TEST REPORT # EMCC-160578AB, 2017-10-23

EQUIPMENT UNDER TEST:

Device:	Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial Number:	#4, #6
Application:	Wireless Router
FCC ID:	2AMAP-BT11021000EN
IC:	22784-BT11021000C
Manufacturer:	SC Bitdefender SRL
Address:	24 Delea Veche St. Offices Building A, floor 7, district 2 024102 Bucharest Romania
Phone :	+40 212 063 470
RELEVANT STANDARD(S) :	47 CFR § 15.407 RSS-247 Issue 2

MEASUREMENT PROCEDURE:

☒ ANSI C63.10-2013 ☒ RSS-Gen Issue 4 ☒ 789033 D02 General UNII Test Procedures New Rules v01r04

TEST REPORT PREPARED BY:

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TEST PERSONNEL:

Ludwig Kraft Patrick Reusch Manuel Zenk

HEAD OF COMMERCIAL EMC AND RADIO DEPT.:

Wolfgang Döring

CONTENTS

1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance with the 47 CFR § 15.407 and RSS-247 Issue 2 requirements for the certification of licence-exempt Intentional Radiator.

1.2 Limits and Reservations

The test results in this report apply only to the particular equipment under test (EUT) as declared in this report. This test report shall not be reproduced except in full without the written permission of EMCCons DR. RAŠEK GmbH & Co. KG.

1.3 Test Location

Test Laboratory:	EMCCons DR. RAŠEK GmbH & Co. KG
DAkkS Accreditation No.:	D-PL-12067-01-02
Address of Labs I, II, III and Head Office:	EMCCons DR. RAŠEK GmbH & Co. KG Boelwiese 8 91320 Ebermannstadt GERMANY
Address of Labs IV and V:	EMCCons DR. RAŠEK GmbH & Co. KG Stoernhofer Berg 15 91364 Unterleinleiter GERMANY
Laboratory:	Test Laboratory IV The 3 m & 10 m semi-anechoic chamber site has been fully described in a report submitted to ISED. This 3m/10m alternative test side is approved by Innovation, Science and Economic Development Canada under file number 3464C-1.
Phone:	+49 9194 7262-0
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E-Mail:	emc.cons@emcc.de
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1.4 Customer

Company Name:	Borea d.o.o
Street:	Mlaka 1 b
City:	4275 Begunje
Country:	SLOVENIA
Name for contact purposes:	Mr Matevz Langus
Phone:	+386 599 28590
Fax:	---
E-Mail:	matevz.langus@borea.si

1.5 Manufacturer

Company Name:	SC Bitdefender SRL
Street:	24 Delea Veche St. Offices Building A, floor 7, district 2
City:	024102 Bucharest
Country:	Romania

1.6 Dates and Test Location

Date of receipt of EUT:	2017-08-11 (#4)
	2017-09-04 (#6)
	2017-09-14 (#6, redelivery after modification)
Test Date:	see table below
Test Location:	Lab IV

1.7 Ordering Information

Purchase Order:	106/2017
Date:	2017-06-12
Vendor Number:	none

1.8 Climatic Conditions

Date	Temperature [°C]	Relative Humidity [%]	Air Pressure [hPa]	Lab	Customer attended tests
2017-09-05	22	49	979	IV	Yes, Mr Cadez and Mr Rahne
2017-09-06	23	54	974	IV	Yes, Mr Cadez and Mr Rahne
2017-09-07	23	51	976	IV	Yes, Mr Cadez and Mr Rahne
2017-09-08	23	50	970	IV	Yes, Mr Cadez and Mr Rahne
2017-09-13	22	51	966	IV	Yes, Mr Cadez
2017-09-14	22	52	965	IV	Yes, Mr Cadez
2017-09-15	22	50	973	IV	Yes, Mr Cadez
2017-10-04	22	48	982	IV	Yes, Mr Rahne
2017-10-05	22	46	968	IV	Yes, Mr Rahne
2017-10-06	22	46	975	IV	Yes, Mr Rahne
2017-10-19	24	44	974	IV	No
2017-10-20	23	45	974	IV	No

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

The following data is based on customer's information.

Trade Name:	Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial Number:	#4, #6
No. of Variants:	0
Application:	Wireless Router
Hardware Version:	BT11021000
Firmware Version:	2.0.1-22~7246625
FCC ID:	2AMAP-BT11021000EN
IC:	22784-BT11021000C
Radio Standard(s):	IEEE 802.11a/b/g/n/ac (b/g in 2.4 GHz range only; not subject of this report)
Frequency Range(s):	2400 – 2483.5 MHz (not subject of this report) 5150 – 5250 MHz 5725 – 5825 MHz
Tested channels:	Refer to test chapters
Modulation:	CCK (2.4 GHz range, only; not subject of this report) OFDM
Nominal Bandwidth(s):	20 MHz 40 MHz 80 MHz
Power Supply:	12 V_{DC} via external AC/DC power supply
Ports:	2x Ethernet
Antenna and max. Gain:	# 1: 4.2 dBi, type: N2420DGY-T-PK1-G90S4 # 2: 4.8 dBi, type: N2410DSY-T8B-PK1-G80S4 # 3: 5.2 dBi, type: N2410DSMY-T8B-PK1-G80S4
Operating Temperature Range:	0 °C – 35 °C
Remarks:	None

2.2 Intended Use

The following information was delivered by the customer:

Bitdefender BOX 2 Smart Home Cybersecurity Hub is used as a security device for home LAN network. It is placed between WAN and LAN networks. It checks all IP packets passing through it and looks for malicious contents. It provides protection for wired and wireless LAN networks.

2.3 EUT Peripherals/Simulators

A standard notebook was used to set up test modes and generating data traffic via Ethernet connection.

2.4 Mode of Operation during Testing and Test Set-up

According to customer's information the equipment under test (EUT) was operated during the tests under the following conditions:

Continuous Transmission:
The EUT was continuously transmitting modulated data at maximum power.
The setting was performed by scripts loaded into the device by the customer.
The scripts for WiFi setup were using iwpriv interface of the WiFi driver for access to the driver configuration.
With iwpriv commands parameters such as channel, modulation, speed, bandwidth, power were changed according to test scenario requirements.

The following modes of operation have been used for testing:

Mode	Nominal BW	Modulation	Channel	Nominal Frequency	Initial Power Setting (dBm)	Final Power Setting (dBm)
VHT20	20 MHz	OFDM	36	5180 MHz	16.5	14.5
			48	5240 MHz	16.5	14.5
			165	5825 MHz	16.5	16.5
VHT40	40 MHz	OFDM	38	5190 MHz	16.5	11.0
			159	5795 MHz	16.5	16.5
VHT80	80 MHz	OFDM	42	5210 MHz	16.5	8.5
			155	5775 MHz	16.5	16.5

2.5 Modifications Required for Compliance

According to customer's information the following modifications and settings have been used during the tests:

1) Use of CAT 6 Ethernet cables

2) Ceramic heatsinks
Initial hardware was using Aluminium heatsinks for the WiFi chipsets. Aluminium heatsinks radiated frequencies, which supposed to be internal to the WiFi chipset. Due to this, we replaced Aluminium heatsinks on the WiFi chipsets with ceramic heatsinks. The product will use ceramic heatsinks on WiFi chipsets.

3) Scripts & Slewrate
Bash scripts were used for configuring WiFi channel, modulation etc. as described in chapter 2.4.
After each boot, a separate script was used which modified the initialization of the CPU. Modifications are as follows:
- slew rates of the digital signals on available interfaces of the CPU were decreased
- applicable internal pull-up or pull-down resistors were enabled inside CPU
- unneeded external clocks, generated from the CPU, were disabled
- blocks of the CPU, which are not needed for the application (like DECT and SATA), were shut down
- unused GPIO signals were put into output direction and into logic state "0"
Modifications made by this script are integrated into all software versions newer than 2.0.1-22~7246625.

4) In order to comply with the restricted band limits at 4500 to 5150 MHz, the rf output power was reduced by the following levels:

Modulation:	VHT20	VHT40	VHT80
Channel:	36	38	42
Reduction of power level by:	2 dB	5.5 dB	8 dB

5) In order to comply with the bandedge limits at channel 48 with VHT20 modulation scheme, the rf output power was reduced by 2 dB.

3 TEST RESULTS SUMMARY

Summary of test results for the following EUT:

Manufacturer: SC Bitdefender SRL
Device: Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No: #4, #6
Modification No: see table below

Requirement	47 CFR Section	RSS Section	Report Section	Modification / Settings	Result
AC POWERLINE CONDUCTED EMISSIONS	§ 15.407; § 15.207	RSS-247; RSS-Gen, 8.8	4	1 – 3	P
RADIATED EMISSIONS 9 kHz – 30 MHz	§ 15.407; § 15.209	RSS-247; RSS-Gen, 8.9	5	1 – 3	P
RADIATED EMISSIONS 30 MHz – 1000 MHz	§ 15.407; § 15.209	RSS-247; RSS-Gen, 8.9	6	1 – 3	P
RADIATED EMISSIONS 1 – 40 GHz	§ 15.407; § 15.209	RSS-247, 5.5; RSS-Gen, 8.9	7	1 – 3	P
EMISSIONS IN RESTRICTED BANDS	§ 15.407	RSS-247, 6.2	8	1 – 4	P
BANDEDGE MEASUREMENTS IN NONRESTRICTED BANDS	§ 15.407	RSS-247, 6.2	9	1 – 3, 5	P
EMISSION BANDWIDTH	§ 15.407	RSS-247, 6.2	10	1 – 3	P
MAXIMUM CONDUCTED OUTPUT POWER	§ 15.407	RSS-247, 6.2	11	1 – 3	P
MAXIMUM CONDUCTED POWER SPECTRAL DENSITY	§ 15.407	RSS-247, 6.2	12	1 – 3	P
FREQUENCY STABILITY	§15.215 § 15.407	N.A.	13	1 – 3	P

P – Passed; F – Failed; N.A. – not applicable; N.T. – Not tested acc. to applicant's order.

The client has made the determination that EUT condition, characterization, and mode of operation are representative of production units and meet the requirements of the specifications referenced herein. Consistent with industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) are factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known industry standards and regulations.
The measurements contained in this report were made in accordance with the procedures described in ANSI C63.10-2013 and all applicable public notices received prior to the date of testing. All requirements were found to be within the limits outlined in this report.

The test results in this report apply only to the particular equipment under test (EUT) as declared in this report.

Test Personnel: Ludwig Kraft, Patrick Reusch, Manuel Zenk
Issuance Date: 2017-10-23

4 AC POWERLINE CONDUCTED EMISSIONS

Test Requirement: 47 CFR, § 15.407, § 15.207
RSS-247; RSS-Gen, 8.8
Test Procedure: ANSI C63.10

4.1 Regulation

§15.407 General technical requirements.
(b) Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:
(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

§15.207 Conducted limits.
(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

RSS-247, 3.1 RSS-Gen compliance
RSS-247 shall be used in conjunction with RSS-Gen, General Requirements for Compliance of Radio Apparatus, for general specifications and information relevant to the equipment for which this standard applies.

RSS-Gen, 8.8 AC Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus
A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits in Table 3.
Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in Table 3 below. The more stringent limit applies at the frequency range boundaries.
The conducted emissions shall be measured in accordance with the reference publication mentioned in Section 3.

Table 3 — AC Power Line Conducted Emissions Limits		
Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

4.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	1	n/a	n/a
EMI Test Receiver	R&S / ESIB40	516	2017-03	2018-03
V-LISN	Schwarzbeck / NNLA8119	1469	2015-11	2017-11
Pulse Limiter	R&S / ESH3-Z2 357.8810.52	1519	2017-10	2019-10
Shielded Cabinet	EMCC / SC2-ULL	1890	n/a	n/a
V-LISN	R&S / ESH2-Z5	1901	2017-10	2019-10
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Notebook	Dell / Latitude E6430	4524	n/a	n/a
EMC Measurement Software	R&S / EMC32 v 10.0.0	5392	n/a	n/a
BNC cable	EMCC / BNC003m0	5551	2017-05	2018-05

4.3 Test Procedures

ANSI C63.10-2013, 6.2.2 Measurement requirements

[…] Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The excess length of the power cord between the EUT and the LISN receptacle (or ac power receptacle where a LISN cannot be used), or an adapter or extension cord connected to and measured with the LISN, shall be folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length; see figure 4. If the EUT does not have a flexible power lead, then the EUT shall be placed at a distance of 80 cm from the LISN (or power receptacle where a LISN cannot be used) and connected thereto by a power lead or appropriate connection no more than 1 m long. The measurement shall be made at the LISN end of this power lead or connection.

6.2.3.2.2 Placement of tabletop EUTs

A stand-alone EUT shall be placed in the center along the back edge of the tabletop. For multiunit tabletop systems, the EUT shall be centered laterally (left to right facing the tabletop) on the tabletop and its rear shall be flush with the rear of the table.

Accessories that are part of an EUT system tested on a tabletop shall be placed in a test arrangement on one or both sides of the host with a 10 cm separation between the nearest points of the cabinets (see figure 5).

The rear of the host and accessories shall be flush with the back of the supporting tabletop unless that would not be typical of normal use. If more than two accessories are present, then an equipment test arrangement shall be chosen that maintains 10 cm spacing between cabinets unless the equipment is normally located closer together. Multiple accessories (more than two) may be distributed around the table as shown in figure 5.

Accessories, such as ac power adapters, which are typically table mounted because of cable length, shall be mounted on the tabletop in a typical manner. Accessories, which are typically floor mounted, shall occupy a floor position directly below the portion of the EUT to which they are typically connected. Power accessories such as ac power adapters (battery eliminators), which power other devices, shall be tested per the following provisions:

a) Power accessories that are not the EUT are configured as follows:

1) If the power accessory connects to a tabletop EUT having a power cord to the power accessory less than 80 cm in length, then the power accessory is placed on the tabletop. If the length of the EUT power cord to the power accessory is 80 cm or greater, then the power accessory is placed on the floor immediately under the EUT.

2) If the power accessory plugs directly into the wall outlet, then it shall be attached to the source of power on top of the ground plane and directly under the EUT with the EUT connected. If the length of the EUT power cord is less than 80 cm, then a nonconductive support for raising the power accessory is needed, along with a short extension cord from the source of power to the raised power accessory.

4.4 Test Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line
0.1731	58.33	---	64.81	6.48	L1
0.1731	---	44.22	54.81	10.59	L1
0.1733	58.63	---	64.8	6.17	L1
0.1733	---	41.88	54.8	12.92	L1
0.1767	59.84	---	64.64	4.8	L1
0.1767	---	43.95	54.64	10.69	L1
0.1769	59.59	---	64.63	5.04	L1
0.1769	---	43.38	54.63	11.25	L1
0.1771	59.85	---	64.62	4.77	L1
0.1771	---	43.62	54.62	11	L1
0.1773	59.81	---	64.61	4.8	L1
0.1773	---	43.42	54.61	11.19	L1
0.1881	57.3	---	64.12	6.82	L1
0.1881	---	42.22	54.12	11.9	L1
0.1919	56.55	---	63.95	7.4	L1
0.1919	---	41.31	53.95	12.64	L1
0.1957	55.68	---	63.79	8.11	L1
0.1957	---	40.84	53.79	12.95	L1
0.1959	55.64	---	63.78	8.14	L1
0.1959	---	40.71	53.78	13.07	L1
0.1997	54.82	---	63.62	8.8	L1
0.1997	---	40.45	53.62	13.17	L1
0.2569	41.56	---	61.53	19.97	N
0.2571	41.89	---	61.53	19.63	N
0.2611	42.71	---	61.4	18.69	N
0.3601	40.25	---	58.73	18.48	L1
0.3641	40.1	---	58.63	18.53	L1

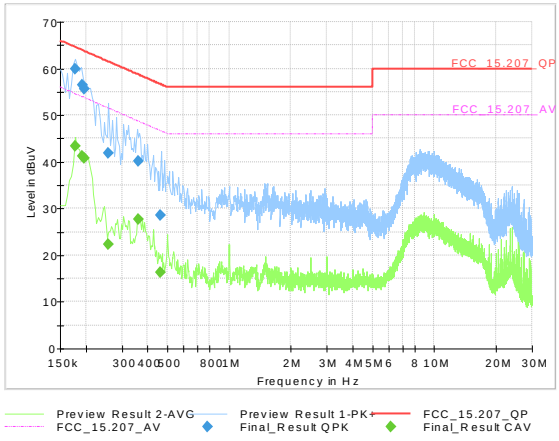
Worst case results listed, only.

Manufacturer:	SC Bitdefender SRL
Device:	Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No:	#6
Modification:	1 - 3
Test date:	2017-10-04
Tested by:	P. Reusch

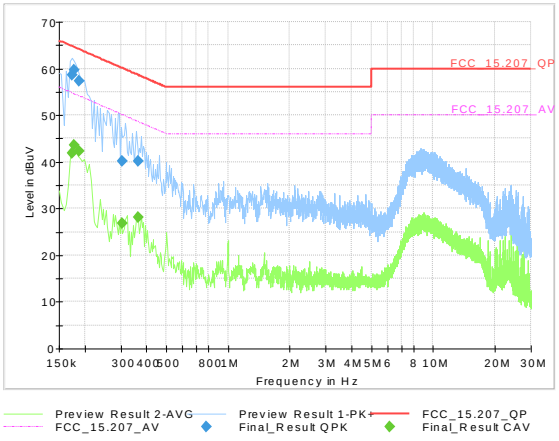
The EUT meets the requirements of this section.

