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

EQUIPMENT UNDER TEST:

Device:	Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial Number(s):	#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 § 15.247 RSS-247 Issue 2

MEASUREMENT PROCEDURE:

☒ ANSI C63.10-2013 ☒ RSS-Gen Issue 4 ☒ 558074 D01 DTS Meas Guidance v04

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HEAD OF COMMERCIAL EMC AND RADIO DEPT.:

Wolfgang Döring

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1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance with the 47 CFR § 15.247 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
Fax:	+49 9194 7262-199
E-Mail:	emc.cons@emcc.de
Web:	www.emcc.de

1.4 Customer

Company Name:	Borea d.o.o
Street:	Mlaka 1b
City:	4275 Begunje
Country:	SLOVENIA
Name for contact purposes:	Mr Matevz Langus
Phone:	+386 599 28590
Fax:	none
E-Mail:	matevz.langus@borea.si

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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
2017-09-04	22	48	977	IV	Yes, Mr Cadez and Mr Rahne
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
2017-09-13	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
2017-10-05	22	46	968	IV	Yes, Mr Rahne
2017-10-06	22	46	975	IV	Yes, Mr Rahne

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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 (a/ac in 5 GHz range only; not subject of this report)
Frequency Range(s):	2400 – 2483.5 MHz 5150 – 5250 MHz (not subject of this test report) 5725 – 5825 MHz (not subject of this test report)
Tested Channels:	Refer to test chapters
Modulation:	CCK OFDM
Nominal Bandwidth(s):	20 MHz 40 MHz 80 MHz (5 GHz range, only; not subject of this test report)
Power Supply:	12 V_{DC} via external AC/DC power supply
Ports:	2x Ethernet
Antenna and max. Gain:	# 1: 3.5 dBi, type: N2420DGY-T-PK1-G90S4 # 2: 5.0 dBi, type: N2410DSY-T8B-PK1-G80S4 # 3: 4.6 dBi, type: N2410DSMY-T8B-PK1-G80S4
Operating Temperature Range:	0 °C – 35 °C
Remarks:	None

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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:

Normal Operation/WiFi Off:
The EUT was set to a normal operating condition with WiFi disabled. A high wired Ethernet data throughput was established. Two laptops were used for link partners. EUT and laptops were generating traffic on both Ethernet ports simultaneously. For traffic generation application iperf was used.

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)
CCK	20 MHz	CCK	1	2412	17.5	12.5
			7	2442	17.5	17.5
			11	2462	17.5	12.5
OFDM	20 MHz	OFDM	1	2412	17.5	11.5
			7	2442	17.5	17.5
			11	2462	17.5	11.5
HT40	40 MHz	OFDM	3	2422	17.5	8.5
			7	2442	17.5	17.5
			9	2452	17.5	9.5

Note: the final power settings shown in the table above are the level settings figured out during testing to comply with the limits. These settings have to be used in the final firmware.

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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 for band 2483.5-2500 MHz, the rf output power was reduced by the following levels:

Mode:	CCK	OFDM	HT40
Channel:	11	11	9
Reduction of power level by:	5 dB	6 dB	8 dB

5) In order to comply with the restricted band limits for band 2310-2390 MHz, the rf output power was reduced by the following levels:

Mode:	CCK	OFDM	HT40
Channel:	1	1	3
Reduction of power level by:	5 dB	6 dB	9 dB

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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	§ 15.107; § 15.207	RSS-Gen, 8.8	4	1 – 3	P
RADIATED EMISSIONS 9 kHz – 30 MHz	§ 15.209; § 15.247	RSS-247, 5.5; RSS-Gen, 8.9	5	1 – 3	P
RADIATED EMISSIONS 30 MHz – 1000 MHz	§ 15.109; § 15.209; § 15.247	RSS-247, 5.5; RSS-Gen, 8.9	6	1 – 3	P
RADIATED EMISSIONS 1 – 26 GHz	§ 15.109; § 15.209; § 15.247	RSS-247, 5.5; RSS-Gen, 8.9	7	1 – 3	P
BANDEDGE COMPLIANCE	§ 15.209; § 15.247	RSS-247, 5.5 RSS-Gen, 8.9	8	1 – 5	P
OCCUPIED BANDWIDTH	§ 15.247	RSS-247, 5.2	9	1 – 3	P
FUNDAMENTAL EMISSION OUTPUT POWER	§ 15.247	RSS-247, 5.4	10	1 – 3	P
POWER SPECTRAL DENSITY	§ 15.247	RSS-247, 5.2	11	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

