EMC TEST REPORT

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

Report Reference No	G0M-1902-8028-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 ISED Testing Laboratory site: 3470A-2
Applicant	dresden elektronik ingenieurtechnik gmbh
Address	Enno-Heidebroek-Straße 12 01237 Dresden GERMANY
Test Specification	
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	2,4GHz IEEE 802.15.4 ZigBee USB dongle with integrated antenna
Model(s)	ConBee II
Additional Model(s)	None
Brand Name(s)	None
Hardware Version(s)	0
Software Version(s)	0
FCC-ID	XVV-CONBEE2
IC	8720A-CONBEE2
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	2019-01-31	
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	2019-03-27	
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	2019-03-27	Initial Release	

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1 Equipment (Test Item) Under Test

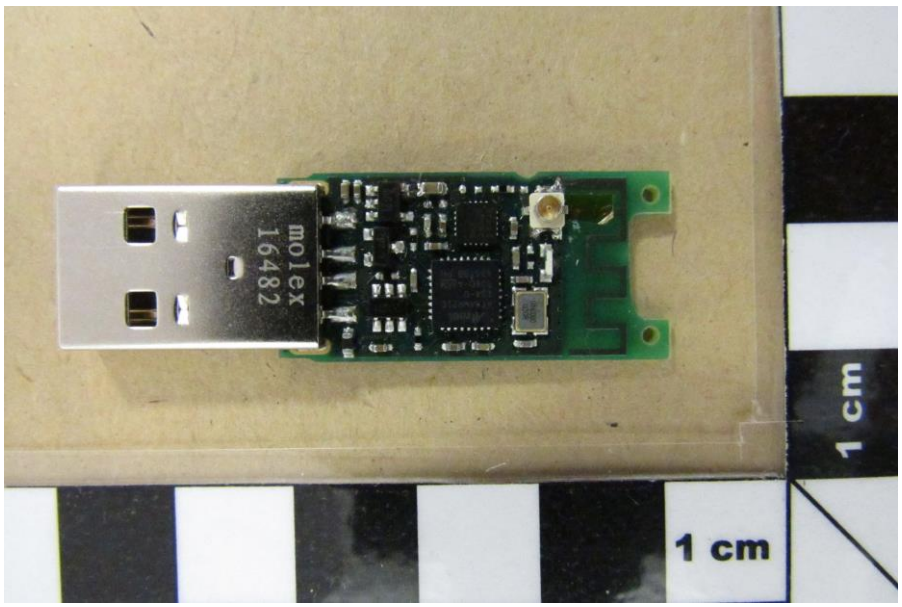
Description	2,4GHz IEEE 802.15.4 ZigBee USB dongle with integrated antenna	
Model	ConBee II	
Additional Model(s)	None	
Brand Name(s)	None	
Serial Number(s)	unspecified	
Hardware Version(s)	0	
Software Version(s)	0	
FCC-ID	XVV-CONBEE2	
IC	8720A-CONBEE2	
Class	Class B	
Equipment type	Table top	
Highest internal frequency [MHz]	2483.5	
Radio Module	Type	IEEE 802.15.4 (ZIGBEE)
	Model	Unspecified
	Manufacturer	Unspecified
	FCC-ID	Unspecified
	IC	Unspecified
Supply Voltage	V_{NOM}	5 VDC (USB)
AC/DC-Adaptor	None	
Manufacturer	dresden elektronik ingenieurtechnik gmbh Enno-Heidebroek-Straße 12 01237 Dresden GERMANY	

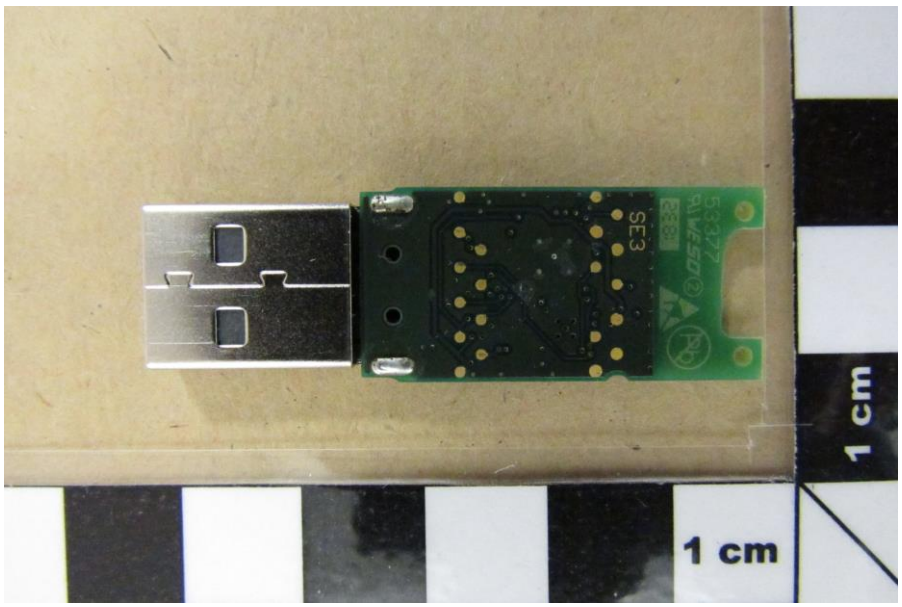
1.1 Equipment Ports

Name	Type	Attributes		Comment
USB	DC;IO	Count: Direction: Service only:	1 IO 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


1.3 Equipment Photos - External

EUT TOP

EUT BOTTOM

1.4 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
AE	Laptop	lenovo	ThinkPad X250	
AE	USB Hub	Lindy	No.42992	
AE	Laptop	Dell	Latitude E6420	S/N HPJ4R1
Description:				
AE	Auxiliary Equipment			
SIM	Simulator			
CBL	Connecting Cable			
Comment:				

1.5 Operational Modes

Mode #	Description
1	EUT powered up. EUT is set in test mode. EUT transmit continuously on Ch.: 20; max power and PRBS data packet.
Comment:	

1.6 EUT Configuration

Configuration #	Description
1	EUT powered via USB from laptop. Terminal program on laptop controlled EUT
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 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:

Reading on Analyser (dBµV) + A.F. (dB/m) = 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/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