4.5 Detailed Measurement Data

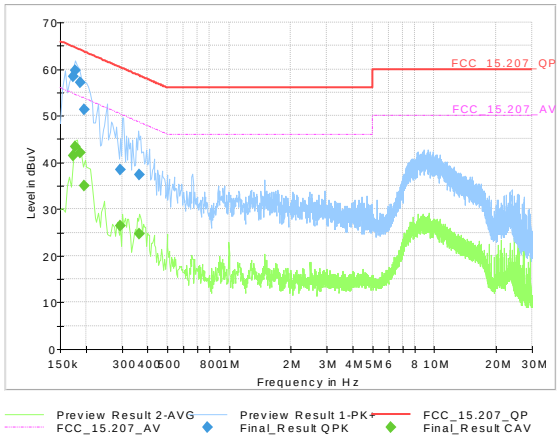
Channel: 36
Mode: VHT20



Channel: 165
Mode: VHT20



Channel: 38
Mode: VHT40



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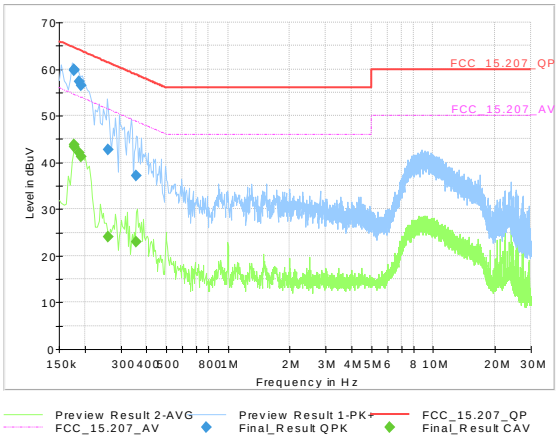
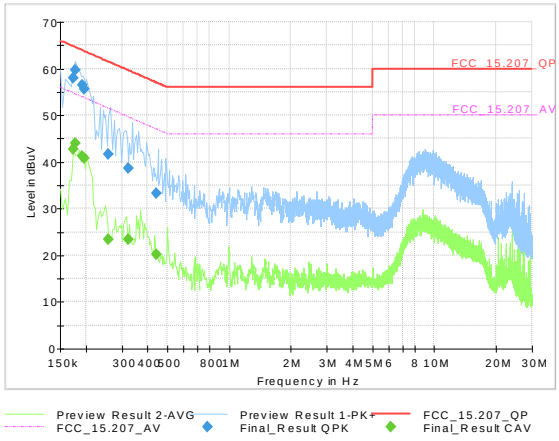
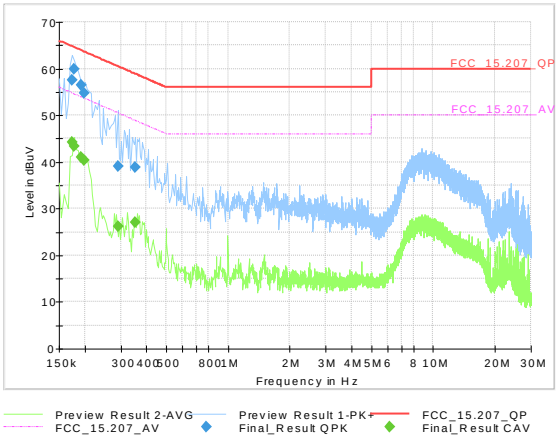
Mode: VHT40



Channel: 42
Mode: VHT80



Channel: 155
Mode: VHT80



5 RADIATED EMISSIONS 9 kHz – 30 MHz

Test requirement: 47 CFR, §§ 15.407, 15.209
RSS-247; RSS-Gen, 8.9
Test procedure: ANSI C63.10

5.1 Regulation

§15.407 General technical requirements.
(b) Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:
(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.
(7) The provisions of §15.205 apply to intentional radiators operating under this section.
(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

§15.209 Radiated emission limits; general requirements
(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency	Field Strength		Measurement Distance
[MHz]	[µV/m]	[dB(µV/m)]	[m]
0.009–0.490	2400/F[kHz]	67.6 – 20 logF[kHz]	300
0.490–1.705	24000/F[kHz]	87.6 – 20 logF[kHz]	30
1.705–30.0	30	29.5	30

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band-edges.
(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

RSS-247, 3.1 RSS-Gen compliance
RSS-247 shall be used in conjunction with RSS-Gen, General Requirements for Compliance of Radio Apparatus, for general specifications and information relevant to the equipment for which this standard applies.

RSS-Gen, 8.9 Transmitter Emission Limits for Licence-Exempt Radio Apparatus

Except when the requirements applicable to a given device state otherwise, emissions from licence‑exempt transmitters shall comply with the field strength limits shown in Table 4 and Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

Table 5 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Below 30 MHz

Frequency	Electric Field Strength (µV/m)	Magnetic Field Strength (H-Field) (µA/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1,705-30 MHz	30	N/A	30

Note: The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector. Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the relevant RSS.

5.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	1	n/a	n/a
Loop Antenna	R&S / HFH 2-Z2	374	2016-07	2018-07
Anechoic Room SAC, SR-ULL-01	EMCC/FRANK / SAC-10	1889	n/a	n/a
EMI Test Receiver	R&S / ESU8	3846	2017-01	2018-01
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
EMC Measurement Software	R&S / EMC32 v10.0.0	5392	n/a	n/a

5.3 Test Procedures

ANSI C63.10, 5.3.2 Test distance for frequencies below 30 MHz
Radiated emissions limits are usually defined at a specific distance from the EUT. Where possible, measurements shall be made at the distance specified in the limits. This might not be possible in all cases, however, due to the physical limitations of the test facility, physical access problems at the required distance (especially for measurements that must be made in situ or on-site), or levels of ambient noise or other radiated signals present at the time and location where measurements are made. See 6.4.3 for more information about antenna selection, location, and test distance. If measurements cannot practically be made at the EUT limit distance, then they may be made at a different distance (usually closer) and extrapolated to the limit distance using one of the procedures described in 6.4.4, 6.4.5, or 7.7, depending on the EUT source and size.31 The test report shall specify the extrapolation method used to determine compliance of the EUT.

ANSI C63.10, 6.4.6 Exploratory radiated emission tests
The tests shall be performed in the frequency range specified in 5.5 and 5.6, using the procedures in clause 5, applying the appropriate modulating signal to the EUT, to determine cable or wire positions of the EUT system that produce the emission with the highest amplitude relative to the limit.
Exploratory measurements below 30 MHz are useful in determining the maximum level of emissions while manipulating and rotating the EUT; however, exploratory and final measurements may be made concurrently, provided care is taken to determine the maximum level of emissions for all configurations and orientations.
The test arrangement, measuring antenna guidelines and operational configurations in 6.3.1 and 6.3.2, shall be followed. The measurement antenna shall be positioned with its plane perpendicular to the ground at the specified distance. When perpendicular to the ground plane, the lowest height of the magnetic antenna shall be 1 m above the ground and shall be positioned at the specified distance from the EUT.50 When the EUT contains a loop antenna that can only be placed in a vertical axis, normal measurements shall be made aligning the measurement antenna along the site axis, and then orthogonal to the axis. For each measurement antenna alignment, the EUT shall be rotated through 0° to 360° on a turntable. When the EUT contains a loop antenna that can be placed in a horizontal or vertical axis, normal measurements shall be made aligning the measurement antenna along the site axis, orthogonal to the axis, and then with the measurement antenna horizontal. For each measurement antenna alignment, the EUT shall be rotated through 0° to 360° on a turntable. The report shall list the six emissions with the smallest margin relative to the limit, for each of the three antenna orientations (parallel, perpendicular, and ground-parallel) unless the margin is greater than 20 dB, then the following statement shall be made: “all emissions were greater than 20 dB below the limit.”

ANSI C63.10, 6.4.7 Final radiated emission tests
Using the orientation and equipment arrangement of the EUT determined in 6.4.6, and applying the appropriate modulating signal to the EUT, perform final radiated emission measurements on the fundamental and highest spurious emissions.

Unless otherwise specified by the regulatory authority, the instrumentation, detector functions, and bandwidths specified in 4.1.4.2.1 shall be used. For pulsed emissions, the procedure in 4.1.4.2.4 shall be used.

Radiated Emissions Test Characteristics	
Frequency range	9 kHz - 30 MHz
Test distance	3 m*
Test instrumentation resolution bandwidth	200 Hz (9 kHz - 150 kHz)
	10 kHz (150 kHz - 30 MHz)
Receive antenna height	1 m
Receive antenna polarization	Vertical, two orientations
Measurement location	Semi Anechoic Chamber (SAC)

* According to Section 15.31 (f)(2): At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The 40 dB/decade factor was used.

5.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits for the restricted band 2.1735 - 2.1905 MHz:

30 µV/m at 30 meters

Using the equation:

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

where

$E_{dB\mu V/m}$ = Field Strength in logarithmic units (dBµV/m)

$E_{\mu V/m}$ = Field Strength in linear units (µV/m)

A field strength limit of 30 µV/m corresponds with 29.5 dBµV/m.

5.5 Field Strength Calculation

All emission measurements described in this chapter performed using the EMI test program transducer factor setting capability, i.e. the field strength value at the test distance was measured directly without the necessity of additional correction factors.
For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f)(2) the field strength result is calculated by adding additionally an extrapolation factor of 40 dB/decade (inverse linear-distance for field strength measurements). The basic equation with a sample calculation is as follows:

FS = FST + DF

where
FS = Field Strength in dBµV/m
FST = Field Strength at test distance in dBµV/m
DF = Distance Extrapolation Factor in dB,
where DF = 40 log (Dtest/Dspec) where Dtest = Test Distance and Dspec = Specified distance

Assuming the tests performed at a Reduced Test Distance of 3 m instead of the Specified Distance of 300 m giving a Distance Extrapolation Factor of DF = 40 log (3 m/300 m) = -80 dB.

Assuming a measured field strength of 55.8 dBµV/m (reading 35.8 dBµV and antenna factor 20 dB(1/m)) is obtained. The Distance Factor of -80 dB is added, giving a field strength of -24.2 dBµV/m. The -24.2 dBµV/m value can be mathematically converted to its corresponding level in µV/m.
FS = 55.8 - 80 = -24.2 [dBµV/m]
Level in µV/m = Common Antilogarithm (-24.2/20) = 0.06

5.6 Final Test Results

Prior to the test, some investigation measurements in both frequency ranges (2.4 GHz and 5 GHz) were performed to figure out the worst case mode. This worst case mode was used for the final measurement.

Freq. [MHz]	Meas. Det. [QPK / AVG]	Result @ 3m [dB(µV/m)]	Limit @ 3m [dB(µV/m)]	Margin [dB]
		All emissions found were more than 20 dB below the limit.		

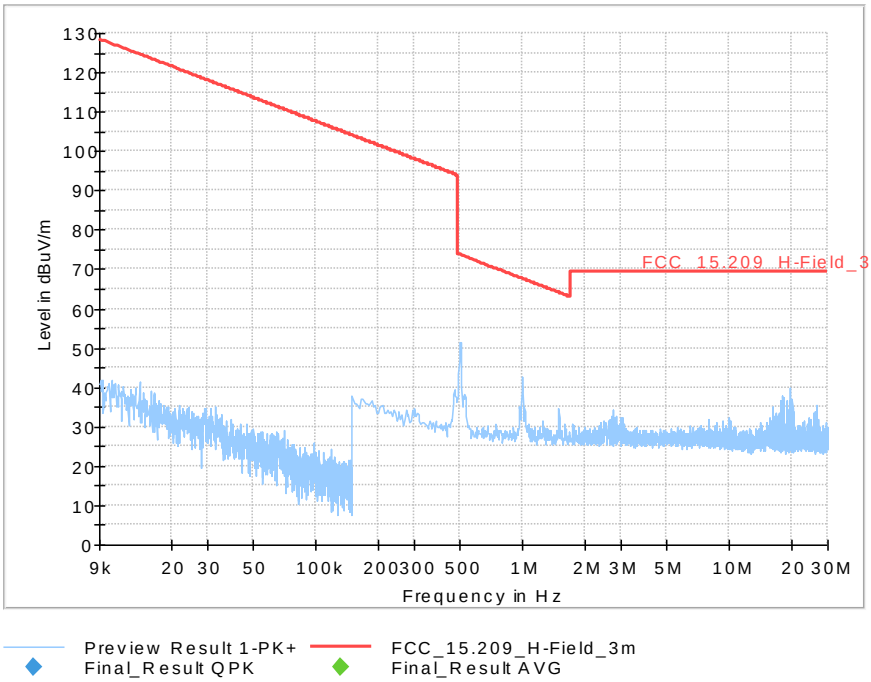
Manufacturer: SC Bitdefender SRL
Device: Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No: #6
Modification No: 1 - 3
Test date: 2017-09-07
Tested by: L. Kraft

The EUT meets the requirements of this section.

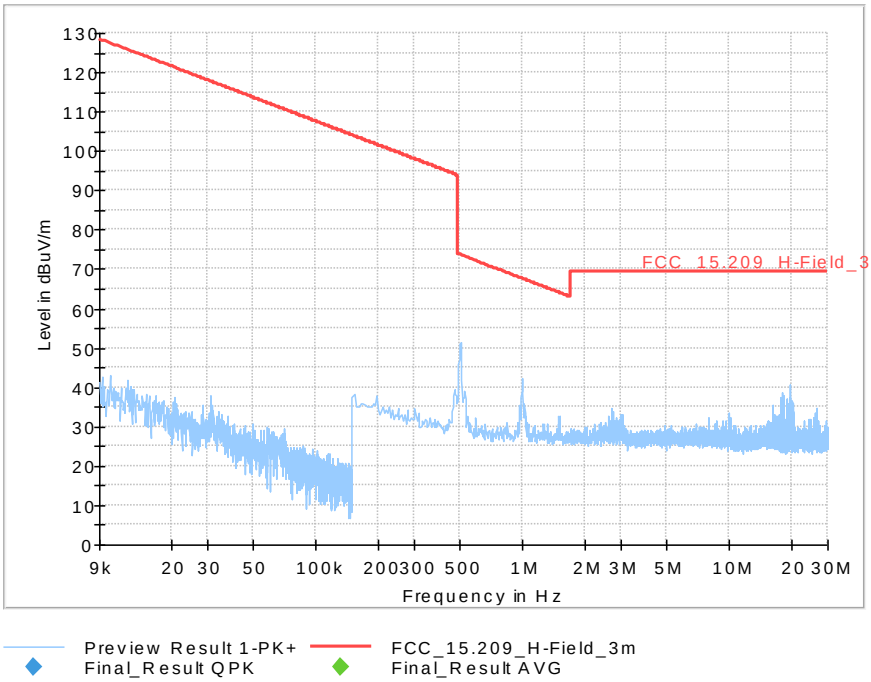
5.7 Detailed Measurement Data

Measurement was performed at 3 m distance. Plots show field strength reading at 3 m distance.
In order to compare the 3 m reading with the specified field strength limits a distance correction as described in 5.5 (40 dB/decade) was applied to the limit (represented by the limit line „FCC_15.209_HField_3m“).

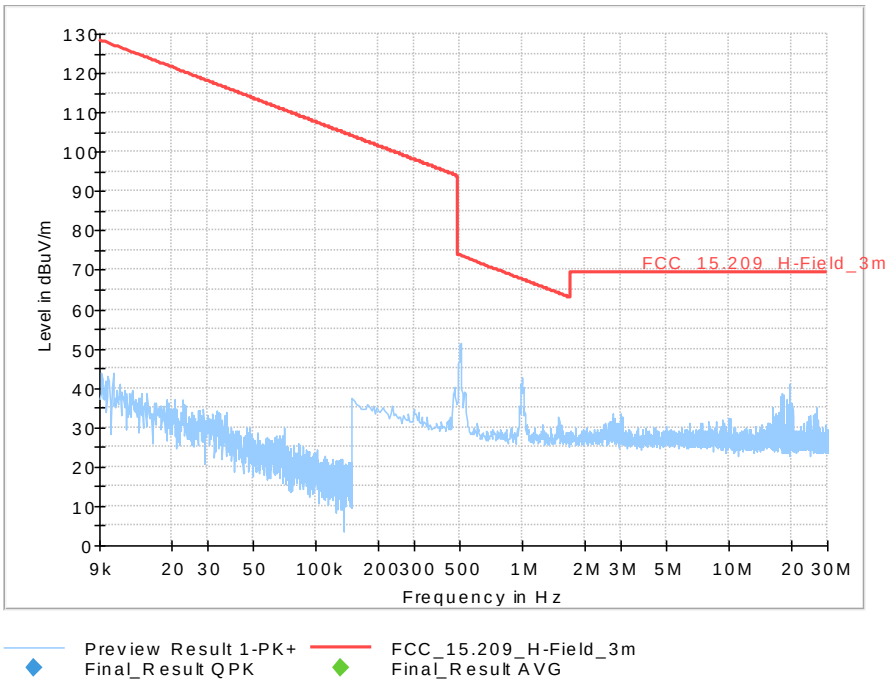
Radiated Emissions 9 kHz – 30 MHz
Mode: VHT20



Radiated Emissions 9 kHz – 30 MHz
Mode: VHT40



Radiated Emissions 9 kHz – 30 MHz
Mode: VHT80



6 RADIATED EMISSIONS 30 MHz – 1000 MHz

Test requirement: 47 CFR, §§ 15.407, 15.209
RSS-247; RSS-Gen, 8.9
Test procedure: ANSI C63.10

6.1 Regulation

§15.407 General technical requirements.
(b) Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:
(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.
(7) The provisions of §15.205 apply to intentional radiators operating under this section.
(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

§15.209 Radiated emission limits; general requirements
(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency	Field Strength	Measurement Distance
[MHz]	[µV/m]	[m]
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band-edges.
(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

RSS-247, 3.1 RSS-Gen compliance
RSS-247 shall be used in conjunction with RSS-Gen, General Requirements for Compliance of Radio Apparatus, for general specifications and information relevant to the equipment for which this standard applies.