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4 AC POWERLINE CONDUCTED EMISSIONS

Test Requirement: 47 CFR, § 15.107, § 15.207
RSS-Gen, 8.8
Test Procedure: ANSI C63.10

4.1 Regulation

§15.107 Conducted limits.
(a) Except for Class A digital devices, for equipment 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 band edges.

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

§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-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

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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
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
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.

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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

Unintentional Radiator:
Mode: Normal Operation/WiFi Off

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line
0.177	59.54	---	64.63	5.09	L1
0.177	---	42.04	54.63	12.59	L1
0.185	53.48	---	64.25	10.77	N
0.185	---	36.19	54.25	18.06	N
0.188	57.30	---	64.12	6.82	L1
0.188	---	42.18	54.12	11.94	L1
0.276	38.97	---	60.95	21.98	N
0.276	---	22.50	50.95	28.45	N
0.368	37.40	---	58.54	21.14	N
0.368	---	24.43	48.54	24.11	N
0.494	---	22.71	46.10	23.39	L1
0.494	31.44	---	56.10	24.66	L1
0.578	28.62	---	56.00	27.38	L1
0.578	---	17.30	46.00	28.70	L1

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Intentional Radiator:
Mode: Continuous Transmission

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line
0.150	56.94	---	66.00	9.06	L1
0.158	61.35	---	65.57	4.22	L1
0.169	59.23	---	65.01	5.77	L1
0.173	58.59	---	64.81	6.22	L1
0.177	60.38	---	64.62	4.24	L1
0.177	---	44.23	54.64	10.41	L1
0.181	58.05	---	64.45	6.40	L1
0.184	58.86	---	64.29	5.43	L1
0.184	---	43.83	54.29	10.46	L1
0.188	58.03	---	64.12	6.09	L1
0.192	56.98	---	63.95	6.97	L1
0.196	56.22	---	63.79	7.57	L1
0.196	---	45.43	53.79	8.36	L1
0.200	54.54	---	63.62	9.07	L1
0.203	54.82	---	63.48	8.65	L1
0.203	---	43.92	53.48	9.55	L1
0.254	52.14	---	61.64	9.50	L1
0.263	53.21	---	61.35	8.14	L1
0.271	51.81	---	61.09	9.28	L1
0.281	51.17	---	60.80	9.63	L1

Worst case results listed, only.

Manufacturer:	SC Bitdefender SRL
Device:	Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No:	#6
Modification No:	1 – 3
Test date:	2017-10-05
Tested by:	P. Reusch

The EUT meets the requirements of this section.

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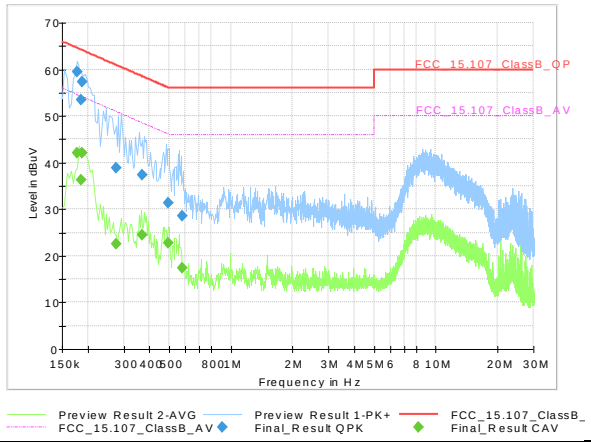
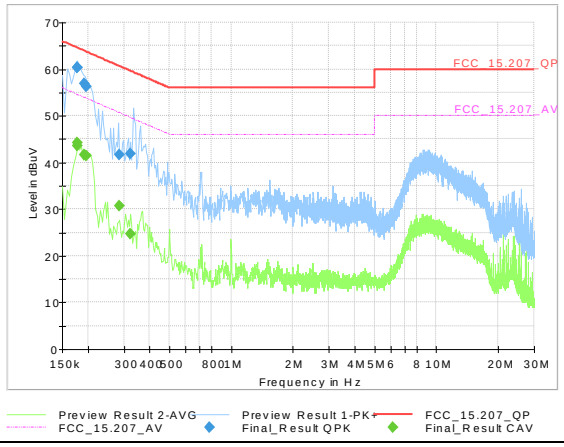
4.5 Detailed Measurement Data