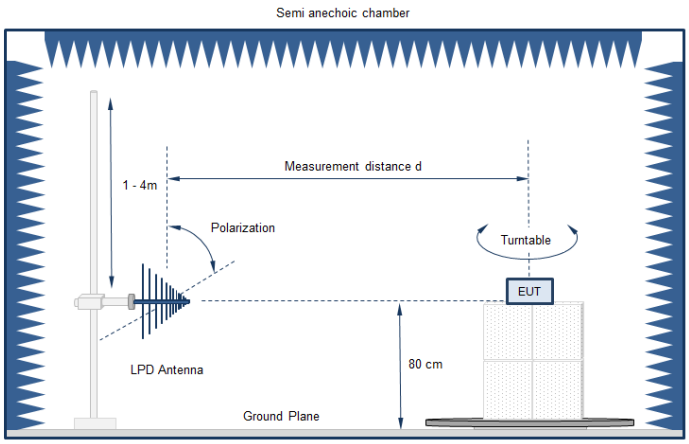
2.1 Test Conditions and Results - Radiated emissions acc. to ANSI C63.4

2.1.1 Information

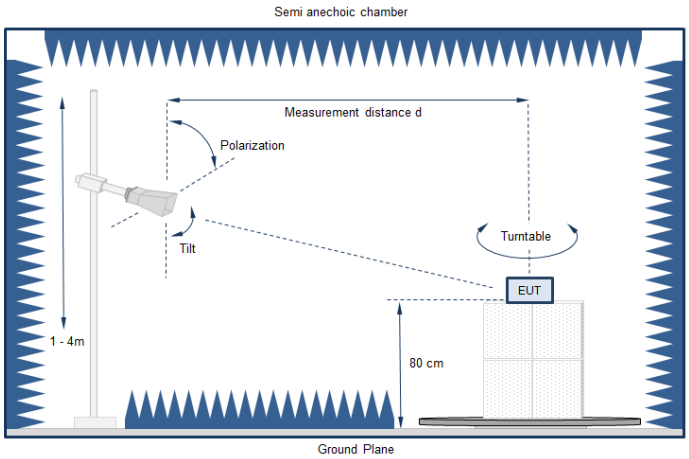
Test Information	
Reference	FCC 15.109, ICES-003, 8, 6.1
Reference method	ANSI C63.4:2014 Section 8
Equipment class	Class B
Equipment type	Table top
Highest internal frequency [MHz]	2483.5
Measurement range	30 MHz to 12417.5 MHz
Temperature [°C]	21
Humidity [%]	32
Operator	Matthias Handrik
Date	2019-03-22

2.1.2 Setup

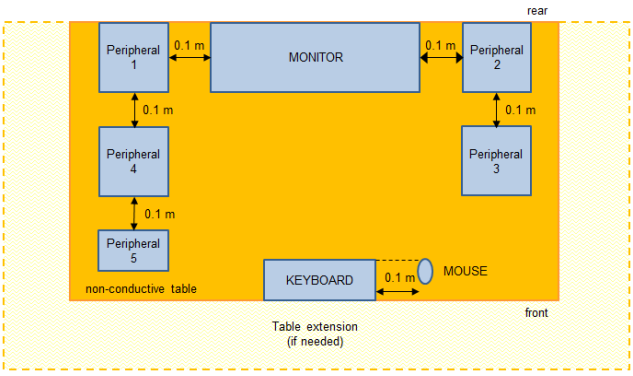
Measurement up to 1 GHz



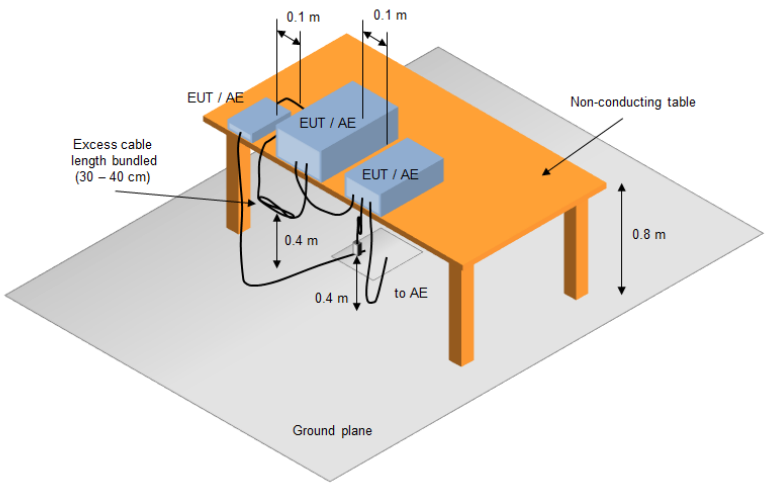
Measurement above 1 GHz



Equipment placement - Table top



Test 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	2018-08	2019-08
Biconical Antenna	R&S	HK 116	EF00186	2018-03	2020-03
LPD Antenna	R&S	HL 223	EF00187	2016-05	2019-05
Horn antenna	Schwarzbeck	BBHA 9120D (1-18GHz)	EF00018	2016-09	2019-09

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

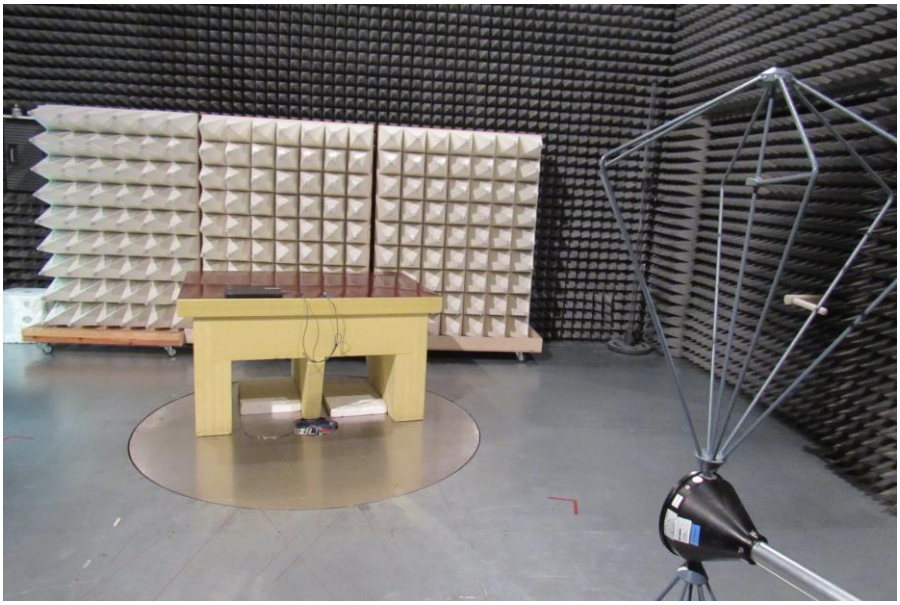
Class B @ 3 m		
Frequency [MHz]	Detector	Limit [dBµV/m]
30 - 88	Quasi-peak	40
88 - 216	Quasi-peak	43.5
216 - 960	Quasi-peak	46
960 - 1000	Quasi-peak	54
> 1000	Peak Average	74 54