RSS-Gen, 8.9 Transmitter Emission Limits for Licence-Exempt Radio Apparatus
Except when the requirements applicable to a given device state otherwise, emissions from licence‑exempt transmitters shall comply with the field strength limits shown in Table 4 and Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz	
Frequency (MHz)	Field Strength (µv/m at 3 metres
30-88	100
88-216	150
216-960	200
Above 960	500

Footnote
Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

6.2 Test Equipment

Type	**Manufacturer/ Model No.**	**EMCC Ident No.**	**Last Calibration**	**Next Calibration**
60-Hz-Converter	AEG / DAMK4/DAGK4	1	n/a	n/a
Anechoic Room SAC, SR-ULL-01	EMCC/FRANK / SAC-10	1889	n/a	n/a
Log Per. Antenna	Schwarzbeck / VUSLP 9111B	3203	2017-01	2019-01
EMI Test Receiver	R&S / ESU8	3846	2017-01	2018-01
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
EMC Measurement Software	R&S / EMC32 v10.0.0	5392	n/a	n/a
VHF Test Dipole	Schwarzbeck / VHBB 9124	5531	2017-06	2019-06

6.3 Test Procedures

ANSI C63.10, 6.3.1 Test arrangement
[..] Tabletop devices shall be placed on a non-conducting platform with nominal top surface dimensions 1 m by 1.5 m. For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m (see 6.6.3.1). A method for evaluating the effects of the table on EUT radiated emissions is given in 5.5 of CISPR 16-1-4:2010 for frequencies up to 18 GHz. The EUT shall be set up in its typical configuration and arrangement and operated in its various modes as described in 5.10. An antenna shall be connected to the EUT in accordance with 5.8 and 5.10.4. The EUT and transmitting antenna shall be centered on the turntable. For devices with multiple antennas that are active simultaneously, the EUT shall be positioned, to the extent possible, with the antennas equally distributed around the center of the device. The exact setup shall be documented in the test report.
Any controlling device (e.g., notebook, laptop, or desktop computer) shall be positioned such that it shall not significantly influence the measurement results. No other peripherals are required to be connected to the controlling device for this test unless the radio is being tested as part of the notebook or PDA qualifications.

ANSI C63.10, 6.5.3 Exploratory radiated emission tests
Exploratory measurements are used to identify the frequencies and amplitudes of the emissions while manipulating and rotating the EUT.
Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT. At near distances, for EUTs of comparably small size, it is relatively easy to determine the spectrum signature of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. Exploratory measurements shall be made on a test site per 5.2. Shielded rooms, not treated with RF absorption material, shall not be used for exploratory measurements.
For each mode of operation required to be tested, the frequency spectrum shall be monitored. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations.

ANSI C63.10, 6.5.4 Final radiated emission tests
Using the orientation and equipment arrangement of the EUT, and based on the measurement results found during the exploratory measurement in 6.5.3, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable) and the frequency and amplitude of the six highest spurious emissions relative to the limit; emissions more than 20 dB below the limit do not need to be reported.
Measurements are performed with the EUT rotated from 0° to 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement shall be explored to maximize the measured emissions.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz – 1000 MHz
Test distance	3 m
Test instrumentation resolution bandwidth	120 kHz
Receive antenna height	1 m - 4 m
Receive antenna polarization	Vertical/Horizontal

6.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits in restricted bands (e.g. 108 to 121.94 MHz (FCC) or 108 to 138 MHz (ISED)) acc. to §15.209 for the frequency band 88-216 MHz:

150 µV/m at 3 meters

Using the equation:

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

where

$E_{dB\mu V/m}$ = Field Strength in logarithmic units (dBµV/m)

$E_{\mu V/m}$ = Field Strength in linear units (µV/m)

A field strength limit of 150 µV/m corresponds with 43.5 dBµV/m.

6.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF

where

FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB

Assuming a receiver reading of 23.5 dBµV is obtained. The Antenna Factor of 7.4 dB(1/m) and a Cable Factor of 1.1 dB are added, giving a field strength of 32 dBµV/m. The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 = 32 [dBµV/m]

Level in µV/m = Common Antilogarithm (32/20) = 39.8

Remark: All emission measurements described in this chapter performed using the EMI test program transducer factor setting capability, i.e. the field strength value at the test distance was measured directly without the necessity of additional correction factors.

6.6 Final Test Results

Frequency [MHz]	Result [dBµV/m]	Limit * [dBµV/m]	Margin [dB]	Remarks
68.10	23.9	40.0	16.1	
99.02	29.3	43.5	14.2	
151.02	30.4	43.5	13.1	
250.00	32.4	46.0	13.6	
275.02	31.9	46.0	14.1	
325.02	36.9	46.0	9.1	
375.02	37.9	46.0	8.1	
500.02	33.8	46.0	12.2	

All tests performed at 3 m distance. The table above contains worst-case emissions, only. For further details refer to the detailed measurement data.

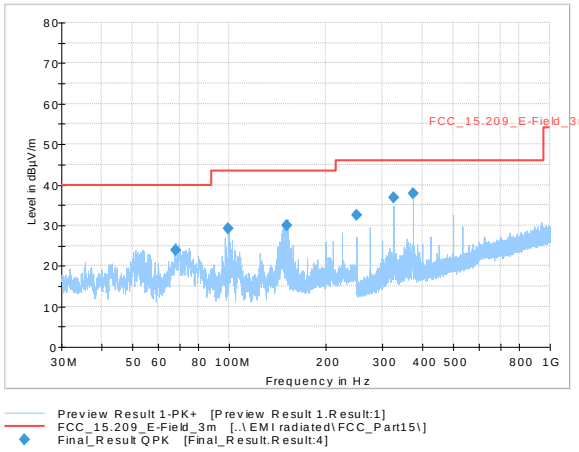
* Note: Limits acc. to 47 CFR §15.209 resp. RSS-Gen 8.9 were used as worst case consideration.

Manufacturer:	SC Bitdefender SRL
Device:	Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No:	#6
Modification No:	1 -3
Test date:	2017-09-05/06
Tested by:	L. Kraft / P. Reusch

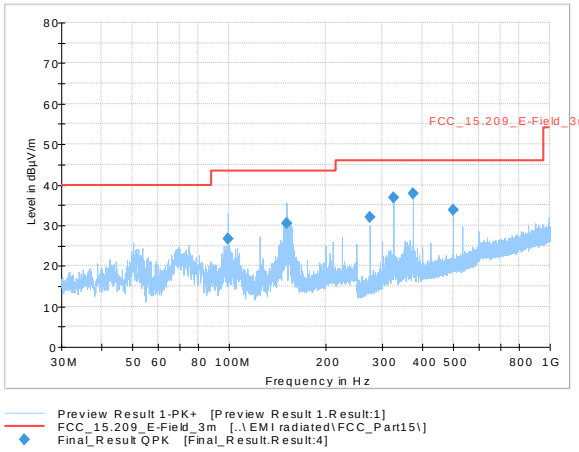
The EUT meets the requirements of this section.

6.7 Detailed Measurement Data

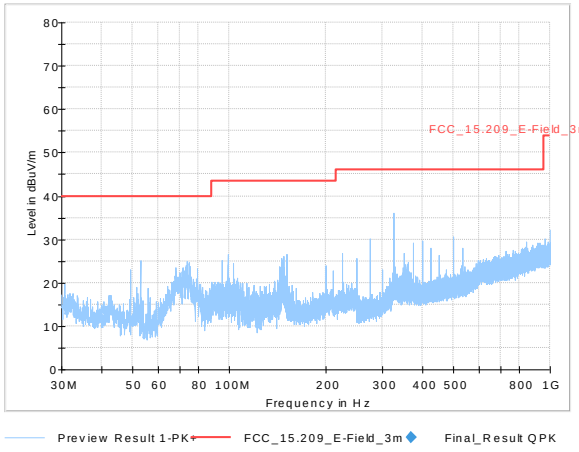
Radiated Emissions 30 – 1000 MHz
Channel: 36
Mode: VHT20



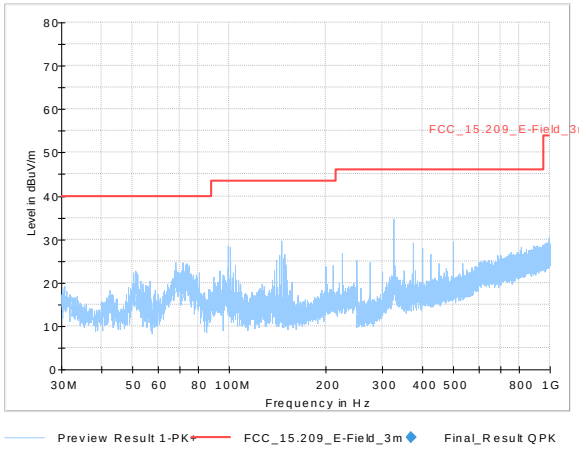
Radiated Emissions 30 – 1000 MHz
Channel: 165
Mode: VHT20



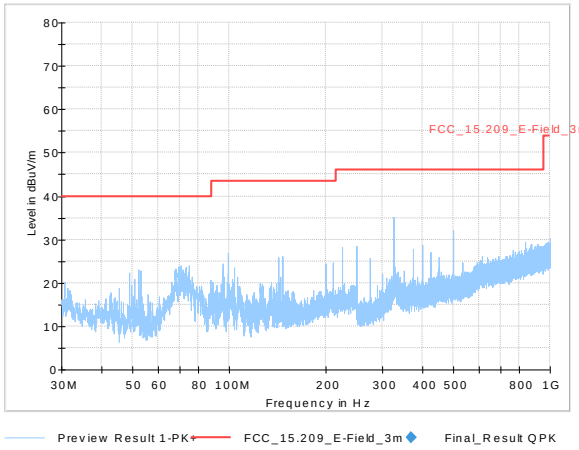
Radiated Emissions 30 – 1000 MHz
Channel: 38
Mode: VHT40



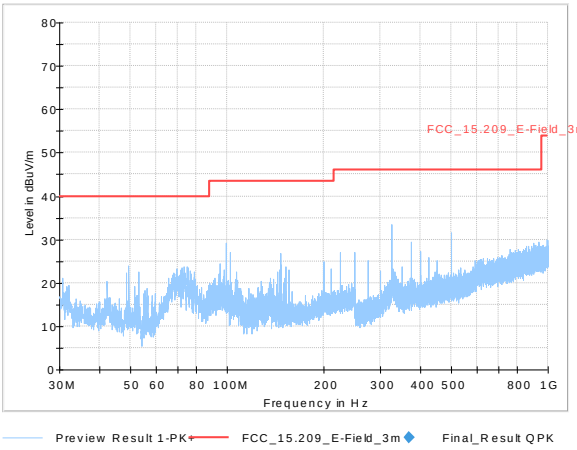
Radiated Emissions 30 – 1000 MHz
Channel: 159
Mode: VHT40



Radiated Emissions 30 – 1000 MHz
Channel: 42
Mode: VHT80



Radiated Emissions 30 – 1000 MHz
Channel: 155
Mode: VHT80



7 RADIATED EMISSIONS 1 – 40 GHz

Test requirement: 47 CFR, §§ 15.407, 15.209
RSS-247, 5.5; RSS-Gen, 8.9
Test procedure: ANSI C63.10

7.1 Regulation

§15.407 General technical requirements.
(b) Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:
(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.
(7) The provisions of §15.205 apply to intentional radiators operating under this section.
(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

§15.209 Radiated emission limits; general requirements
(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency [MHz]	Field Strength [µV/m]	Measurement Distance [m]
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band-edges.
(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

RSS-247, 3.1 RSS-Gen compliance
RSS-247 shall be used in conjunction with RSS-Gen, General Requirements for Compliance of Radio Apparatus, for general specifications and information relevant to the equipment for which this standard applies.

RSS-Gen, 8.9 Transmitter Emission Limits for Licence-Exempt Radio Apparatus

Except when the requirements applicable to a given device state otherwise, emissions from licence‑exempt transmitters shall comply with the field strength limits shown in Table 4 and Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz	
Frequency (MHz)	Field Strength (µv/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960	500

Footnote

Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

7.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	1	n/a	n/a
Octave Bandpass Filter	Microphase / K0919	1035	2017-07	2019-07
Standard Gain Horn Antenna	Mid Century / MC 20/31B	1229	n/a	n/a
Standard Gain Horn Antenna	Mid Century / MC 22/31B	1300	n/a	n/a
Anechoic Room SAC, SR-ULL-01	EMCC/FRANK. / SAC-10	1889	n/a	n/a
K-Cable K/50	Insulated Wire / KPS-1501-600-KPS	3061	2017-05	2018-05
Double Ridged Guide Antenna	Schwarzbeck / BBHA 9120D	3235	2017-05	2019-05
EMI Test Receiver	Rohde & Schwarz / ESU8	3846	2017-01	2018-01
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2017-09	2018-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
High Pass Filter	dBd communications / DBD-FTR-13SH-U8000-O/O	5367	2017-10	2019-10
EMC Measurement Software	Rohde & Schwarz / EMC32	5392	n/a	n/a
RF cable assembly	Rosenberger / LA2-025-7000	5616	2017-09	2018-09

7.3 Test Procedures

ANSI C63.10, 6.6.3.1 Tabletop equipment
For emission measurements above 1 GHz, the EUT shall be placed at a height of 1.5 m above the floor on a support that is RF transparent for the frequencies of interest. The 1.5 m height EUT support shall be constructed using a low permittivity and low loss tangent (tanδ) material with a height of 1.5 m, or a low permittivity and low loss tangent (tanδ) material may be placed on top of a typical table with a height of 0.8 m or 1 m. One typical low-permittivity and low-loss tangent material is styrene. Due to its dielectric properties for frequencies above 1 GHz, the use of styrene or building insulation foam is recommended, rather than, for example, wood. Support equipment shall be placed far enough away from the EUT, such that changes in relative position of the EUT and support equipment do not cause changes in measured values. Final measurements for the EUT require a measurement antenna height scan of 1 m to 4 m.
Where possible, the methods for portable, handheld, or body-worn equipment detailed in 6.6.3.3 may be employed for smaller tabletop equipment to allow the use of shorter cabling between measurement antennas and measuring receiver/spectrum analyzer by restricting the upper height of the measurement antenna.

ANSI C63.10, 6.6.4.2 Exploratory radiated emissions measurements
Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. The frequencies of maximum emission may be determined by manually positioning the antenna close to the EUT, and then moving the antenna over all sides of the EUT while observing a spectral display. It is advantageous to have prior knowledge of the frequencies of emissions, although this may be determined from such a near-field scan. The near-field scan shall only be used to determine the frequency but not the amplitude of the emissions. Where exploratory measurements are not adequate to determine the worst-case operating modes and are used only to identify the frequencies of the highest emissions, additional preliminary tests can be required. Preliminary tests shall be performed following the procedures in 6.3 on a site meeting the requirements of 5.2. For emissions from the EUT, the maximum level shall be determined by rotating the EUT and its antenna through 0° to 360°. For each mode of operation required to be tested, the frequency spectrum (based on findings from exploratory measurements) shall be monitored.

Broadband antennas and a spectrum analyzer or a radio-noise meter with a panoramic display are often useful in this type of test. If either antenna height or EUT azimuth are not fully measured during exploratory testing, then complete testing can be required at the OATS or semi-anechoic chamber when the final full spectrum testing is performed.

ANSI C63.10, 6.6.4.3 Final radiated emissions measurements

The final measurements are performed on a site meeting the requirements of 5.2. Using the orientation and equipment arrangement of the EUT based on the measurement results found during the preliminary (exploratory) measurements per 6.6.4.2, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable), as well as the frequency and amplitude of the six highest spurious emissions relative to the limit. Emissions more than 20 dB below the limit do not need to be reported.

Measurements are performed with the EUT rotated from 0° to 360°; the antenna height scanned in accordance with 6.6.3.1, 6.6.3.2, or 6.6.3.3, as appropriate; and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement shall be explored to maximize the measured emissions.