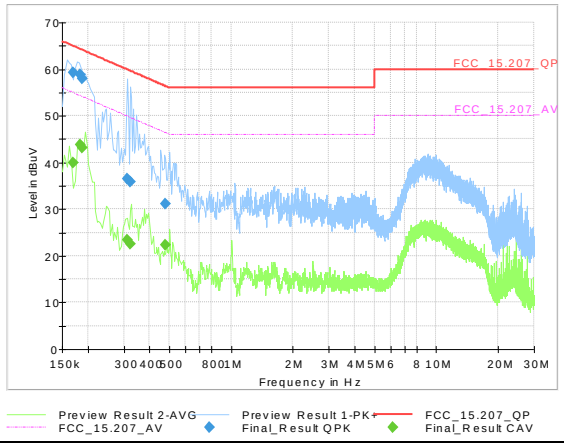
Unintentional Radiator
Normal Operation/WiFi Off



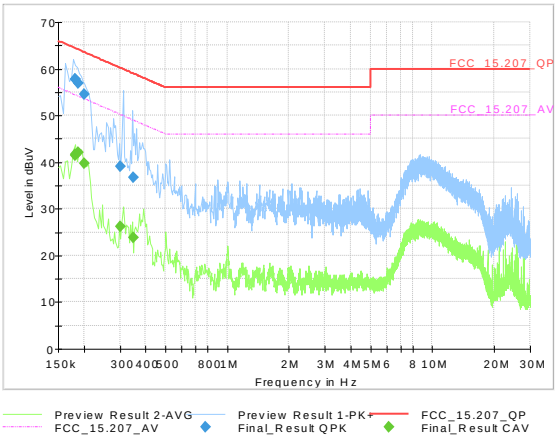
Intentional Radiator
Channel: 1
Mode: CCK



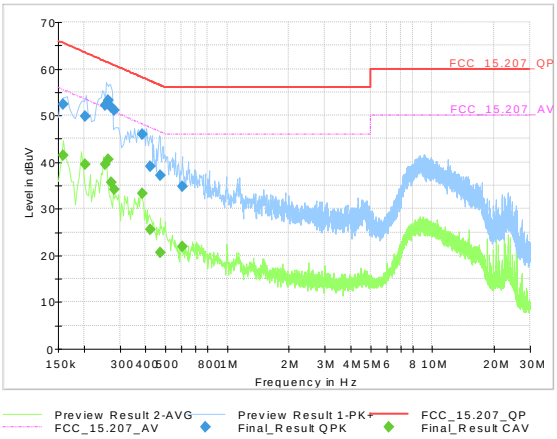
Intentional Radiator
Channel: 7
Mode: CCK



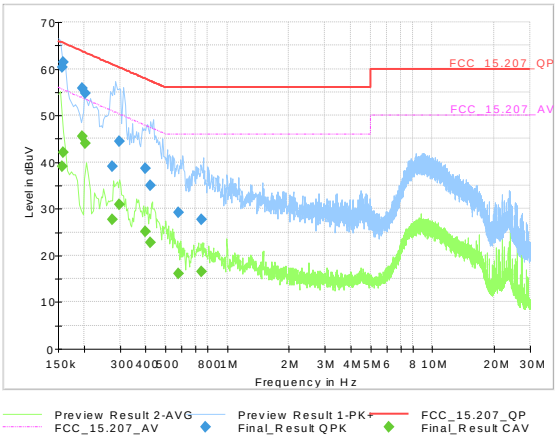
Intentional Radiator
Channel: 11
Mode: CCK