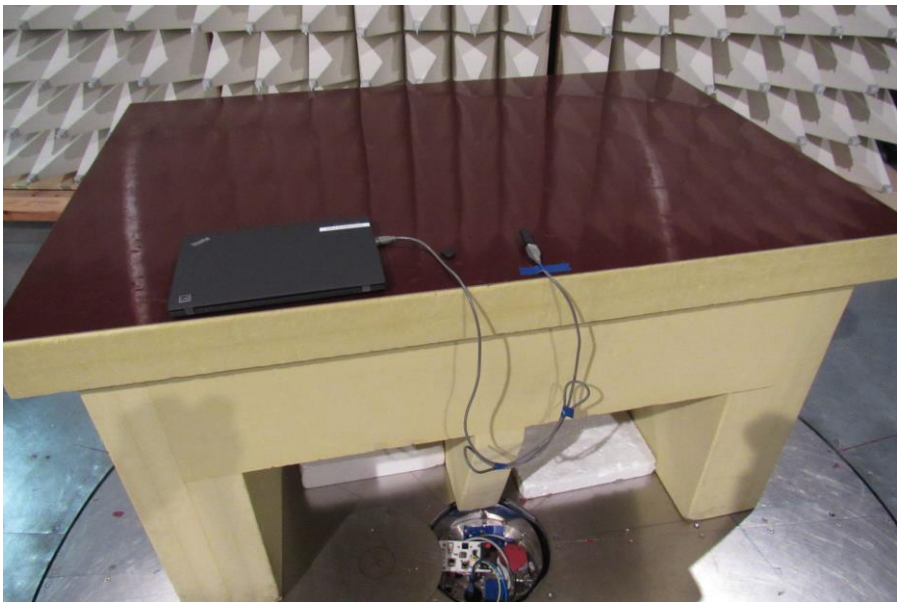
Class A @ 10 m		
Frequency [MHz]	Detector	Limit [dBµV/m]
30 - 88	Quasi-peak	39
88 - 216	Quasi-peak	43.5
216 - 960	Quasi-peak	46.5
960 - 1000	Quasi-peak	49.5
> 1000	Peak Average	69.5 49.5

2.1.6 Results

Test Results			
Operational mode	EUT Configuration	Verdict	Remark
1	1	PASS	

2.1.7 Setup Photos

Test setup I


Test setup II


2.1.8 Records

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1902-8028

Applicant:	dresden elektronik ingenieurtechnik gmbh
EUT Name:	2,4GHz IEEE 802.15.4 ZigBee USB dongle with integrated antenna
Model:	ConBee II
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 21°C, Unom: 5.0 VDC (USB powered)
Antenna:	Rohde & Schwarz HK 116, Vertical
Measurement distance:	3m
Mode:	mode# 1
Test Date:	2019-03-22
Note:	

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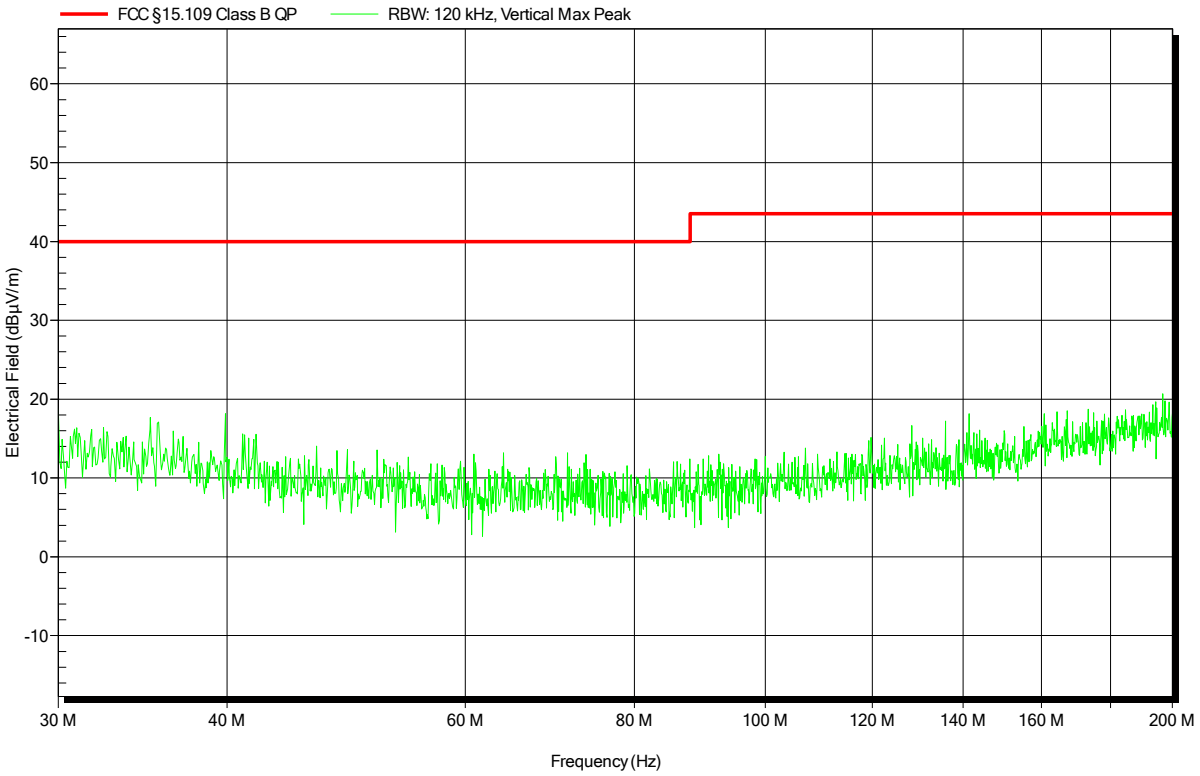