The emission signal shall be kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT is measured. This may be achieved by either pointing the antenna at an angle toward the source of the emission or by testing the EUT as described in 6.6.3.3.

If the emission is pulsed, then refer to Annex C for guidelines on selecting bandwidth and determining pulse desensitization factors, as necessary.

As noted in 6.6.4.1, when performing these measurements, the sensitivity of the complete measurement system relative to the limit shall be determined before the test. If the overall measurement sensitivity is inadequate, then low-noise preamplifiers, closer measurement distances, higher gain antennas, or narrower bandwidths may be used. If closer measurement distances or higher gain antennas are used, then the beamwidth of the measurement antenna versus the physical size of the EUT shall be taken into account, so that the physical sizes of the EUT dimensions are encompassed by the beamwidth of the measurement antenna. Also, measurement system overload protection shall be determined to be adequate when preamplifiers are used. The effects on the measured emission value using bandwidths different from those specified shall be determined if such bandwidth changes are made. Any changes from the specific measurement conditions shall be described in the report of the measurements.

Radiated Emissions Test Characteristics	
Frequency range	1 GHz – 25 GHz
Test distance	3 m [1)]
Test instrumentation resolution bandwidth	1 MHz
Receive antenna height	1 m – 4 m [2)]
Receive antenna polarization	Vertical/Horizontal

[1)] Explorative measurements performed at closer distance
[2)] Explorative measurements performed without height scan

7.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits acc. to §15.209 for frequencies above 960 MHz:

500 µV/m at 3 meters

Using the equation:

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

where

$E_{dB\mu V/m}$ = Field Strength in logarithmic units (dBµV/m)

$E_{\mu V/m}$ = Field Strength in linear units (µV/m)

A field strength limit of 500 µV/m corresponds with 54 dBµV/m.

7.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF

where

FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB

Assuming a receiver reading of 23.5 dBµV is obtained. The Antenna Factor of 7.4 dB(1/m) and a Cable Factor of 1.1 dB are added, giving a field strength of 32 dBµV/m. The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 = 32 [dBµV/m]
Level in µV/m = Common Antilogarithm (32/20) = 39.8

Remark: All emission measurements described in this chapter performed using the EMI test program transducer factor setting capability, i.e. the field strength value at the test distance was measured directly without the necessity of additional correction factors.

For average measurements, the measured peak field strength is corrected by a Duty Cycle correction factor DCF. Please refer to chapter 2.6 for details.

$FS_{AV} = FS + DCF$

where

FS_{AV} = Average Field Strength in dBµV/m
FS = Peak Field Strength in dBµV/m
DCF = Correction Factor in dB

Assuming a peak field strength of 57.7 dBµV/m, the value for the average field strength with a Duty Cycle correction factor DCF of -32.8 dB corresponds with 24.9 dBµV/m.

7.6 Final Test Results

Radiated Spurious Emissions 1 – 40 GHz – Average Results				
Frequency [MHz]	**Result [dBµV/m]**	**Limit * [dBµV/m]**	**Margin [dB]**	**Remarks**
3453.3	49.3	54	4.7	
3460.0	49.4	54	4.6	
3473.3	49.5	54	4.5	
3850.0	50.9	54	3.1	
3863.3	49.8	54	4.2	
3883.5	48.9	54	5.1	

Remark:
The table above contains worst-case emissions, only. For further details refer to the pre-scan test plots.

* Note: Limits acc. to 47 CFR §15.209 resp. RSS-Gen 8.9 were used as worst case consideration.

Radiated Spurious Emissions 1 – 40 GHz – Peak Results				
Frequency [MHz]	**Result [dBµV/m]**	**Limit * [dBµV/m]**	**Margin [dB]**	**Remarks**
3453.3	54.2	74	19.8	
3460.0	54.4	74	19.6	
3473.3	54.1	74	19.9	
3850.0	54.5	74	19.5	
3863.3	53.6	74	20.4	
3883.5	53.2	74	20.8	

Remark:
The table above contains worst-case emissions, only. For further details refer to the pre-scan test plots.

* Note: Limits acc. to 47 CFR §15.209 resp. RSS-Gen 8.9 were used as worst case consideration.

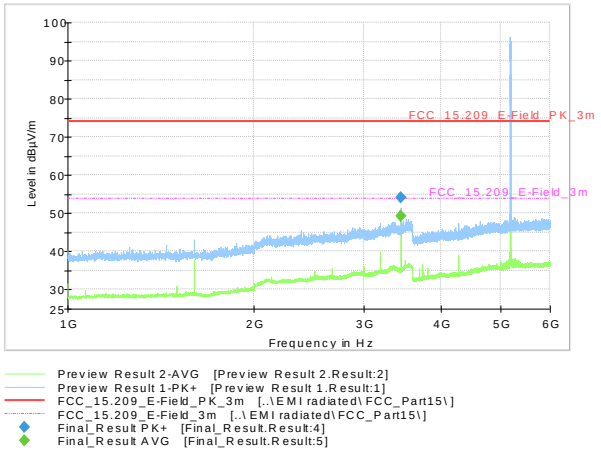
Manufacturer:	SC Bitdefender SRL
Device:	Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No:	#6
Modification No:	1 - 3
Test date:	2017-09-08/13
Tested by:	L. Kraft / M. Zenk

The EUT meets the requirements of this section.

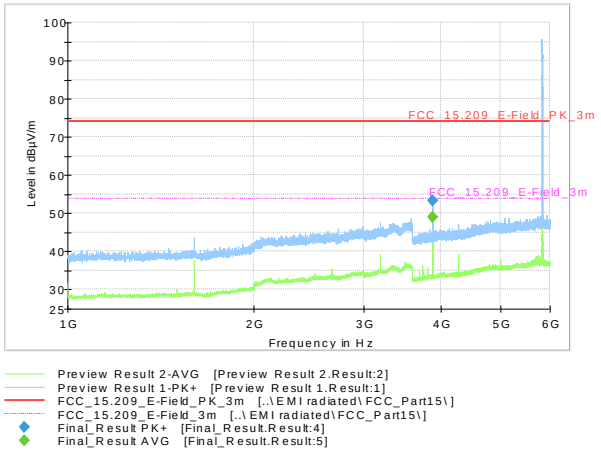
7.7 Detailed Measurement Data

Prescan measurements below 6 GHz were performed at 3 m distance, above 6 GHz measurement was performed as explorative measurement in close distance of approx. 20 cm. All final measurements were performed at 3m distance.

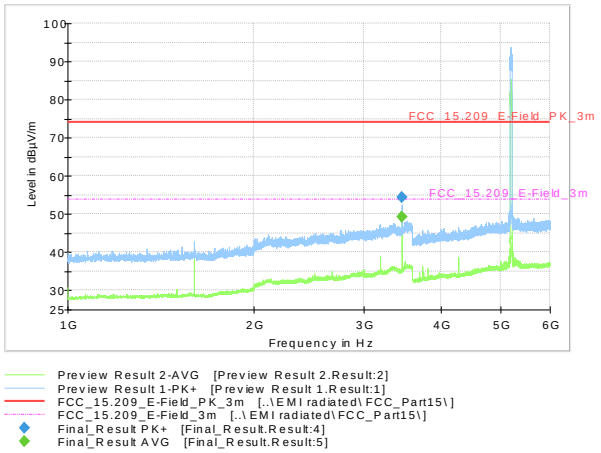
Radiated Emissions 1 – 6 GHz
Channel: 36
Mode: VHT20



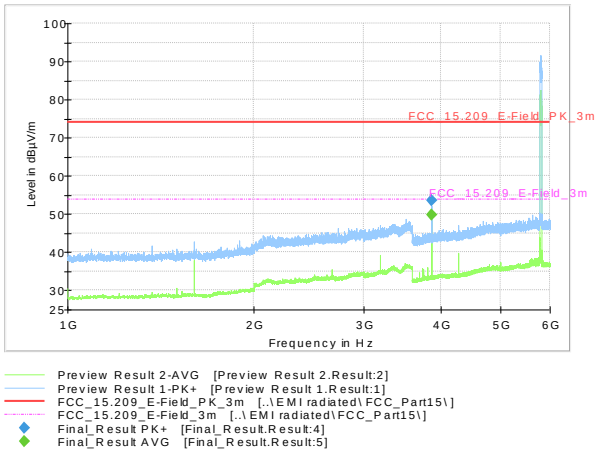
Radiated Emissions 1 – 6 GHz
Channel: 165
Mode: VHT20



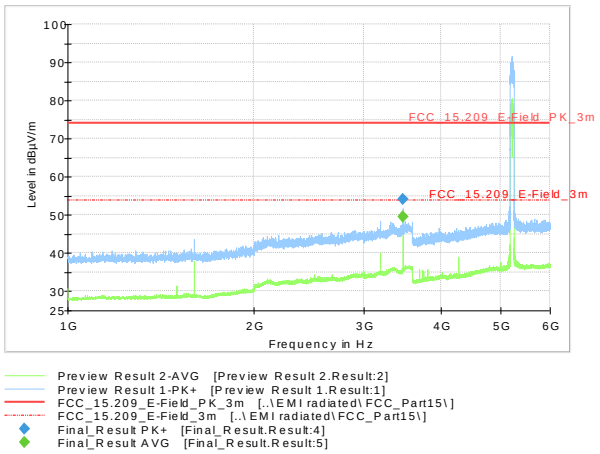
Radiated Emissions 1 – 6 GHz
Channel: 38
Mode: VHT40



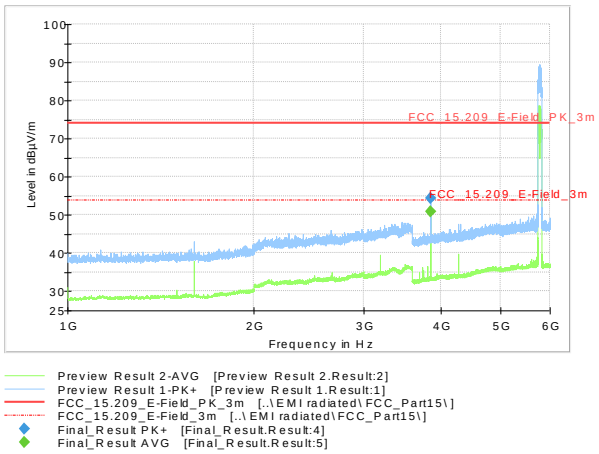
Radiated Emissions 1 – 6 GHz
Channel: 159
Mode: VHT40



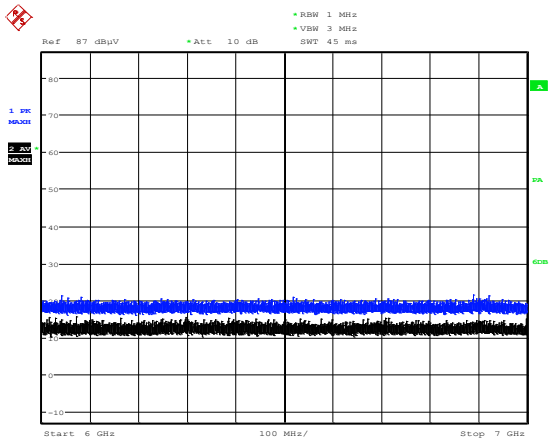
Radiated Emissions 1 – 6 GHz
Channel: 42
Mode: VHT80



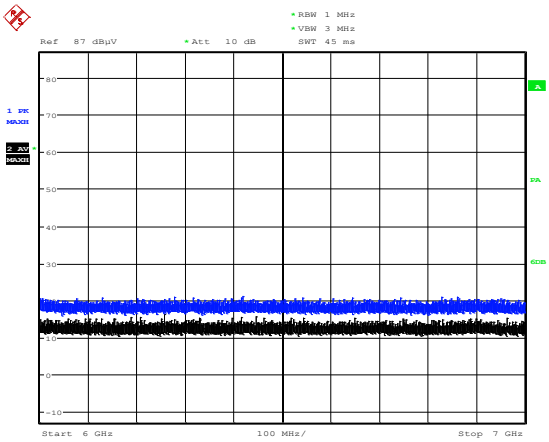
Radiated Emissions 1 – 6 GHz
Channel: 155
Mode: VHT80



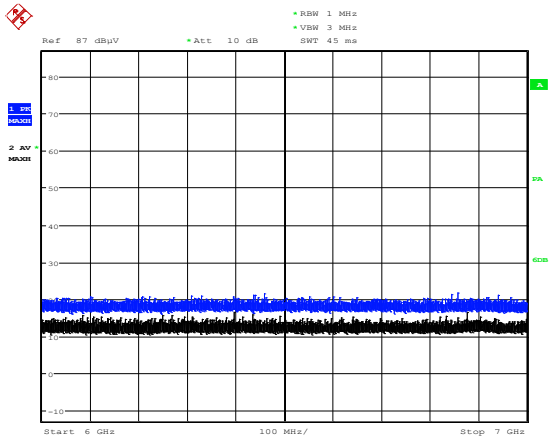
Radiated Emissions 6 – 7 GHz
Channel: 36
Mode: VHT20



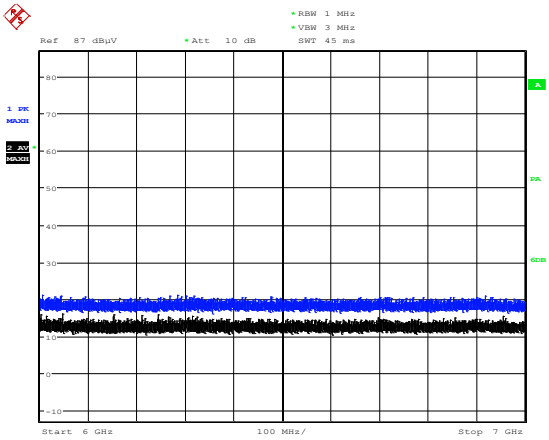
Radiated Emissions 6 – 7 GHz
Channel: 165
Mode: VHT20



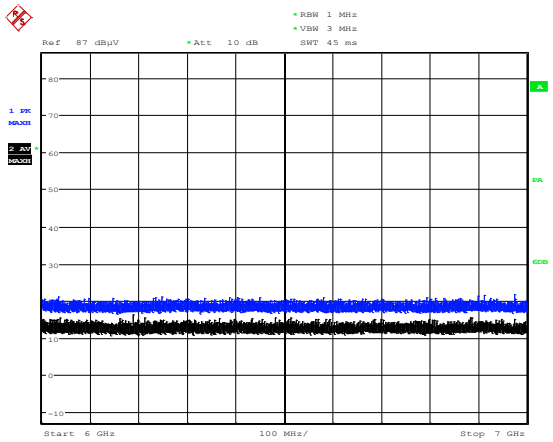
Radiated Emissions 6 – 7 GHz
Channel: 38
Mode: VHT40



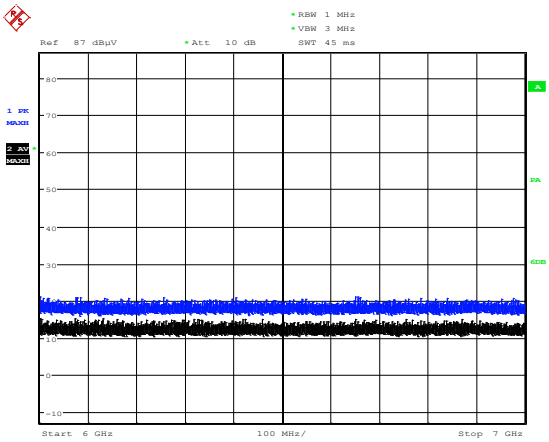
Radiated Emissions 6 – 7 GHz
Channel: 159
Mode: VHT40



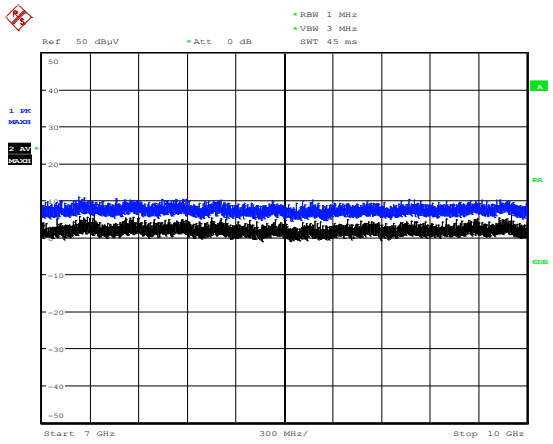
Radiated Emissions 6 – 7 GHz
Channel: 42
Mode: VHT80



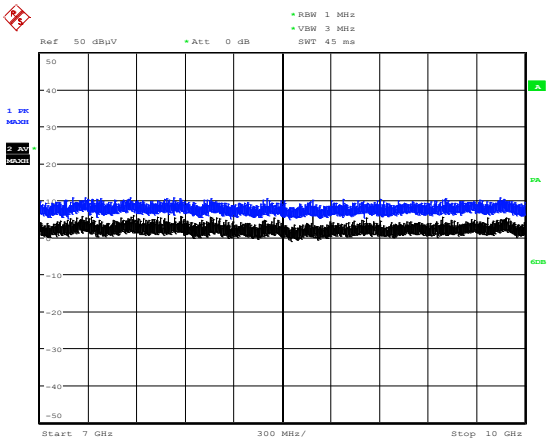
Radiated Emissions 6 – 7 GHz
Channel: 155
Mode: VHT80