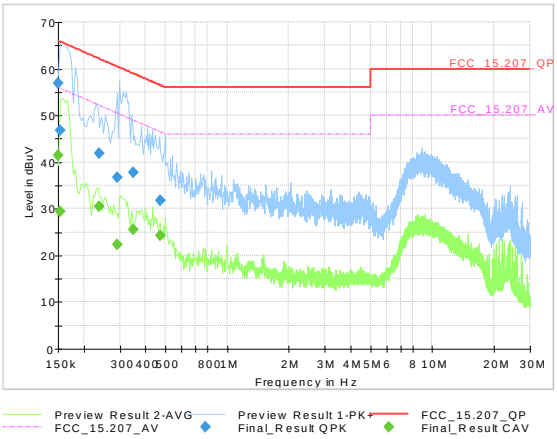
Intentional Radiator
Channel: 1
Mode: OFDM



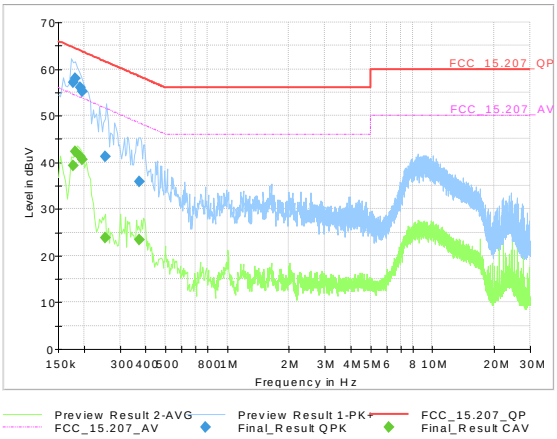
Intentional Radiator
Channel: 7
Mode: ODFM



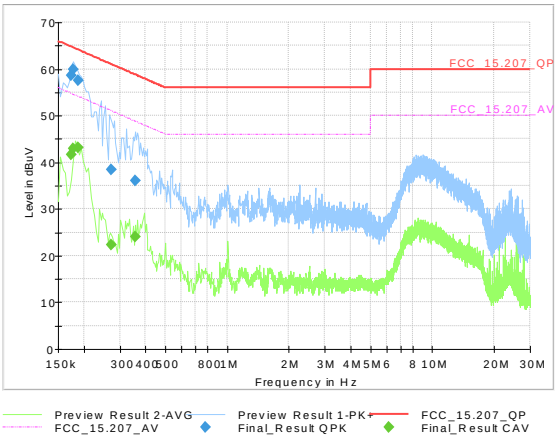
Intentional Radiator
Channel: 11
Mode: OFDM



Intentional Radiator
Channel: 3
Mode: HT40



Intentional Radiator
Channel: 7
Mode: HT40



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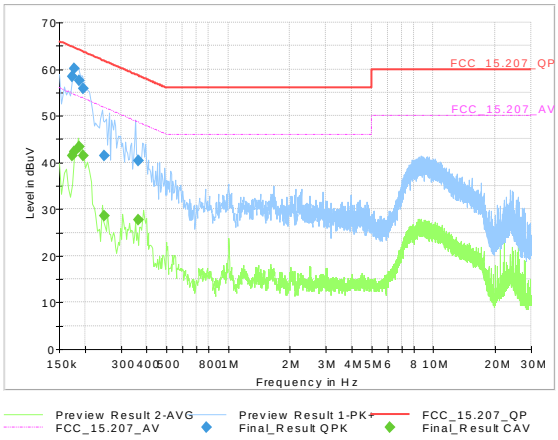
Intentional Radiator
Channel: 9
Mode: HT40



5 RADIATED EMISSIONS 9 kHz – 30 MHz

Test requirement: 47 CFR, §§ 15.209, 15.247
RSS-247, 5.5; RSS-Gen, 8.9
Test procedure: ANSI C63.10

5.1 Regulation

§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.

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

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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.

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.