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1902-8028

Applicant:	dresden elektronik ingenieurtechnik gmbh
EUT Name:	2,4GHz IEEE 802.15.4 ZigBee USB dongle with integrated antenna
Model:	ConBee II
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 21°C, Unom: 5.0 VDC (USB powered)
Antenna:	Rohde & Schwarz HK 116, Horizontal
Measurement distance:	3m
Mode:	mode# 1
Test Date:	2019-03-22
Note:	

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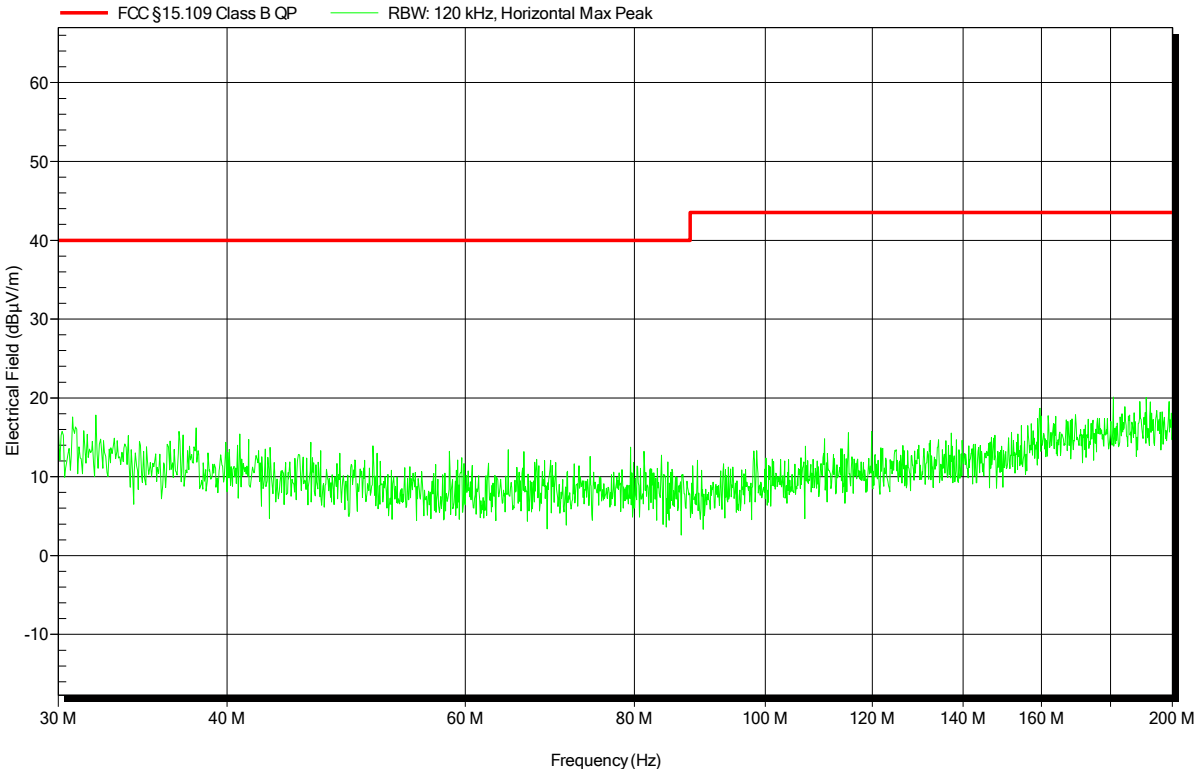

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1902-8028

Applicant:	dresden elektronik ingenieurtechnik gmbh
EUT Name:	2,4GHz IEEE 802.15.4 ZigBee USB dongle with integrated antenna
Model:	ConBee II
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 21°C, Unom: 5.0 VDC (USB powered)
Antenna:	Rohde & Schwarz HL 223, Vertical
Measurement distance:	3m
Mode:	mode# 1
Test Date:	2019-03-22
Note:	

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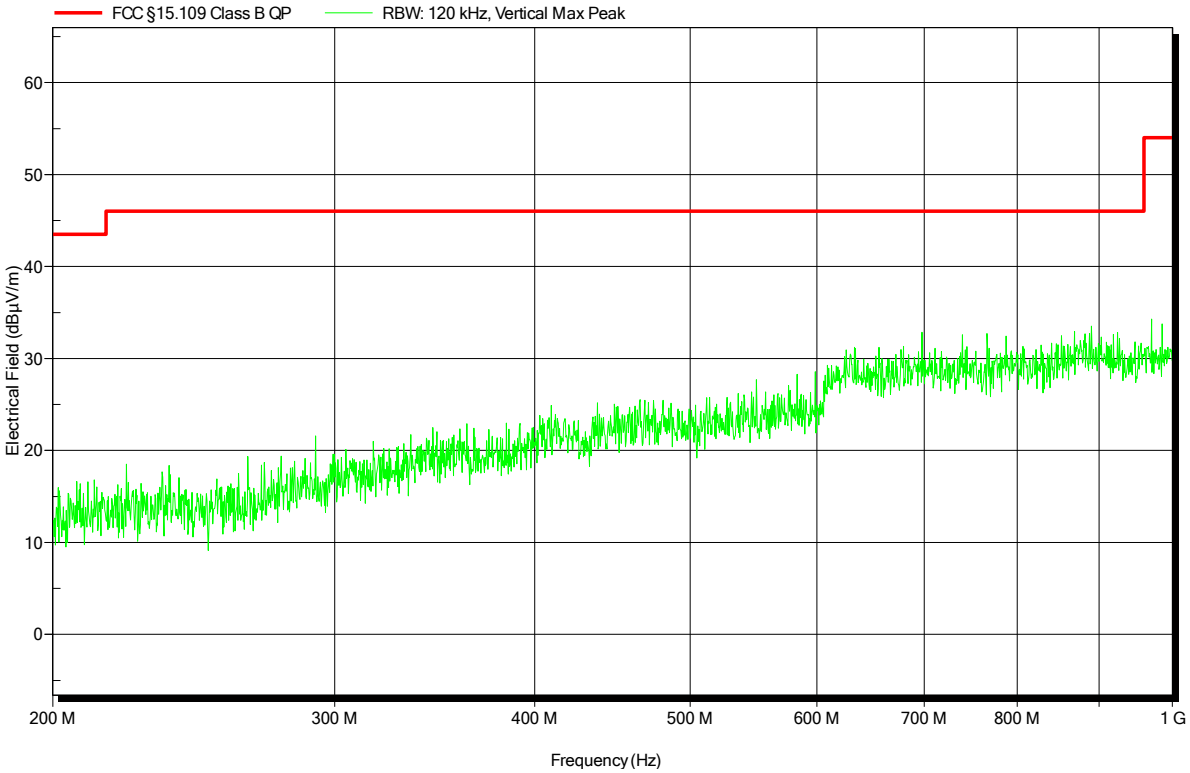