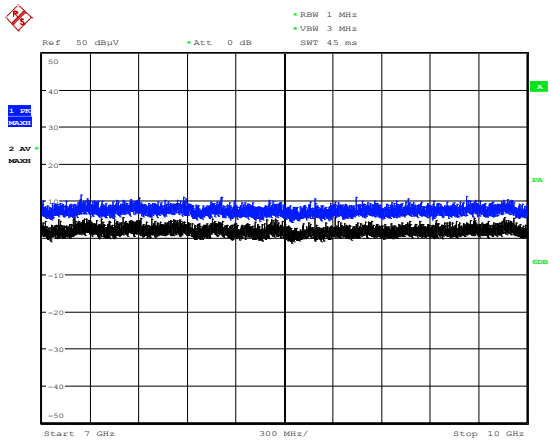
Radiated Emissions 7 – 10 GHz
Channel: 36
Mode: VHT20



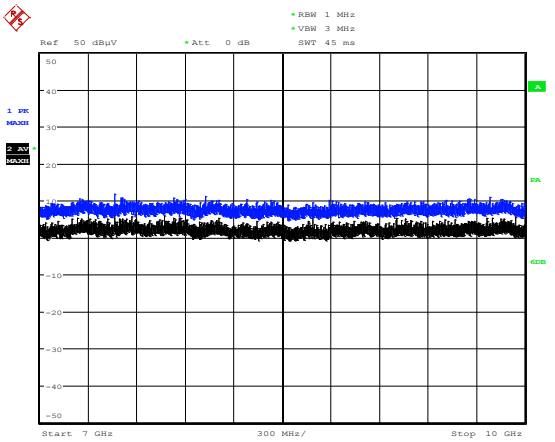
Radiated Emissions 7 – 10 GHz
Channel: 165
Mode: VHT20



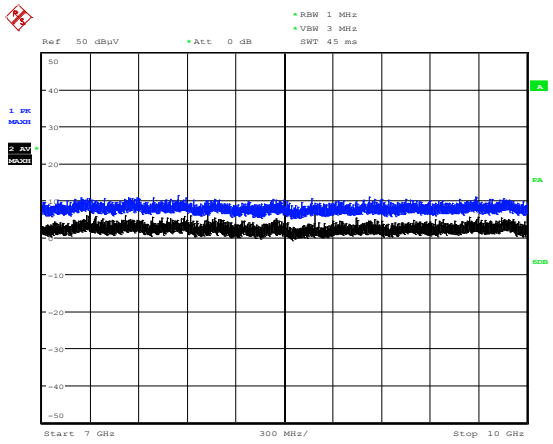
Radiated Emissions 7 – 10 GHz
Channel: 38
Mode: VHT40



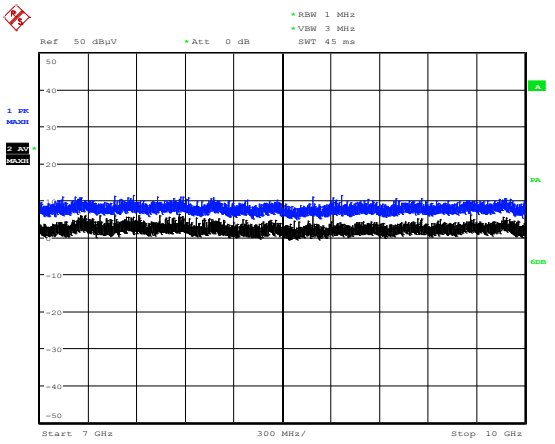
Radiated Emissions 7 – 10 GHz
Channel: 159
Mode: VHT40



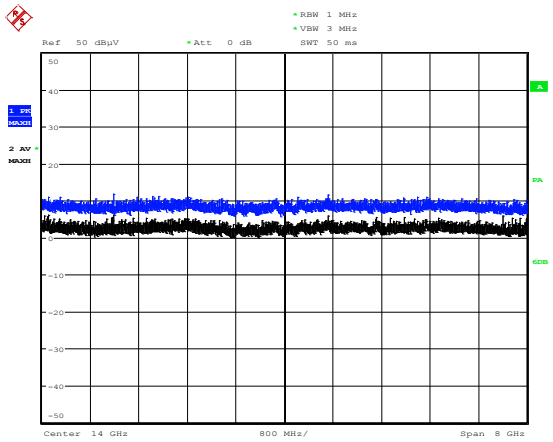
Radiated Emissions 7 – 10 GHz
Channel: 42
Mode: VHT80



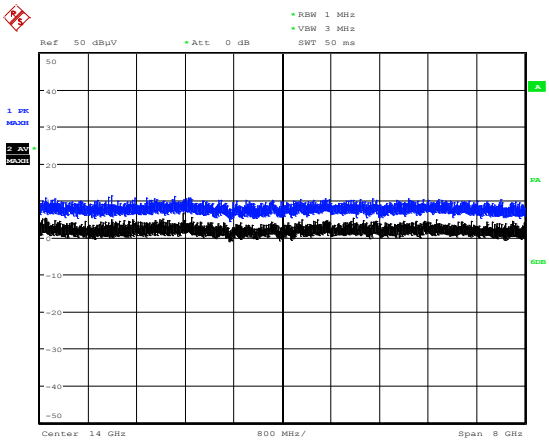
Radiated Emissions 7 – 10 GHz
Channel: 155
Mode: VHT80



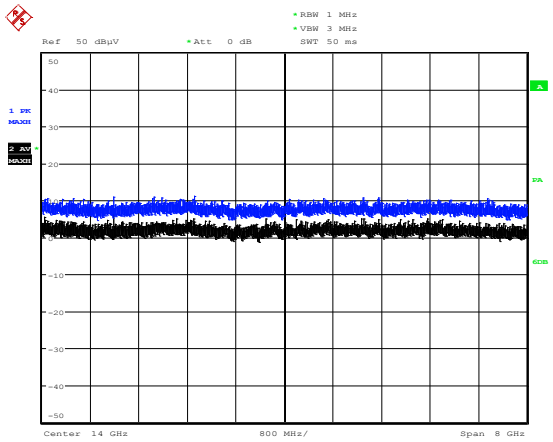
Radiated Emissions 10 – 18 GHz
Channel: 36
Mode: VHT20



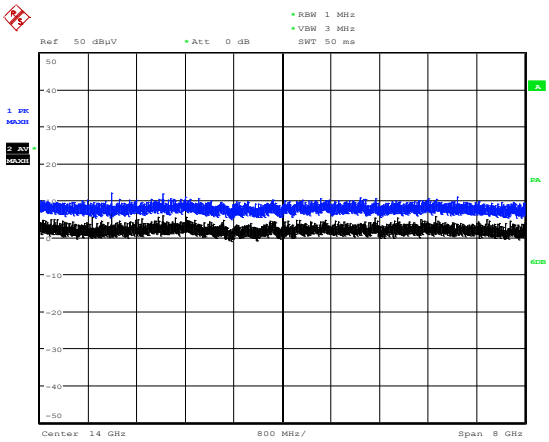
Radiated Emissions 10 – 18 GHz
Channel: 165
Mode: VHT20



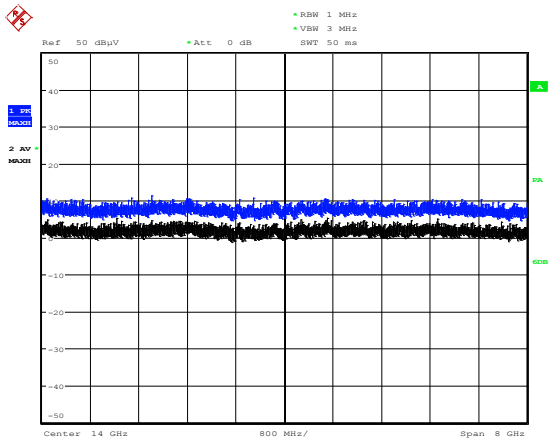
Radiated Emissions 10 – 18 GHz
Channel: 38
Mode: VHT40



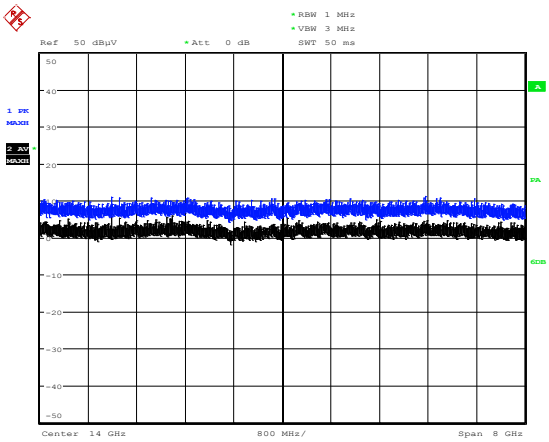
Radiated Emissions 10 – 18 GHz
Channel: 159
Mode: VHT40



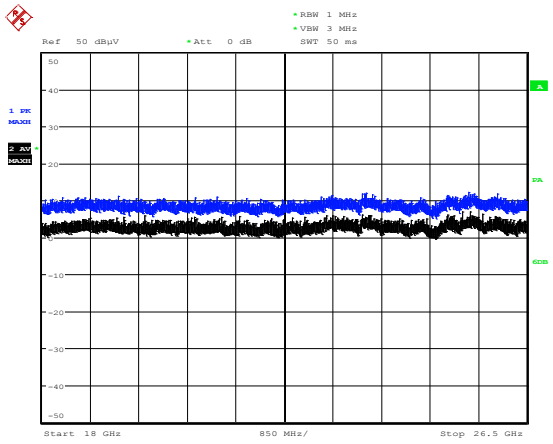
Radiated Emissions 10 – 18 GHz
Channel: 42
Mode: VHT80



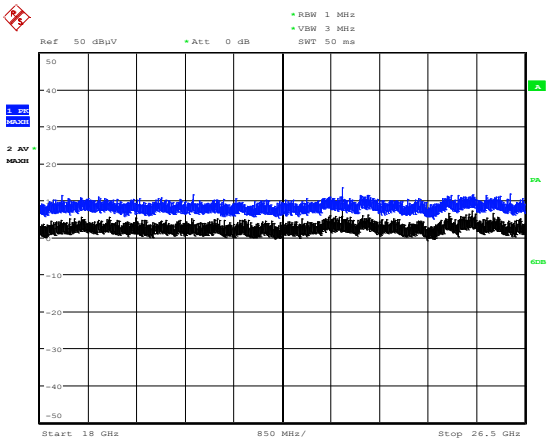
Radiated Emissions 10 – 18 GHz
Channel: 155
Mode: VHT80



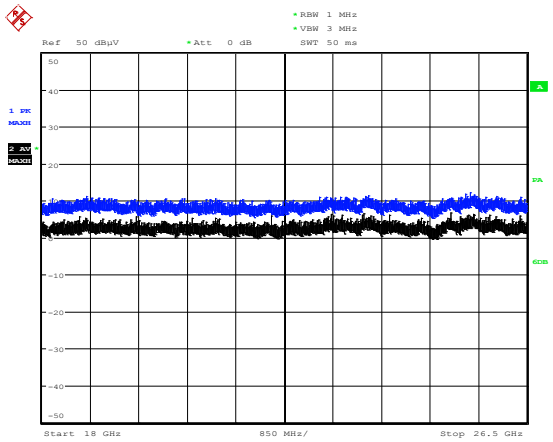
Radiated Emissions 18 – 26.5 GHz
Channel: 36
Mode: VHT20



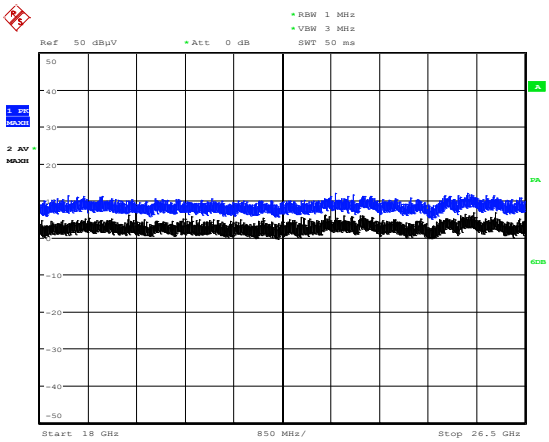
Radiated Emissions 18 – 26.5 GHz
Channel: 165
Mode: VHT20



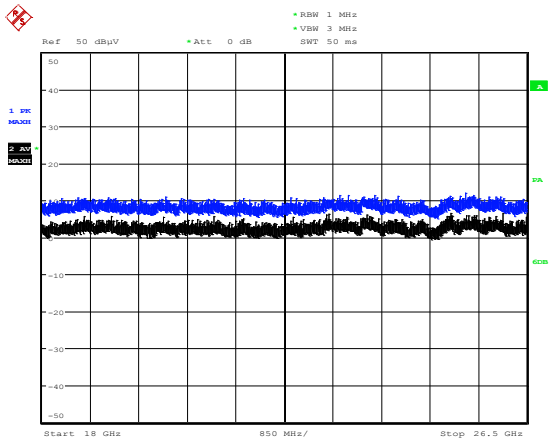
Radiated Emissions 18 – 26.5 GHz
Channel: 38
Mode: VHT40



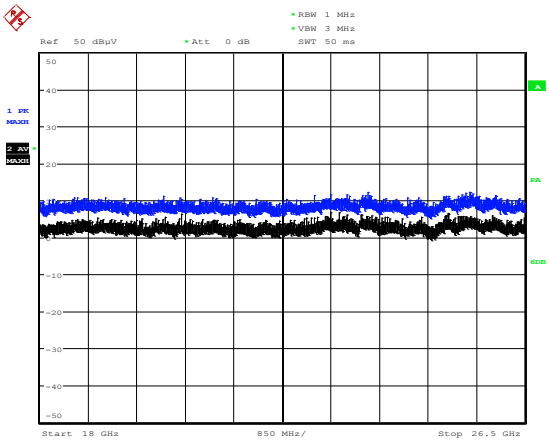
Radiated Emissions 18 – 26.5 GHz
Channel: 159
Mode: VHT40



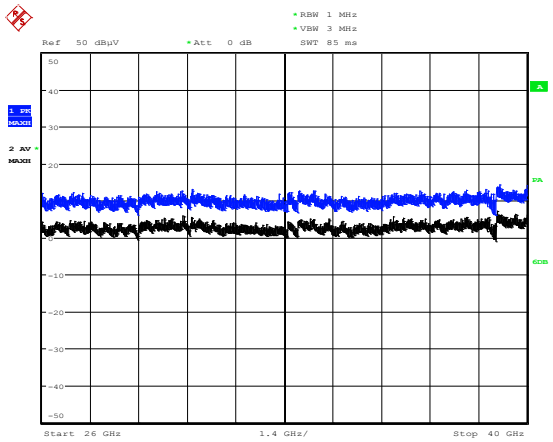
Radiated Emissions 18 – 26.5 GHz
Channel: 42
Mode: VHT80



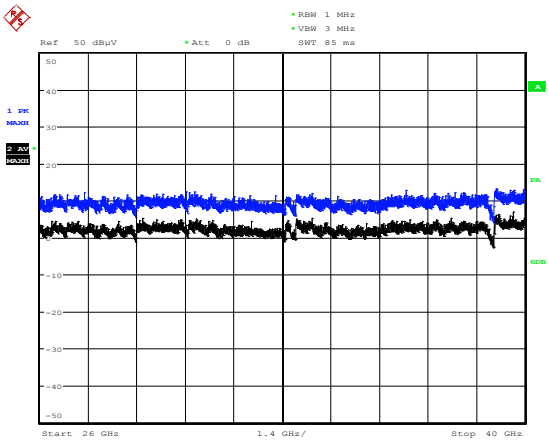
Radiated Emissions 18 – 26.5 GHz
Channel: 155
Mode: VHT80



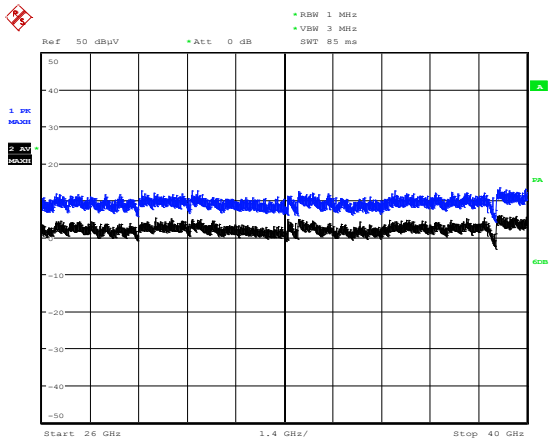
Radiated Emissions 26 – 40 GHz
Channel: 36
Mode: VHT20