RSS-247, 5.5 Unwanted emissions
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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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.”

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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.

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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]
0.5	QPK	58.5	73.6	15.1
1.0	QPK	48.7	67.6	19.0

Manufacturer: SC Bitdefender SRL
Device: Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No: #6
Modification No: 1 – 3
Test date: 2017-09-06/14
Tested by: L. Kraft

The EUT meets the requirements of this section.

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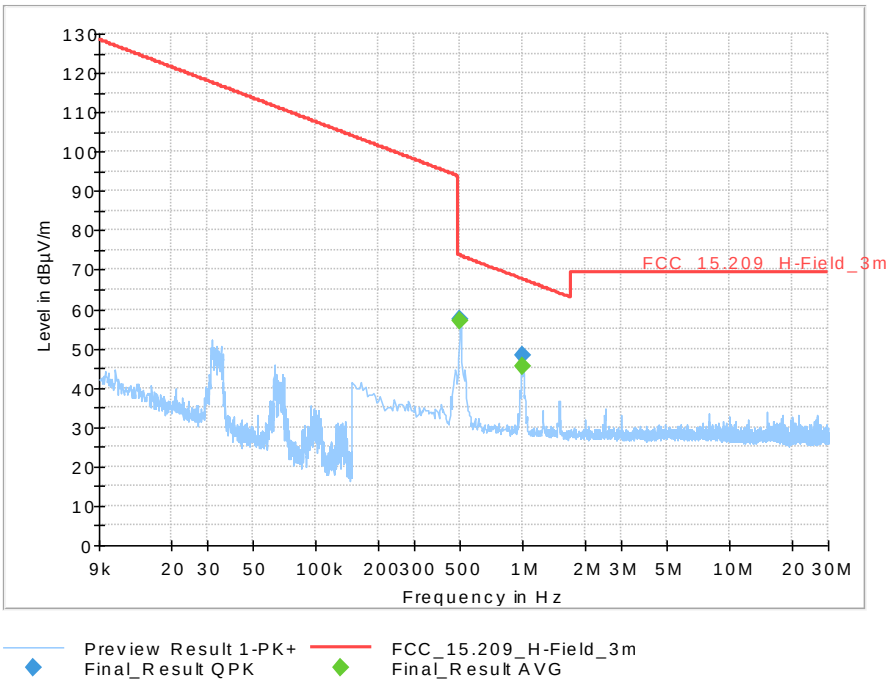
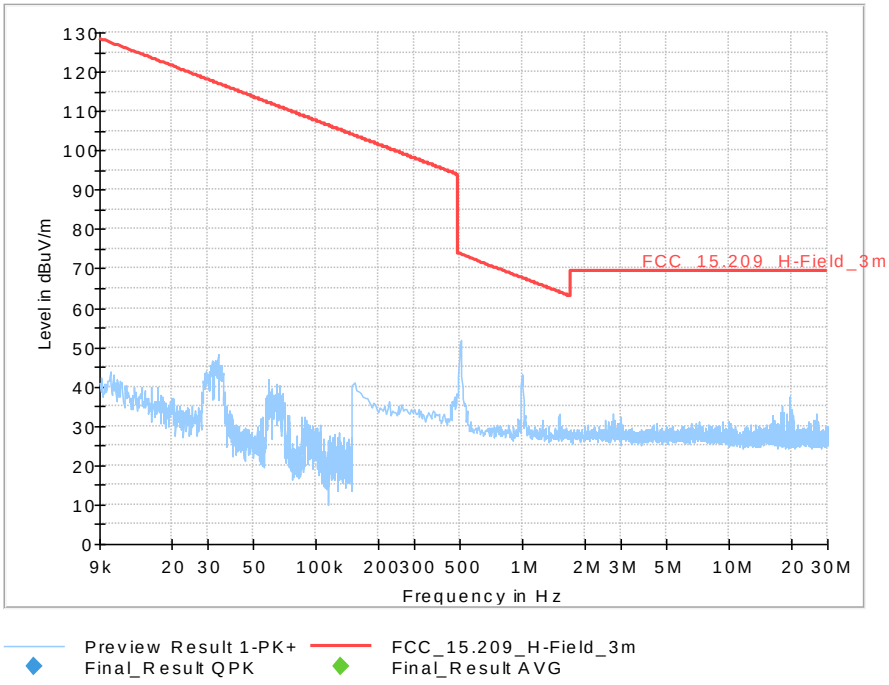
5.7 Detailed Measurement Data

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“).