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1902-8028

Applicant:	dresden elektronik ingenieurtechnik gmbh
EUT Name:	2,4GHz IEEE 802.15.4 ZigBee USB dongle with integrated antenna
Model:	ConBee II
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 21°C, Unom: 5.0 VDC (USB powered)
Antenna:	Rohde & Schwarz HL 223, Horizontal
Measurement distance:	3m
Mode:	mode# 1
Test Date:	2019-03-22
Note:	

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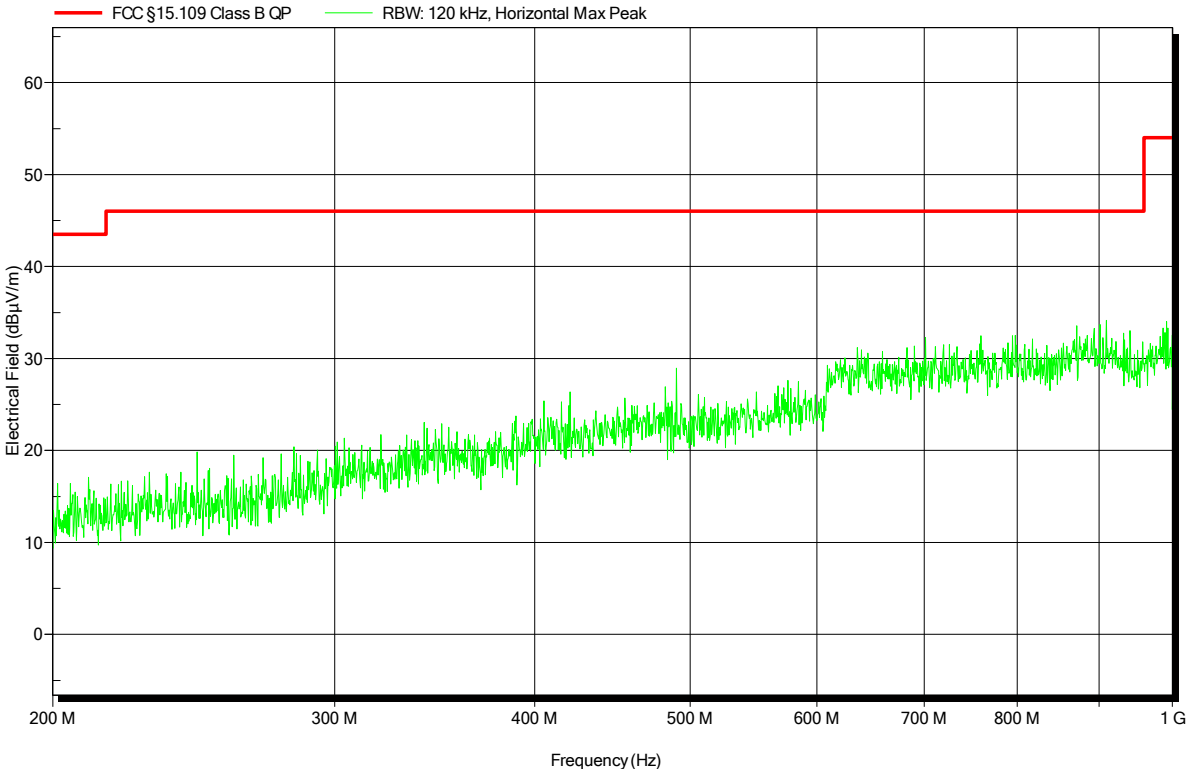

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1902-8028

Applicant:	dresden elektronik ingenieurtechnik gmbh
EUT Name:	2,4GHz IEEE 802.15.4 ZigBee USB dongle with integrated antenna
Model:	ConBee II
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 21°C, Unom: 5.0 VDC (USB powered)
Antenna:	Schwarzbeck BBHA 9120D, Vertical
Measurement distance:	3m
Mode:	mode# 1
Test Date:	2019-03-22
Note:	