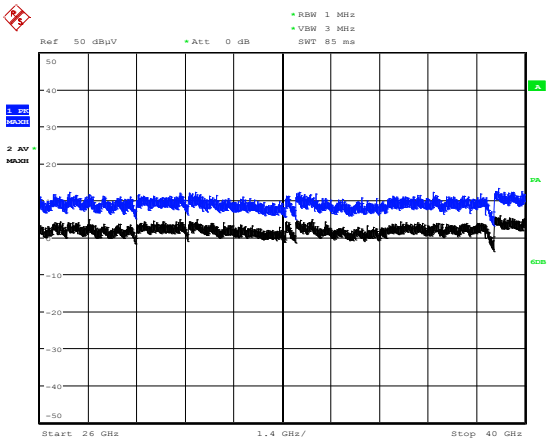
Radiated Emissions 26 – 40 GHz
Channel: 165
Mode: VHT20



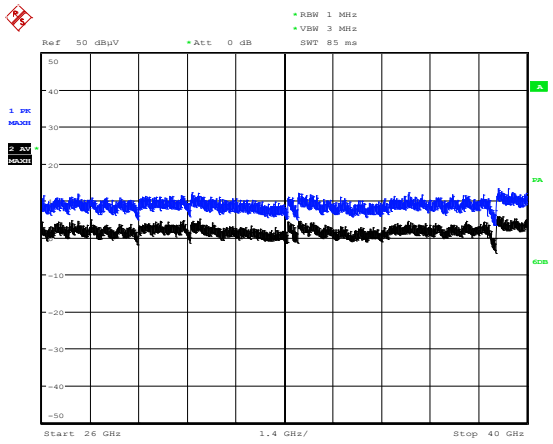
Radiated Emissions 26 – 40 GHz
Channel: 38
Mode: VHT40



Radiated Emissions 26 – 40 GHz
Channel: 159
Mode: VHT40

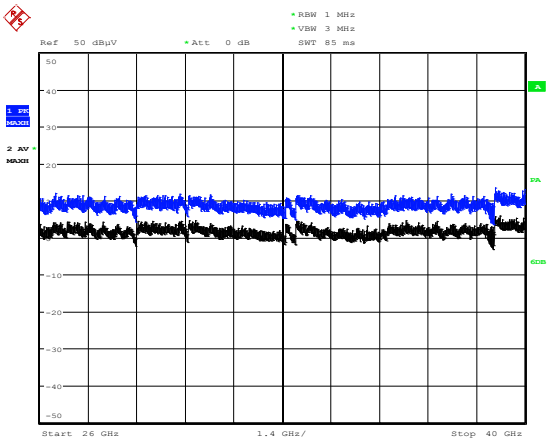


Radiated Emissions 26 – 40 GHz
Channel: 42
Mode: VHT80



Date: 13.SEP.2017 16:28:16

Radiated Emissions 26 – 40 GHz
Channel: 155
Mode: VHT80



Date: 13.SEP.2017 16:31:59

8 EMISSIONS IN RESTRICTED BANDS

Test Requirement: 47 CFR, § 15.407
RSS-247, 6.2
Test Procedure: 789033 D02 General U-NII Test Procedures New Rules v01r04

8.1 Regulation

§15.407 General technical requirements.
(7) The provisions of §15.205 apply to intentional radiators operating under this section.

§15.205 Restricted bands of operation.
(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

RSS-Gen, 8.10 Restricted Frequency Bands
Restricted bands, identified in table 6, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

Fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of Table 6 except for apparatus complying under RSS-287;
Unwanted emissions that fall into restricted bands of table 6 shall comply with the limits specified in RSS-Gen; and
unwanted emissions that do not fall within the restricted frequency bands of table 6 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

Table 6 — Restricted Frequency Bands		
MHz	**MHz**	**GHz**
0.090-0.110	240-285	9.0-9.2
2.1735-2.1905	322-335.4	9.3-9.5
3.020-3.026	399.9-410	10.6-12.7
4.125-4.128	608-614	13.25-13.4
4.17725-4.17775	960-1427	14.47-14.5
4.20725-4.20775	1435-1626.5	15.35-16.2
5.677-5.683	1645.5-1646.5	17.7-21.4
6.215-6.218	1660-1710	22.01-23.12
6.26775-6.26825	1718.8-1722.2	23.6-24.0
6.31175-6.31225	2200-2300	31.2-31.8
8.291-8.294	2310-2390	36.43-36.5
8.362-8.366	2655-2900	Above 38.6
8.37625-8.38675	3260-3267	
8.41425-8.41475	3332-3339	
12.29-12.293	3345.8-3358	
12.51975-12.52025	3500-4400	
12.57675-12.57725	4500-5150	
13.36-13.41	5350-5460	
16.42-16.423	7250-7750	
16.69475-16.69525	8025-8500	
16.80425-16.80475		
25.5-25.67		
37.5-38.25		
73-74.6		
74.8-75.2		
108-138		
156.52475-156.52525		
156.7-156.9		

8.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	1	n/a	n/a
Anechoic Room SAC, SR-ULL-01	EMCC/FRANK. / SAC-10	1889	n/a	n/a
Double Ridged Guide Antenna	Schwarzbeck / BBHA 9120D	3235	2017-05	2019-05
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2017-09	2018-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
EMC Measurement Software	Rohde & Schwarz / EMC32	5392	n/a	n/a
RF cable assembly	Rosenberger / LA2-025-7000	5616	2017-09	2018-09

8.3 Test Procedures

G. Unwanted Emission Measurement
Note: Sections 1. and 2. below cover measurements in the restricted and non-restricted bands, respectively. However, those sections are not self-contained. Rather, they reference the general unwanted emissions measurement requirements in section 3. and the specific measurement procedures in sections 4., 5., and 6.
1. Unwanted Emissions in the Restricted Bands
a) For all measurements, follow the requirements in II.G.3. “General Requirements for Unwanted Emissions Measurements.”
b) At frequencies below 1000 MHz, use the procedure described in II.G.4. “Procedure for Unwanted Emissions Measurements Below 1000 MHz.”
c) At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in II.G.5. and II.G.6, respectively, must satisfy the respective peak and average limits. If all peak measurements satisfy the average limit, then average measurements are not required.
d) For conducted measurements above 1000 MHz, EIRP shall be computed as specified in II.G.3.b) and then field strength shall be computed as follows (see KDB Publication 412172):
(i) E[dBµV/m] = EIRP[dBm] x 20 log (d[meters]) + 104.77, where E = field strength and d = distance at which field strength limit is specified in the rules;
(ii) E[dBµV/m] = EIRP[dBm] + 95.2, for d = 3 meters.
e) For conducted measurements below 1000 MHz, the field strength shall be computed as specified in d), above, and then an additional 4.7 dB shall be added as an upper bound on the field strength that would be observed on a test range with a ground plane for frequencies between 30 MHz and 1000 MHz, or an additional 6 dB shall be added for frequencies below 30 MHz.

8.4 Test Result

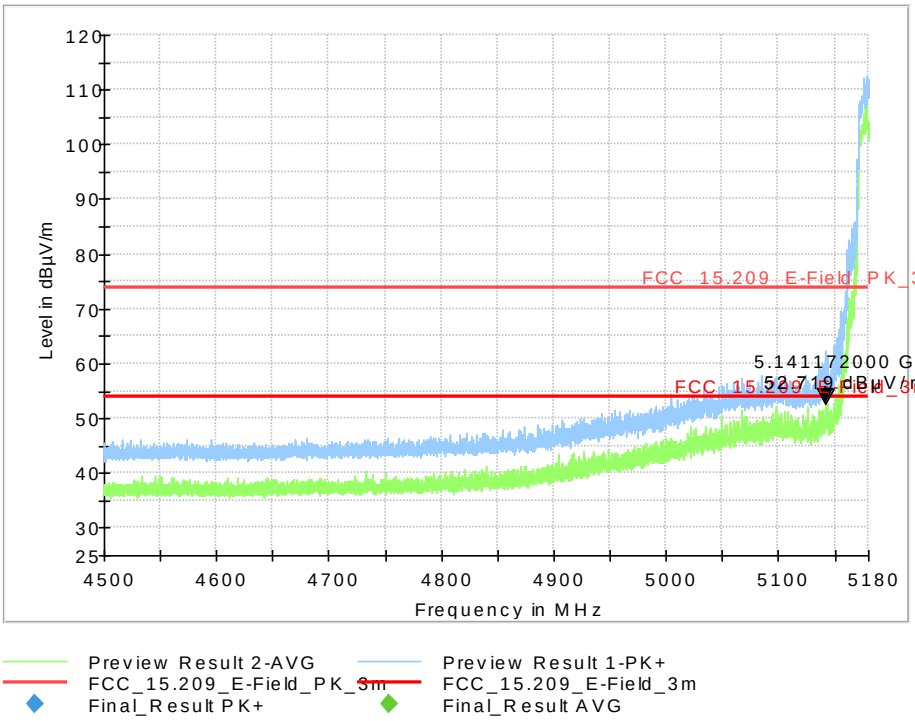
Emissions in Restricted Bands – Average Results						
Channel	**Mode**	**Frequency [MHz]**	**Result [dBµV/m]**	**Limit [dBµV/m]**	**Margin [dB]**	**Remarks**
36	VHT20	5141.2	52.7	54	1.3	Reduced output power by 2 dB
38	VHT40	5143.4	52.1	54	1.9	Reduced output power by 5.5 dB
42	VHT80	5146.6	52.6	54	1.4	Reduced output power by 8 dB

Manufacturer: SC Bitdefender SRL
Device: Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No: #6
Modification No: 1 – 4
Tested port: 1 - 3
Test date: 2017-10-06
Tested by: M. Zenk

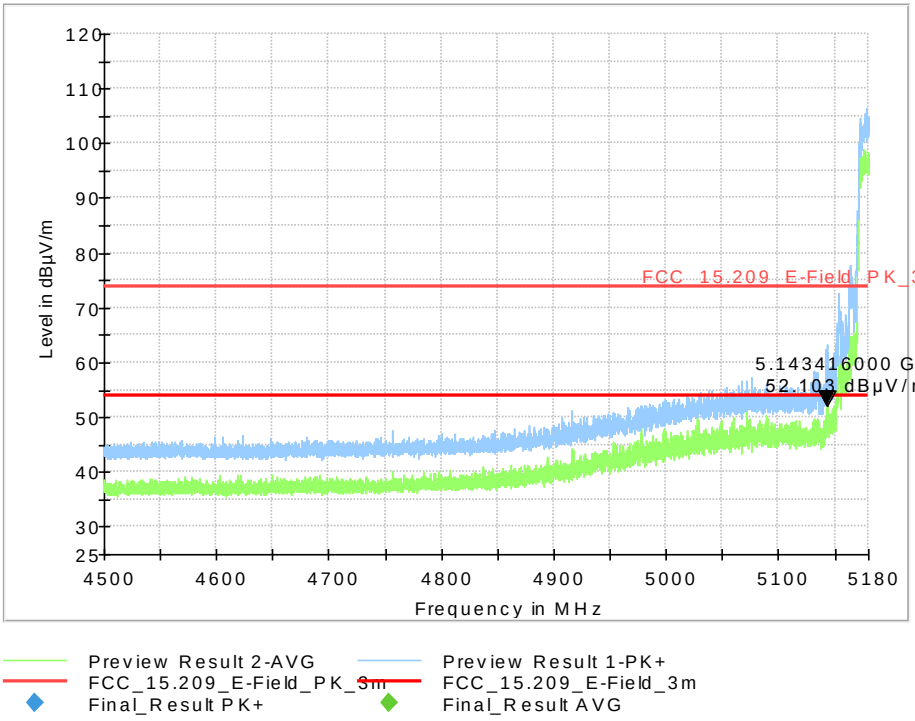
The EUT meets the requirements of this section.

8.5 Detailed Measurement Data

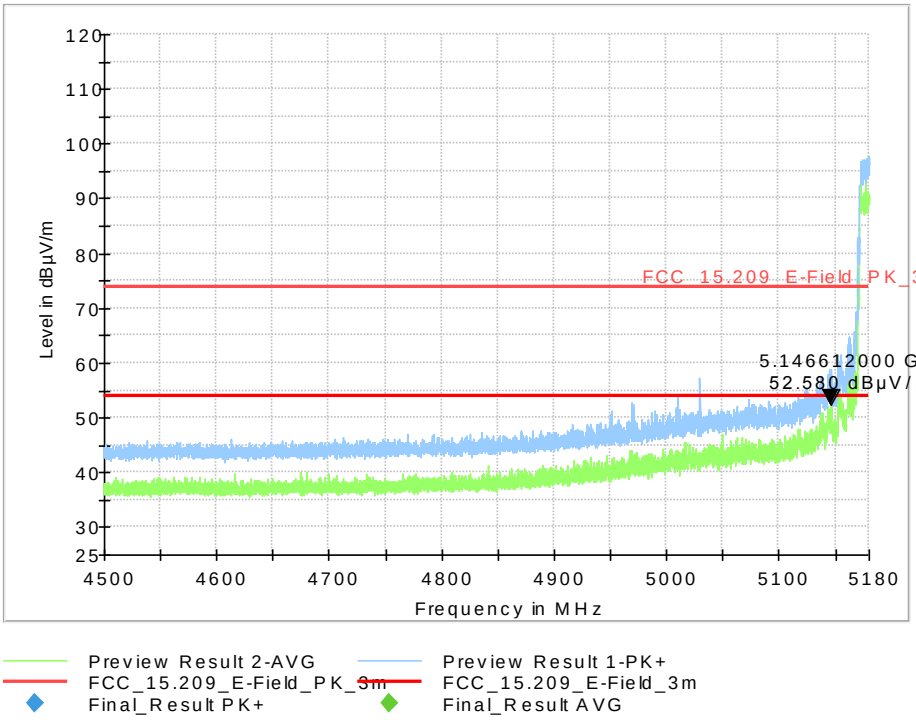
Radiated Emissions in Restricted Bands
Mode: VHT20



Radiated Emissions in Restricted Bands
Mode: VHT40



Radiated Emissions in Restricted Bands
Mode: VHT80



9 BANDEDGE MEASUREMENTS IN NONRESTRICTED BANDS

Test Requirement: 47 CFR, § 15.407
RSS-247, 6.2
Test Procedure: 789033 D02 General U-NII Test Procedures New Rules v01r04

9.1 Regulation

(b) Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:
(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.
(4) For transmitters operating in the 5.725-5.85 GHz band:
(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.
(ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.
(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.
(7) The provisions of §15.205 apply to intentional radiators operating under this section.

RSS-247, 6.2.1 Frequency band 5150-5250 MHz
6.2.1.2 Unwanted emission limits
For transmitters with operating frequencies in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. Any unwanted emissions that fall into the band 5250-5350 MHz shall be attenuated below the channel power by at least 26 dB, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth (i.e. 99% bandwidth), above 5250 MHz. The 26 dB bandwidth may fall into the 5250-5350 MHz band; however, if the occupied bandwidth also falls within the 5250-5350 MHz band, the transmission is considered as intentional and the devices shall comply with all requirements in the band 5250-5350 MHz including implementing dynamic frequency selection (DFS) and TPC, on the portion of the emission that resides in the 5250-5350 MHz band.

RSS-247, 6.2.4 Frequency band 5725-5850 MHz
6.2.4.2 Unwanted emission limits
Devices operating in the band 5725-5850 MHz with antenna gain greater than 10 dBi can have unwanted emissions that comply with either the limits in this section or in section 5.5 until six (6) months after the publication date of this standard for certification. Certified devices that do not comply with emission limits in this section shall not be manufactured, imported, distributed, leased, offered for sale or sold after April 1, 2018.
Devices operating in the band 5725-5850 MHz with antenna gain of 10 dBi or less can have unwanted emissions that comply with either the limits in this section or in section 5.5 until April 1, 2018 for certification. Certified devices that do not comply with emission limits in this section shall not be manufactured, imported, distributed, leased, offered for sale or sold after April 1, 2020.
Devices operating in the band 5725-5850 MHz shall have e.i.r.p. of unwanted emissions comply with the following:

a) 27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 Bm/MHz at 5 MHz above or below the band edges;
b) 15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges;
c) 10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to -27 dBm/MHz at 75 MHz above or below the band edges; and
d) -27 dBm/MHz at frequencies more than 75 MHz above or below the band edges.

9.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	1	n/a	n/a
2 W Attenuator 10 dB	Weinschel / 54A-10	1745	2016-06	2018-06
K-Cable K/50	IW / KPS-1501-600-KPS	3061	2017-05	2018-05
5W Termination	NARDA / 370 NM	3135	2017-06	2019-06
Coaxial Termination	Agilent/HP / 909A	3555	2015-10	2017-10
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2017-09	2018-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04

9.3 Test Procedures

3. General Requirements for Unwanted Emissions Measurements
The following requirements apply to all unwanted emissions measurements, both in and outside of the restricted bands:
d) Band edge measurements. Unwanted band-edge emissions may be measured using either of the special band-edge measurement techniques (the marker-delta or integration methods) described below. Note that the marker-delta method is primarily a radiated measurement technique that requires the 99% occupied bandwidth edge to be within 2 MHz of the authorized band edge, whereas the integration method can be used in either a radiated or conducted measurement without any special requirement with regards to the displacement of the unwanted emission(s) relative to the authorized bandwidth.
(ii) Integration Method
- For average emissions measurements, follow the procedures described in II.G.6., “Procedures for Average Unwanted Emissions Measurements above 1000 MHz,” except for the following changes:
◦ Set RBW = 100 kHz
◦ Set VBW ≥ 3 × RBW
◦ Perform a band-power integration across the 1 MHz bandwidth in which the band-edge emission level is to be measured.