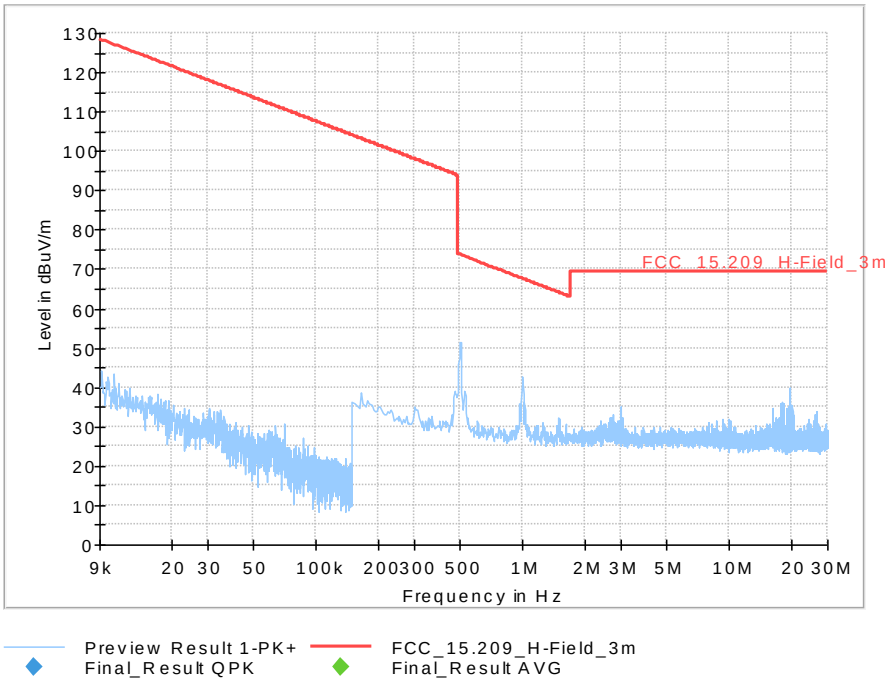
Radiated Emissions 9 kHz – 30 MHz
Mod.: 1 – 3
Mode: CCK



Radiated Emissions 9 kHz – 30 MHz
Mod.: 1 & 3
Mode: OFDM



Radiated Emissions 9 kHz – 30 MHz
Mod.: 1 & 3
Mode: HT40



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6 RADIATED EMISSIONS 30 MHz – 1000 MHz

Test requirement: 47 CFR, §§ 15.109, 15.209, 15.247
RSS-247, 5.5; RSS-Gen, 8.9
Test procedure: ANSI C63.10

6.1 Regulation

§15.109 Radiated emission limits.
(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

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

§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.

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§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

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.

RSS-247, 5.5 Unwanted emissions
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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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 nonconducting 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.

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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.

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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.

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6.6 Final Test Results

Unintentional Radiator:
Mode: Normal Operation/WiFi Off

Frequency [MHz]	Result [dBµV/m]	Limit * [dBµV/m]	Margin [dB]	Remarks
101.9	30.4	43.5	13.1	
125.0	29.5	43.5	14.0	
325.0	38.3	46.0	7.7	
350.0	31.5	46.0	14.5	
500.0	36.8	46.0	9.2	
533.0	35.8	46.0	10.2	

Intentional Radiator:
Mode: Continuous Transmission

Frequency [MHz]	Result [dBµV/m]	Limit * [dBµV/m]	Margin [dB]	Remarks
75.0	35.5	40	4.5	
97.7	29.1	43.5	14.4	
151.8	29.6	43.5	13.9	
152.9	34.6	43.5	8.9	
250.0	37.7	46	8.3	
275.0	32.1	46	13.9	
375.0	43	46	3	
500.0	37.5	46	8.5	

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:	2017-09-04/05
Tested by:	L. Kraft / P. Reusch

The EUT meets the requirements of this section.