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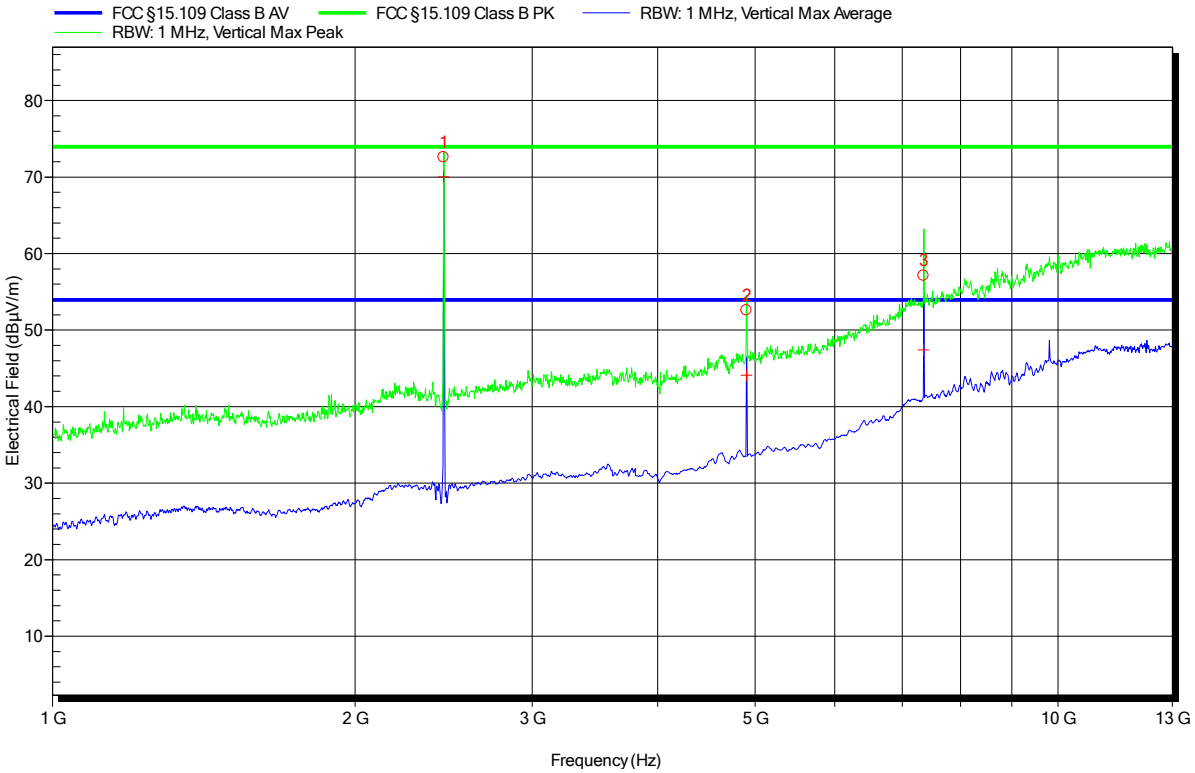

Peak Number	Frequency	
1	2.45 GHz	1st harmonic
2	4.901 GHz	2nd harmonic
3	7.35 GHz	3rd harmonic

Radiated emissions under normal conditions according to FCC Part 15b

Project number: G0M-1902-8028

Applicant:	dresden elektronik ingenieurtechnik gmbh
EUT Name:	2,4GHz IEEE 802.15.4 ZigBee USB dongle with integrated antenna
Model:	ConBee II
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Handrik
Test Conditions:	Tnom: 21°C, Unom: 5.0 VDC (USB powered)
Antenna:	Schwarzbeck BBHA 9120D, Horizontal
Measurement distance:	3m
Mode:	mode# 1
Test Date:	2019-03-22
Note:	

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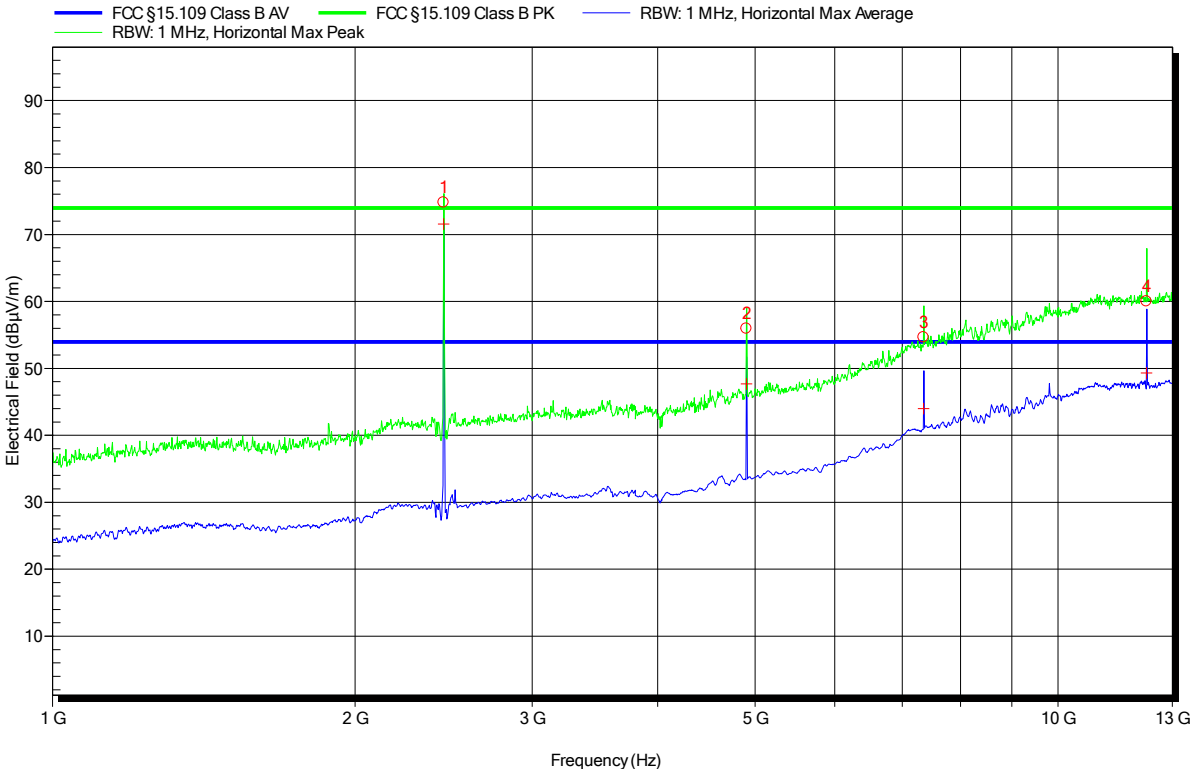


Peak Number	Frequency	Peak	Angle	Height
1	2.45 GHz	1st harmonic		
2	4.9 GHz	2nd harmonic		
3	7.35 GHz	3rd harmonic		
4	12.25 GHz	5th harmonic		

