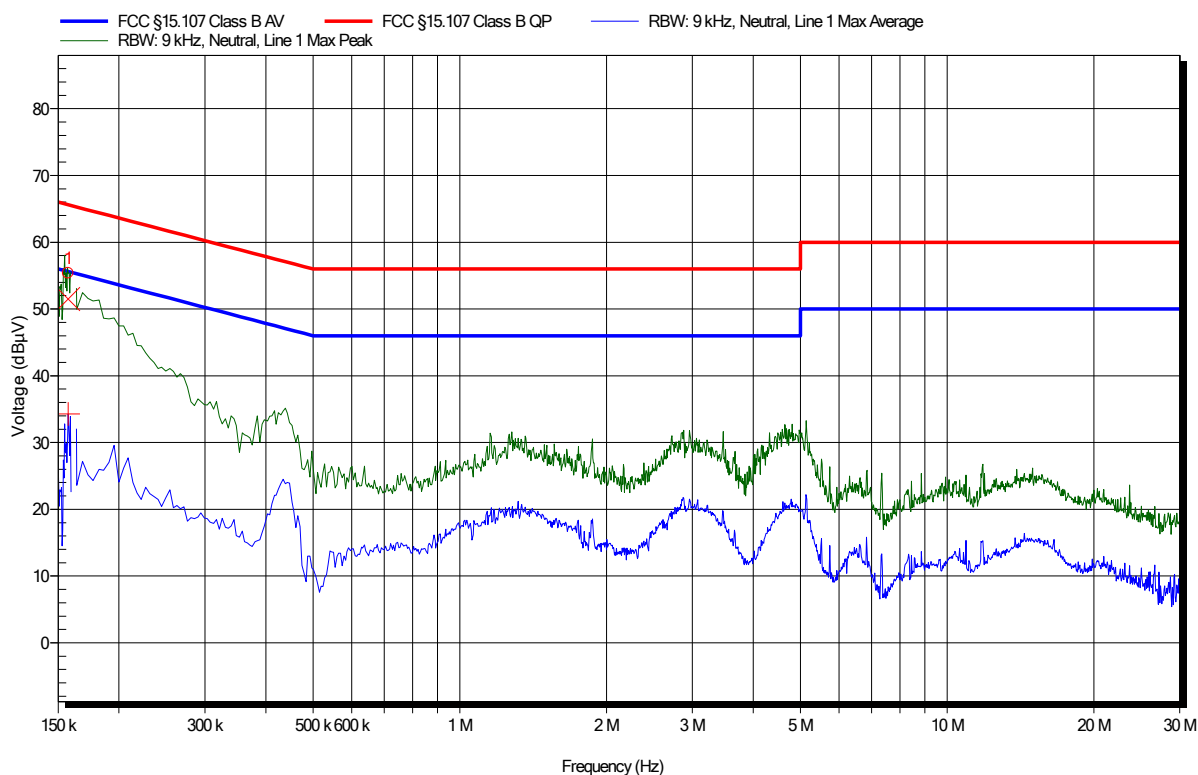


2.2.8 Records

Conducted emissions at the mains power port according to FCC part 15B

Project Number: G0M-1910-8555
 Applicant: dresden elektronik ingenieurtechnik gmbh
 Model Description: Zigbee Radio Module for Raspberry Pi
 Model: RaspBee II
 Test Sample ID: 1
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Liebich
 Test Date: 2019-12-16
 Operating Conditions: ambient temperature: 23 °C
 power input: 120 V / 60 Hz
 LISN: Rohde & Schwarz ESH3-Z5
 Mode: 1
 Applied to Port: POWER

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Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	LISN
1	157.2 kHz	51.49 dBμV	65.61 dBμV	-14.12 dB	Pass	Neutral
Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	LISN
1	157.2 kHz	34.26 dBμV	55.61 dBμV	-21.35 dB	Pass	Neutral

Test Report No.: G0M-1910-8555-EF0115B-V01

Eurofins Product Service GmbH
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