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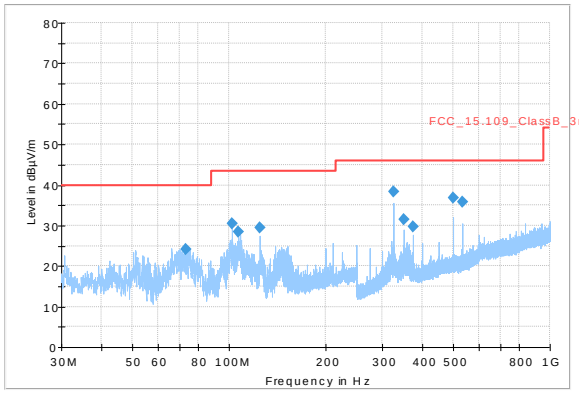
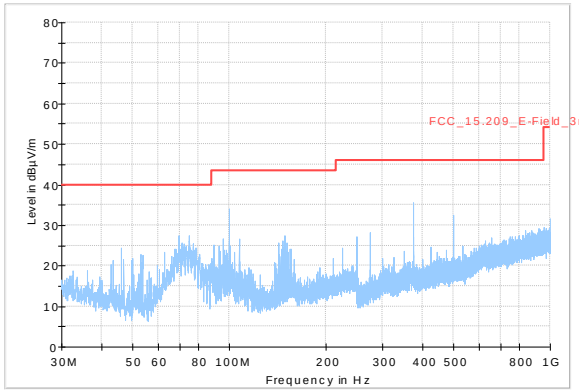
6.7 Detailed Measurement Data

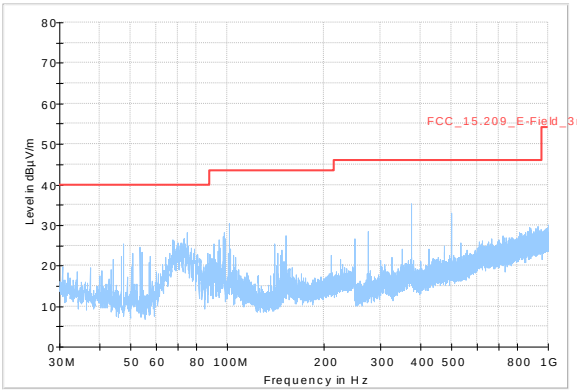
Unintentional Radiator
Normal Operation/WiFi Off



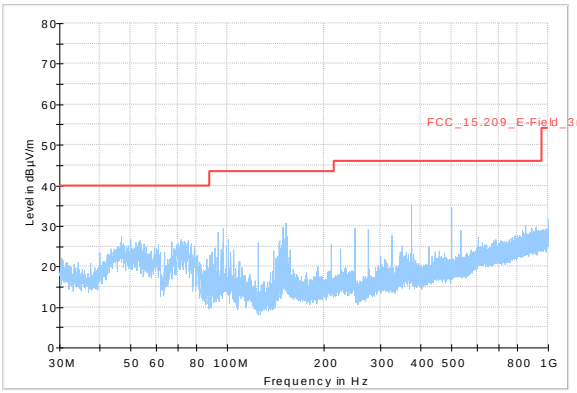
Radiated Emissions 30 – 1000 MHz
Channel: 1
Mode: CCK



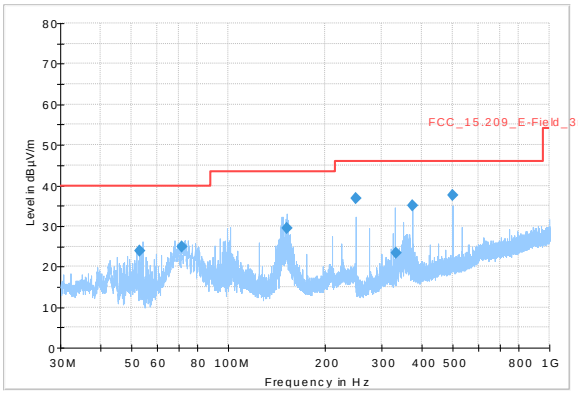
Radiated Emissions 30 – 1000 MHz
Channel: 7
Mode: CCK