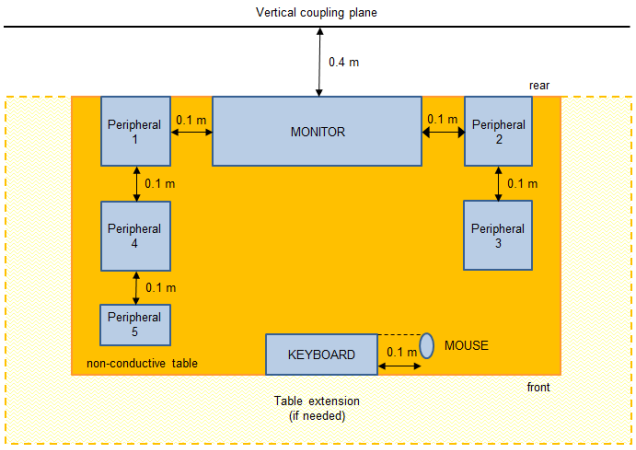
2.2 Test Conditions and Results - Conducted emissions acc. to ANSI C63.4

2.2.1 Information

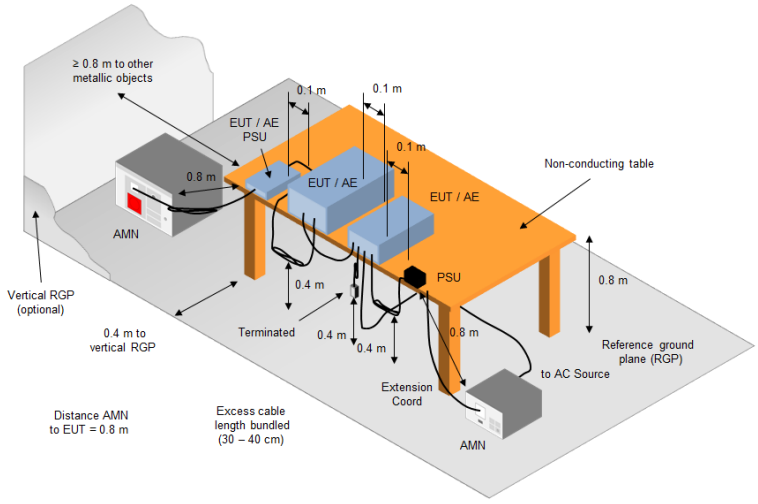
Test Information	
Reference	FCC 15.107, ICES-003, 8, 6.2
Reference method	ANSI C63.4:2014 Section 12
Measurement range	150 kHz to 30 MHz
Equipment class	Class B
Equipment type	Table top
Temperature [°C]	21
Humidity [%]	32
Operator	Matthias Handrik
Date	2019-03-22

2.2.2 Setup

Equipment placement



Test 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	2017-01	2019-07
Pulse Limiter	R&S	ESH3-Z2	EF01063	2018-07	2019-07
EMI Test Receiver	R&S	ESR 7	EF00943	2018-07	2019-07

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

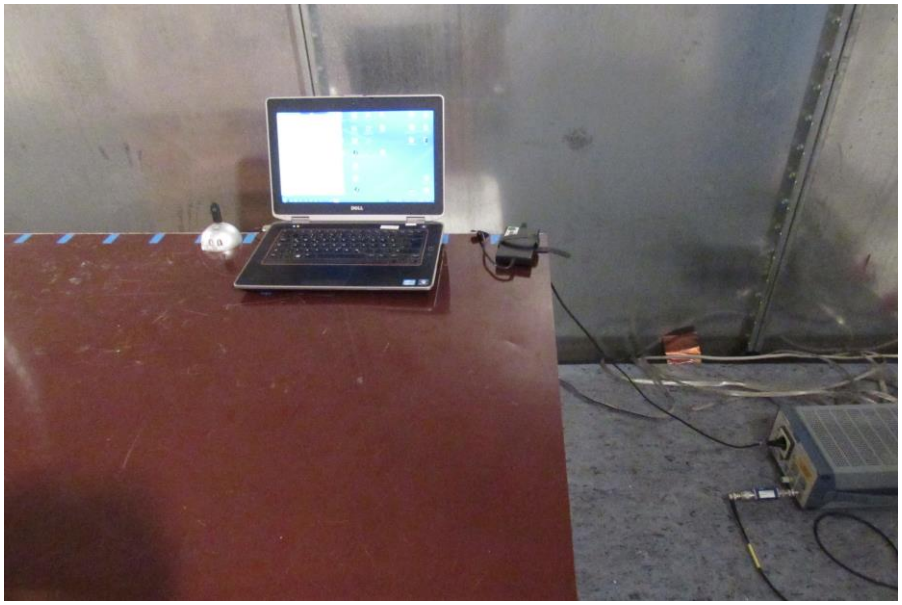
2.2.5 Limits

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
USB	AMN	1	1	PASS	

2.2.7 Setup Photos

test setup


2.2.8 Records

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

Project number: G0M-1902-8028

Applicant:	dresden elektronik ingenieurtechnik gmbh
EUT Name:	2,4GHz IEEE 802.15.4 ZigBee USB dongle with integrated antenna
Model:	ConBee II
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Treffke
Test Conditions:	Tnom: 21°C, Unom: 120V AC (AC/DC adaptor)
LISN:	ESH3-Z5 (N)
Mode:	Mode# 1
Test Date:	2019-03-08
Note:	