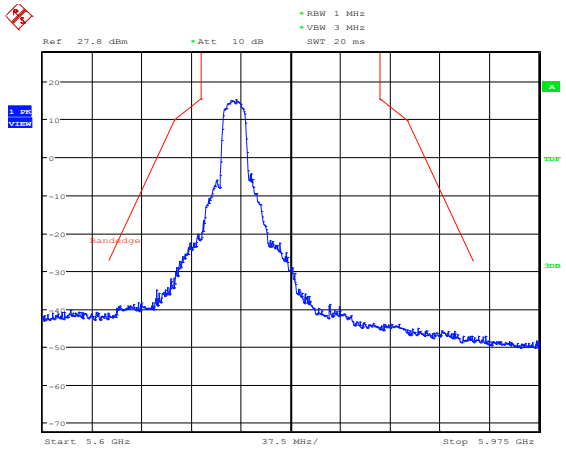
9.4 Test Result

Band 5150 – 5250 MHz:

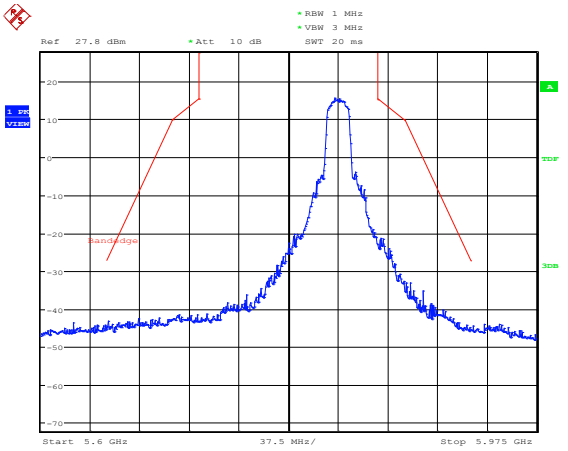
Bandedge [MHz]	Modulation	Channel	Result [dBm/MHz]	Limit [dBm/MHz]	Remarks
5150	VHT20	36	-41.4	-27	
	VHT40	38	-38.8	-27	
	VHT80	42	-38.8	-27	
5250	VHT20	48	-27.2	-27	Reduced output power by 2 dB
	VHT40	46	-31.1	-27	
	VHT80	42	-36.1	-27	

Band 5725 – 5850 MHz:

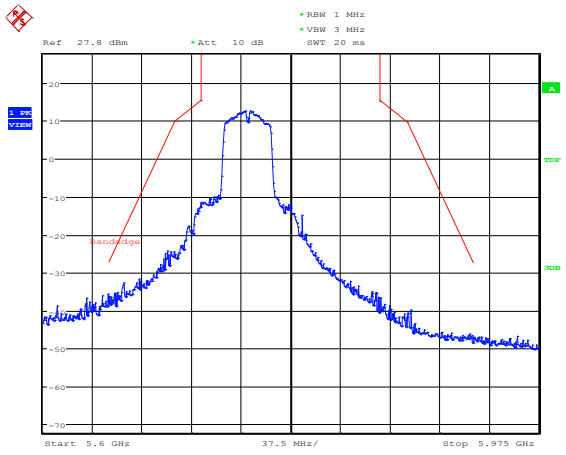
Channel: 149
Mode: VHT20



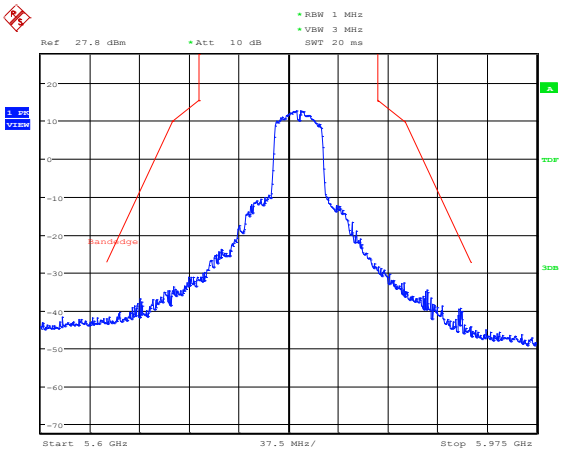
Channel: 165
Mode: VHT20



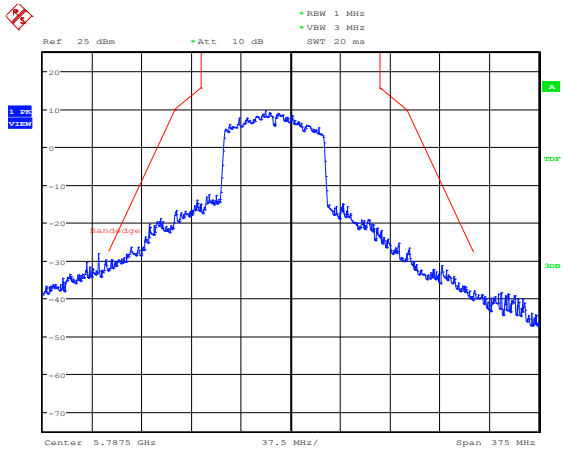
Channel: 151
Mode: VHT40

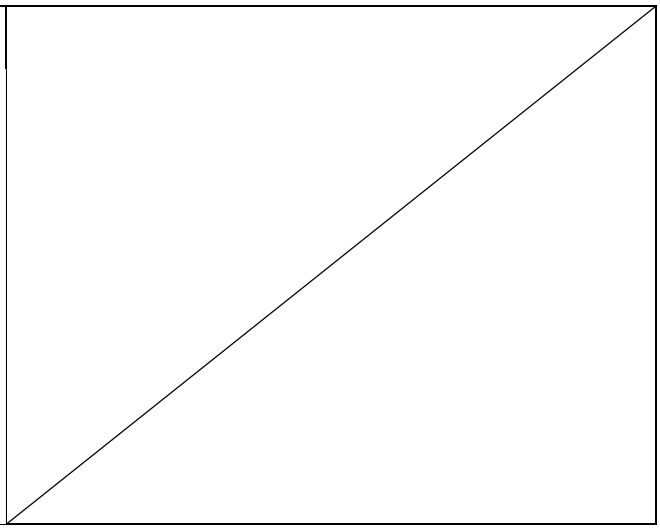


Channel: 159
Mode: VHT40



Channel: 155
Mode: VHT80





Manufacturer:	SC Bitdefender SRL
Device:	Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No:	#4
Modification No:	1 – 3, 5
Tested port:	3
Test date:	2017-09-15 and 2017-10-05
Tested by:	M. Zenk

The EUT meets the requirements of this section.

10 EMISSION BANDWIDTH

Test Requirement: 47 CFR, § 15.407
RSS-247, 6.2
Test Procedure: 789033 D02 General U-NII Test Procedures New Rules v01r04

10.1 Regulation

§15.407 General technical requirements.
(a) Power limits:
(e) Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

RSS-247, 6.2 Power and unwanted emissions limits
6.2.1 Frequency band 5150-5250 MHz
6.2.1.1 Power limits
For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 log10B, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.
For other devices, the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 log10B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.
6.2.4 Frequency band 5725-5850 MHz
6.2.4.1 Power limits
For equipment operating in the band 5725-5850 MHz, the minimum 6 dB bandwidth shall be at least 500 kHz.

RSS-247, 6.2.1 Frequency band 5150-5250 MHz
6.2.1.2 Unwanted emission limits
For transmitters with operating frequencies in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. Any unwanted emissions that fall into the band 5250-5350 MHz shall be attenuated below the channel power by at least 26 dB, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth (i.e. 99% bandwidth), above 5250 MHz. The 26 dB bandwidth may fall into the 5250-5350 MHz band; however, if the occupied bandwidth also falls within the 5250-5350 MHz band, the transmission is considered as intentional and the devices shall comply with all requirements in the band 5250-5350 MHz including implementing dynamic frequency selection (DFS) and TPC, on the portion of the emission that resides in the 5250-5350 MHz band.

RSS-247, 6.2.4 Frequency band 5725-5850 MHz
6.2.4.2 Unwanted emission limits
Devices operating in the band 5725-5850 MHz with antenna gain greater than 10 dBi can have unwanted emissions that comply with either the limits in this section or in section 5.5 until six (6) months after the publication date of this standard for certification. Certified devices that do not comply with emission limits in this section shall not be manufactured, imported, distributed, leased, offered for sale or sold after April 1, 2018.
Devices operating in the band 5725-5850 MHz with antenna gain of 10 dBi or less can have unwanted emissions that comply with either the limits in this section or in section 5.5 until April 1, 2018 for certification. Certified devices that do not comply with emission limits in this section shall not be manufactured, imported, distributed, leased, offered for sale or sold after April 1, 2020.
Devices operating in the band 5725-5850 MHz shall have e.i.r.p. of unwanted emissions comply with the following:
a) 27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 Bm/MHz at 5 MHz above or below the band edges;
b) 15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges;
c) 10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to -27 dBm/MHz at 75 MHz above or below the band edges; and
d) -27 dBm/MHz at frequencies more than 75 MHz above or below the band edges.

10.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	1	n/a	n/a
2 W Attenuator 10 dB	Weinschel / 54A-10	1745	2016-06	2018-06
K-Cable K/50	IW / KPS-1501-600-KPS	3061	2017-05	2018-05
5W Termination	NARDA / 370 NM	3135	2017-06	2019-06
Coaxial Termination	Agilent/HP / 909A	3555	2015-10	2017-10
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2017-09	2018-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04

10.3 Test Procedures

789033 D02 General UNII Test Procedures New Rules v01r04

C. Bandwidth Measurement

2. Minimum Emission Bandwidth for the band 5.725 - 5.85 GHz
Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 kHz for the band 5.725 - 5.85 GHz. The following procedure shall be used for measuring this bandwidth:
a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 x RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

D. 99% Occupied Bandwidth

The 99% occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5 % of the total mean power of the given emission. Measurement of the 99% occupied bandwidth is required only as a condition for using the optional band-edge measurement techniques described in II.G.3.d). Measurements of 99% occupied bandwidth may also optionally be used in lieu of the EBW to define the minimum frequency range over which the spectrum is integrated when measuring maximum conducted output power as described in II.E. However, the EBW must be measured to determine bandwidth dependent limits on maximum conducted output power in accordance with 15.407(a).

The following procedure shall be used for measuring (99 %) power bandwidth:
1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1 % to 5 % of the OBW
4. Set VBW ≥ 3 · RBW
5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
6. Use the 99 % power bandwidth function of the instrument (if available).

7. If the instrument does not have a 99 % power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5 % of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

10.4 Test Result

99 % Bandwidth				
Mode	**Operating Channel**	**Nominal Tx Frequency [MHz]**	**99 % Bandwidth [MHz]**	**Limit [MHz]**
VHT20	36	5180	17.9	n/a
	165	5825	17.9	n/a
VHT40	38	5190	36.7	n/a
	159	5795	36.5	n/a
VHT80	42	5210	75.9	n/a
	155	5775	75.9	n/a

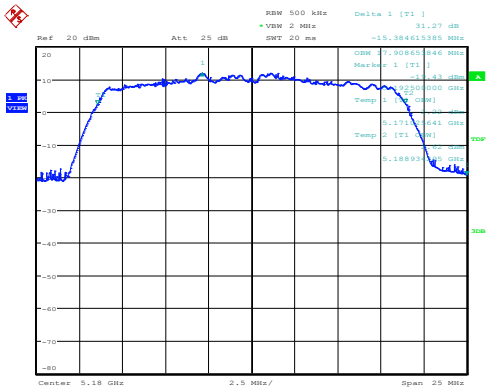
6 dB Bandwidth				
Mode	**Operating Channel**	**Nominal Tx Frequency [MHz]**	**6 dB Bandwidth [MHz]**	**Limit [MHz]**
VHT20	165	5825	9.1	≥ 0.5
VHT40	159	5795	9.1	≥ 0.5
VHT80	155	5775	8.7	≥ 0.5

Manufacturer: SC Bitdefender SRL
Device: Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No: #4
Modification No: 1 - 3
Tested port: 3
Test date: 2017-10-05
Tested by: M. Zenk

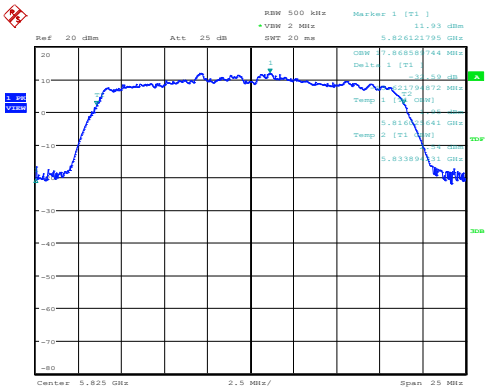
The EUT meets the requirements of this section.

10.5 Detailed Measurement Data

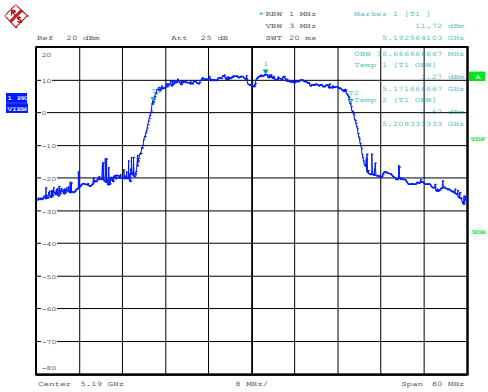
99% Bandwidth
Channel: 36
Mode: VHT20



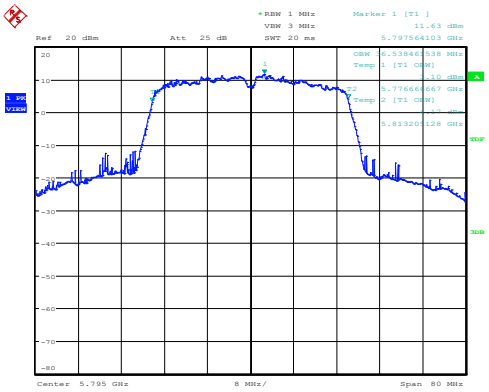
99% Bandwidth
Channel: 165
Mode: VHT20



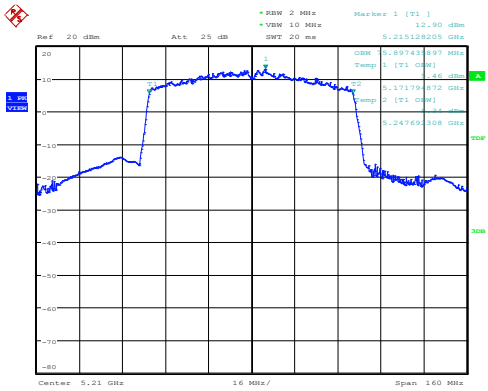
99% Bandwidth
Channel: 38
Mode: VHT40



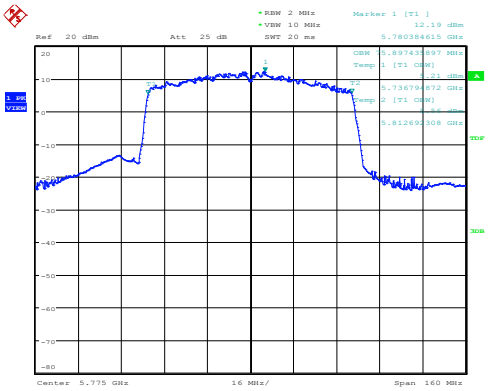
99% Bandwidth
Channel: 159
Mode: VHT40



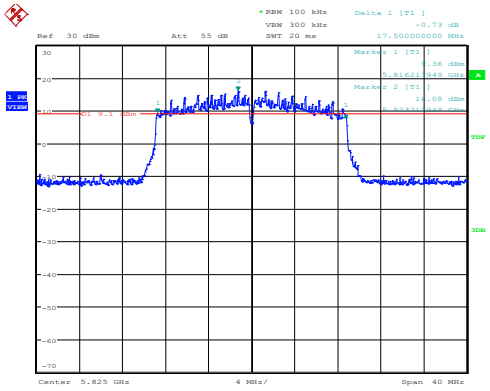
99% Bandwidth
Channel: 42
Mode: VHT80



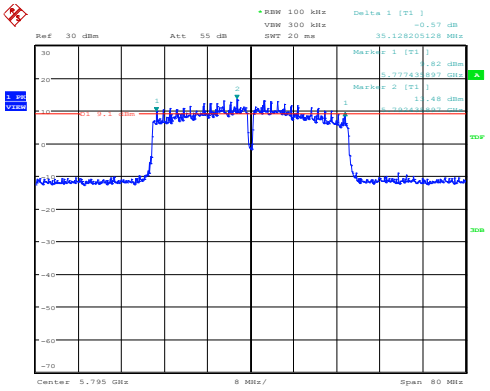
99% Bandwidth
Channel: 155
Mode: VHT80



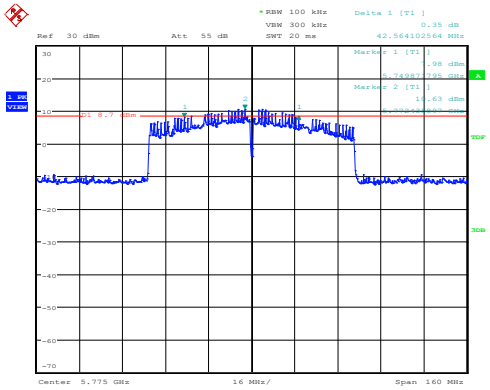
6dB Bandwidth
Channel: 165
Mode: VHT20



6dB Bandwidth
Channel: 159
Mode: VHT40



6dB Bandwidth
Channel: 155
Mode: VHT80



11 MAXIMUM CONDUCTED OUTPUT POWER

Test Requirement: 47 CFR, § 15.407
RSS-247, 6.2
Test Procedure: 789033 D02 General U-NII Test Procedures New Rules v01r04

11.1 Regulation

§15.407 General technical requirements.
(a) Power limits:

(1) For the band 5.15-5.25 GHz.
(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations

(4) The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

RSS-247, 6.2 Power and unwanted emissions limits

6.2.1 Frequency band 5150-5250 MHz
6.2.1.1 Power limits
For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 log10B, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.
For other devices, the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 log10B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.
6.2.4 Frequency band 5725-5850 MHz
6.2.4.1 Power limits
The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

11.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	1	n/a	n/a
2 W Attenuator 10 dB	Weinschel / 54A-10	1745	2016-06	2018-06
K-Cable K/50	IW / KPS-1501-600-KPS	3061	2017-05	2018-05
5W Termination	NARDA / 370 NM	3135	2017-06	2019-06
Coaxial Termination	Agilent/HP / 909A	3555	2015-10	2017-10
RF Power Meter	Boonton / 4542	3857	2017-08	2019-08
Peak Power Sensor	Boonton / 57518	3858	2017-08	2019-08
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04

11.3 Test Procedures

E. Maximum Conducted Output Power

Maximum conducted output power may be measured using a spectrum analyzer/EMI receiver or an RF power meter.

1. Device Configuration
If possible, configure or modify the operation of the EUT so that it transmits continuously at its maximum power control level (see II.B.).
a) The intent is to test at 100% duty cycle; however a small reduction in duty cycle (to no lower than 98%) is permitted if required by the EUT for amplitude control purposes. Manufacturers are expected to provide software to the test lab to permit such continuous operation.
b) If continuous transmission (or at least 98% duty cycle) cannot be achieved due to hardware limitations (e.g., overheating), the EUT shall be operated at its maximum power control level with the transmit duration as long as possible and the duty cycle as high as possible.

3. Measurement using a Power Meter (PM)
a) Method PM (Measurement using an RF average power meter):
(i) Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied.
- The EUT is configured to transmit continuously or to transmit with a constant duty cycle.
- At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
- The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
(ii) If the transmitter does not transmit continuously, measure the duty cycle, x, of the transmitter output signal as described in II.B.
(iii) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
(iv) Adjust the measurement in dBm by adding 10 log (1/x) where x is the duty cycle (e.g.,10 log (1/0.25) if the duty cycle is 25%).

11.4 Test Result

Maximum Conducted Output Power						
Mode	Operating Channel	single port			Total Power [dBm]	Limit [dBm]
		#1 [dBm]	#2 [dBm]	#3 [dBm]		
VHT20	36	15.2	15.3	15.2	20.0	22.5
	165	15.6	15.2	15.1	20.1	30.0
VHT40	38	15.4	15.1	15.5	20.1	23.0
	159	15.9	14.9	15.1	20.1	30.0
VHT80	42	15.6	14.7	15.3	20.0*	23.0
	155	15.7	14.6	14.7	19.8	30.0

Remark: *with Modification No. 4 the power setting was reduced by 8 dB resulting in a final total power of 12 dBm (calculated), refer to chapter 2.5.

Manufacturer:	SC Bitdefender SRL
Device:	Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No:	#4
Modification No:	1 - 3
Tested port:	1 - 3
Test date:	2017-09-14
Tested by:	M. Zenk

The EUT meets the requirements of this section.

12 MAXIMUM CONDUCTED POWER SPECTRAL DENSITY

Test Requirement: 47 CFR, § 15.407
RSS-247, 6.2
Test Procedure: 789033 D02 General U-NII Test Procedures New Rules v01r04

12.1 Regulation

§15.407 General technical requirements.
(a) Power limits:

(1) For the band 5.15-5.25 GHz.
(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations

(5) The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements in the 5.725-5.85 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. Measurements in the 5.15-5.25 GHz, 5.25-5.35 GHz, and the 5.47-5.725 GHz bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

RSS-247, 6.2 Power and unwanted emissions limits
6.2.1 Frequency band 5150-5250 MHz
6.2.1.1 Power limits
For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 log10B, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.
For other devices, the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 log10B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

6.2.4 Frequency band 5725-5850 MHz
6.2.4.1 Power limits
The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the

amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

12.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	1	n/a	n/a
2 W Attenuator 10 dB	Weinschel / 54A-10	1745	2016-06	2018-06
K-Cable K/50	IW / KPS-1501-600-KPS	3061	2017-05	2018-05
5W Termination	NARDA / 370 NM	3135	2017-06	2019-06
Coaxial Termination	Agilent/HP / 909A	3555	2015-10	2017-10
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2017-09	2018-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04

12.3 Test Procedures

F. Maximum Power Spectral Density (PSD)

The rules requires “maximum power spectral density” measurements where the intent is to measure the maximum value of the time average of the power spectral density measured during a period of continuous transmission.

1. Create an average power spectrum for the EUT operating mode being tested by following the instructions in II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, “Compute power….” (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)

2. Use the peak search function on the instrument to find the peak of the spectrum and record its value.

3. Make the following adjustments to the peak value of the spectrum, if applicable:
a) If Method SA-2 or SA-2 Alternative was used, add 10 log (1/x), where x is the duty cycle, to the peak of the spectrum.
b) If Method SA-3 Alternative was used and the linear mode was used in step II.E.2.g)(viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.

4. The result is the Maximum PSD over 1 MHz reference bandwidth.

5. For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in Section 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or
500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 kHz bandwidth, the following adjustments to the procedures apply:
a) Set RBW ≥ 1/T, where T is defined in II.B.I.a).
b) Set VBW ≥ 3 RBW.

c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10 log (500 kHz/RBW) to the measured result, whereas RBW (<500 kHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add 10 log (1MHz/RBW) to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.
e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Note: As a practical matter, it is recommended to use reduced RBW of 100 kHz for steps 5.c) and 5.d) above, since RBW=100 KHZ is available on nearly all spectrum analyzers.

E. Maximum Conducted Output Power
d) Method SA-2 (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).
(i) Measure the duty cycle, x, of the transmitter output signal as described in II.B.
(ii) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
(iii) Set RBW = 1 MHz.
(iv) Set VBW ≥ 3 MHz.
(v) Number of points in sweep ≥ 2 × span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
(vi) Sweep time = auto.
(vii) Detector = power averaging (rms), if available. Otherwise, use sample detector mode.
(viii) Do not use sweep triggering. Allow the sweep to “free run.”
(ix) Trace average at least 100 traces in power averaging (rms) mode; however, the number of traces to be averaged shall be increased above 100 as needed to ensure that the average accurately represents the true average over the on and off periods of the transmitter.

12.4 Test Result

Power Spectral Density						
Mode	Operating Channel	PSD at single port			Total PSD	Limit [dBm]
		#1 [dBm]	#2 [dBm]	#3 [dBm]		
VHT20	36	-26.5	-16.3	-15.0	-12.4	17
	165	-18.4	-20.0	-16.3	-13.2	30
VHT40	38	-34.2	-31.8	-25.9	-24.4	17
	159	-29.5	-30.4	-35.3	-26.3	30
VHT80	42	-32.7	-36.5	-36.2	-30.0	17
	155	-38.4	-39.0	-39.8	-34.3	30

Note: Reference bandwidth is 1 MHz in the frequency range 5150 – 5250 MHz and 500 kHz in the frequency range of 5725 – 5850 MHz.

Manufacturer:	SC Bitdefender SRL
Device:	Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No:	#4
Modification No:	1 - 3
Tested port:	1 - 3
Test date:	2017-09-14/15
Tested by:	M. Zenk

The EUT meets the requirements of this section.

13 FREQUENCY STABILITY

Test Requirement: 47 CFR, §15.215(), § 15.407(g)
Test Procedure: ANSI C63.10-2013

13.1 Regulation

§15.215 Additional provisions to the general radiated emission limitations.
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

§15.407 General technical requirements.
(g) Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

13.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
AC Power Source	Elgar	29	n/a	n/a
2 W Attenuator 20dB	Bird	2733	2017-06	2019-06
10 W Termination	Weinschel	2063	2016-08	2018-08
Coaxial Termination	Agilent/HP / 909A	3555	2015-10	2017-10
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2017-09	2018-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
Thermal Chamber	Weiss	2998	2017-02	2019-02
Notebook	Samsung	3195	n/a	n/a
Data Logger	Ahlborn	4932	2017-01	2019-01
Thermoconnector	Ahlborn	4686	2016-02	2018-02

13.3 Test Procedure

ANSI C63.10-2013:
Section 6.8.1 Frequency stability with respect to ambient temperature

a) Supply the EUT with a nominal ac voltage or install a new or fully charged battery in the EUT. If possible, a dummy load shall be connected to the EUT because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, then the EUT shall be placed in the center of the chamber with the antenna adjusted to the shortest length possible. Turn ON the EUT and tune it to one of the number of frequencies shown in 5.6.

b) Couple the unlicensed wireless device output to the measuring instrument by connecting an antenna to the measuring instrument with a suitable length of coaxial cable and placing the measuring antenna near the EUT (e.g., 15 cm away), or by connecting a dummy load to the measuring

instrument, through an attenuator if necessary.
NOTE - An instrument that has an adequate level of accuracy as specified by the procuring or regulatory agency is the recommended measuring instrument.

c) Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument but is strong enough to allow measurement of the operating or fundamental frequency of the EUT).

d) Turn the EUT OFF and place it inside the environmental temperature chamber. For devices that have oscillator heaters, energize only the heater circuit.

e) Set the temperature control on the chamber to the highest specified in the regulatory requirements for the type of device and allow the oscillator heater and the chamber temperature to stabilize.

f) While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.

g) Measure the frequency at each of frequencies specified in 5.6.

h) Switch OFF the EUT but do not switch OFF the oscillator heater.

i) Lower the chamber temperature by not more than 10 °C, and allow the temperature inside the chamber to stabilize.

j) Repeat step f) through step i) down to the lowest specified temperature.

Section 6.8.2 Frequency stability when varying supply voltage
Unless otherwise specified, these tests shall be made at ambient room temperature (+15 °C to +25 °C). An antenna shall be connected to the antenna output terminals of the EUT if possible. If the EUT is equipped with or uses an adjustable-length antenna, then it shall be fully extended.

a) Supply the EUT with nominal voltage or install a new or fully charged battery in the EUT. Turn ON the EUT and couple its output to a frequency counter or other frequency-measuring instrument.
NOTE - An instrument that has an adequate level of accuracy as specified by the procuring or regulatory agency is the recommended measuring instrument.

b) Tune the EUT to one of the number of frequencies required in 5.6. Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument but is strong enough to allow measurement of the operating or fundamental frequency of the EUT).

c) Measure the frequency at each of the frequencies specified in 5.6.

d) Repeat the above procedure at 85% and 115% of the nominal supply voltage as described in 5.13.

EUT operating conditions:
The EUT was operated on the lowest, middle and highest operating frequencies of the U-NII-1 and U-NII-3 band, respectively. EUT was transmitting at max. power setting in VHT20 and VHT80 transmit mode, respectively.

Applied procedure for measurement with modulation:
Measurement was performed with a spectrum analyzer employing its 99 % bandwidth measurement capability. The corresponding edge frequencies f_{Low} and f_{High} of the 99 % bandwidth were recorded for comparison with the allowed band of operation.

13.4 Test Result

13.4.1 Frequency vs. Voltage

Ambient temperature: 20 °C

Nominal Frequency [MHz] / Mode	Supply Voltage [V]					
	102 (85 %)		120 (100 %)		138 (+115 %)	
	f_{Low} [MHz]	f_{High} [MHz]	f_{Low} [MHz]	f_{High} [MHz]	f_{Low} [MHz]	f_{High} [MHz]
U-NII-1: 5150 … 5250 MHz						
5180 / VHT20	5171.216	5188.808	5171.216	5188.820	5171.218	5188.808
5210 / VHT80	5172.440	5247.760	5172.400	5247.760	5172.400	5247.760
5240 / VHT20	5231.228	5248.844	5231.228	5248.844	5231.228	5248.832
U-NII-3: 5725 … 5850 MHz						
5745 / VHT20	5736.204	5753.820	5736.216	5753.820	5736.204	5753.808
5775 / VHT80	5737.360	5812.800	5737.360	5812.720	5737.360	5812.760
5825 / VHT20	5816.228	5833.832	5816.216	5833.820	5816.216	5833.832

13.4.2 Frequency vs. Temperature

Supply voltage: 120 VAC (100 %)

Nominal Frequency [MHz] / Mode	Temperature [°C]					
	35		30		20	
	f_{Low} [MHz]	f_{High} [MHz]	f_{Low} [MHz]	f_{High} [MHz]	f_{Low} [MHz]	f_{High} [MHz]
U-NII-1: 5150 … 5250 MHz						
5180 / VHT20	5171.204	5188.796	5171.768	5188.184	5171.216	5188.820
5210 / VHT80	5172.400	5247.680	5172.440	5247.720	5172.400	5247.760
5240 / VHT20	5231.204	5248.820	5231.768	5248.196	5231.228	5248.844
U-NII-3: 5725 … 5850 MHz						
5745 / VHT20	5736.180	5753.796	5736.768	5753.196	5736.216	5753.820
5775 / VHT80	5737.320	5812.760	5737.320	5812.760	5737.360	5812.720
5825 / VHT20	5816.204	5833.820	5816.792	5833.208	5816.216	5833.820

Supply voltage: 120 VAC (100 %)

Nominal Frequency [MHz] / Mode	Temperature [°C]					
	10		0			
	f_{Low} [MHz]	f_{High} [MHz]	f_{Low} [MHz]	f_{High} [MHz]		
U-NII-1: 5150 … 5250 MHz						
5180 / VHT20	5171.216	5188.820	5171.240	5188.820		
5210 / VHT80	5172.360	5247.760	5172.400	5247.760		
5240 / VHT20	5231.240	5248.832	5231.252	5248.844		
U-NII-3: 5725 … 5850 MHz						
5745 / VHT20	5736.216	5753.820	5736.228	5753.820		
5775 / VHT80	5737.360	5812.800	5737.360	5812.840		
5825 / VHT20	5816.228	5833.820	5816.240	5833.832		

Supply voltage: 120 VAC (100 %), operating at 5210 MHz / VHT80

Time [min]	Temperature [°C]					
	35		30		20	
	f_{Low} [MHz]	f_{High} [MHz]	f_{Low} [MHz]	f_{High} [MHz]	f_{Low} [MHz]	f_{High} [MHz]
U-NII-1: 5150 … 5250 MHz						
0	5172.400	5247.720	5172.360	5247.760	5172.440	5247.760
2	5172.400	5247.720	5172.400	5247.720	5172.360	5247.760
5	5172.360	5247.720	5172.440	5247.760	5172.400	5247.760
10	5172.400	5247.680	5172.440	5247.720	5172.400	5247.760

Supply voltage: 120 VAC (100 %), operating at 5210 MHz / VHT80

Time [min]	Temperature [°C]					
	10		0			
	f_{Low} [MHz]	f_{High} [MHz]	f_{Low} [MHz]	f_{High} [MHz]		
U-NII-1: 5150 … 5250 MHz						
0	5172.440	5247.760	5172.400	5247.760		
2	5172.400	5247.760	5172.400	5247.760		
5	5172.400	5247.800	5172.400	5247.760		
10	5172.360	5247.760	5172.400	5247.760		

Manufacturer: SC Bitdefender SRL
Device: Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No: #4
Modification No: 1 - 3
Tested port: 3
Test date: 2017-10-19/20
Tested by: Patrick Reusch

The EUT meets the requirements of this section.

14 MEASUREMENT UNCERTAINTY

Measurement	Measurement Uncertainty
Radiated emissions, H field (9 kHz – 30 MHz)	± 3.0 dB
Radiated Emissions (30 MHz – 1000 MHz)	± 5.7 dB
Radiated Emissions (Above 1000 MHz)	± 5.3 dB
Temperature	± 1.7 K

The reported uncertainty values are based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of 95%.

If not otherwise stated, the given values are worst case values calculated on the basis of the following documents:
TR 100 028-1 V1.4.1 (2001-12)
TR 100 028-2 V1.4.1 (2001-12)
ISO: Guide to the Expression of Uncertainty in Measurement: 1993.

15 LIST OF ANNEXES

Following annexes are separated parts from this test report.

Description	Pages
Annex 1: Photographs of test set-up	6
Annex 2: Internal photographs of equipment under test (EUTs)	6
Annex 3: External photographs of equipment under test (EUTs)	6
Annex 4: Photographs of ancillary equipment	2