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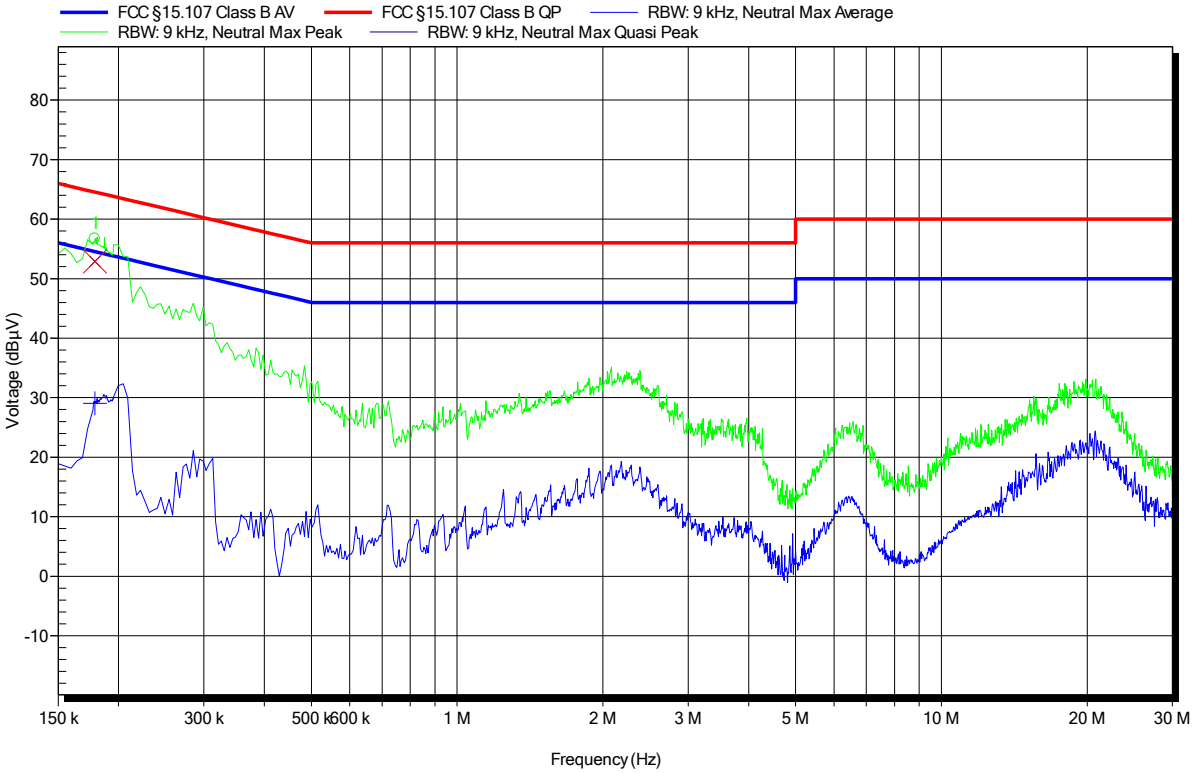

Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status
1	178.8 kHz	52.9 dBµV	64.54 dBµV	-11.64 dB	Pass

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status
1	178.8 kHz	29.05 dBµV	54.54 dBµV	-25.49 dB	Pass

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

Project number: G0M-1902-8028

Applicant:	dresden elektronik ingenieurtechnik gmbh
EUT Name:	2,4GHz IEEE 802.15.4 ZigBee USB dongle with integrated antenna
Model:	ConBee II
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Treffke
Test Conditions:	Tnom: 21°C, Unom: 120V AC (AC/DC adaptor)
LISN:	ESH3-Z5 (L)
Mode:	Mode# 1
Test Date:	2019-03-08
Note:	

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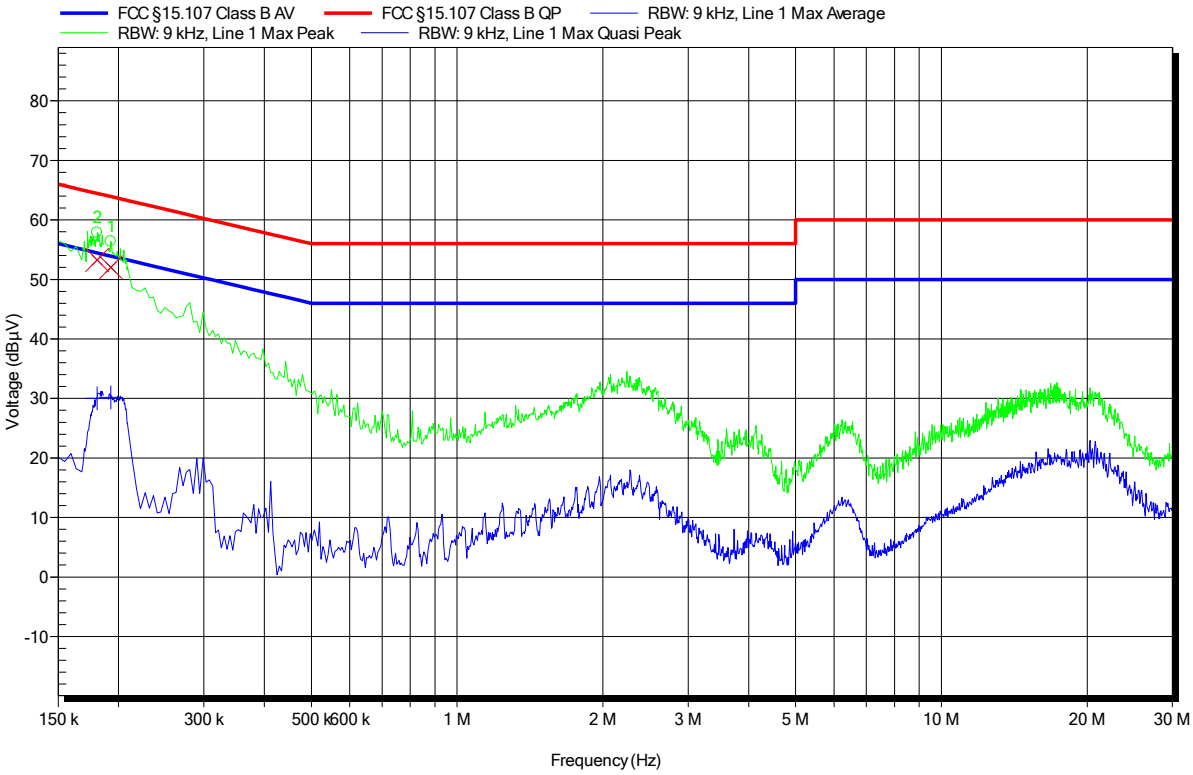

Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status
1	192.75 kHz	52 dBµV	63.92 dBµV	-11.92 dB	Pass
2	180.6 kHz	53.25 dBµV	64.46 dBµV	-11.21 dB	Pass

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status
1	192.75 kHz	30.16 dBµV	53.92 dBµV	-23.76 dB	Pass
2	180.6 kHz	29.99 dBµV	54.46 dBµV	-24.47 dB	Pass