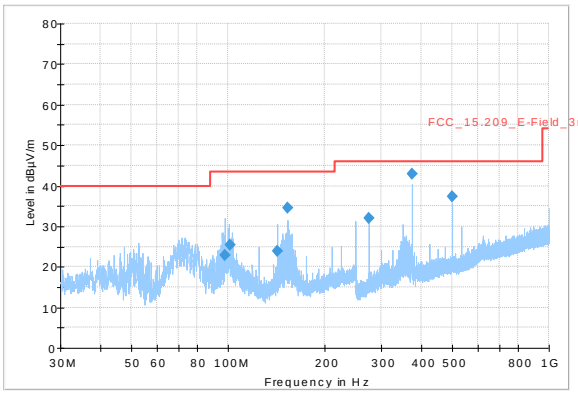
Radiated Emissions 30 – 1000 MHz
Channel: 11
Mode: CCK



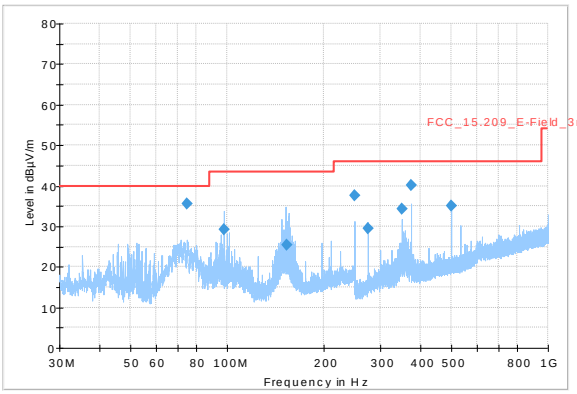
Radiated Emissions 30 – 1000 MHz
Channel: 1
Mode: OFDM



Radiated Emissions 30 – 1000 MHz
Channel: 7
Mode: OFDM



Radiated Emissions 30 – 1000 MHz
Channel: 11
Mode: OFDM



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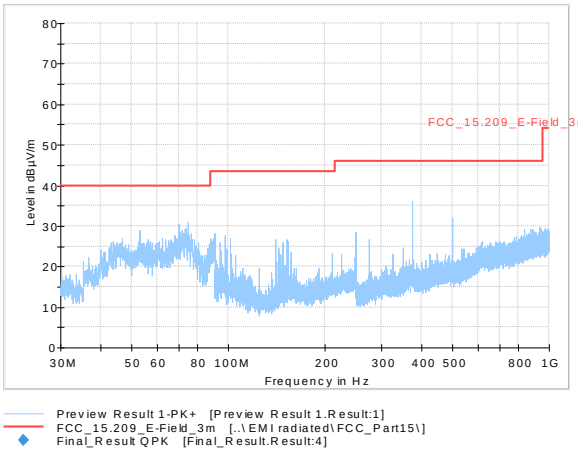
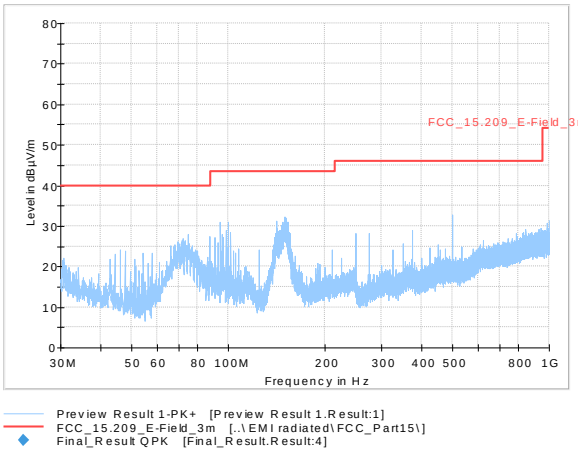
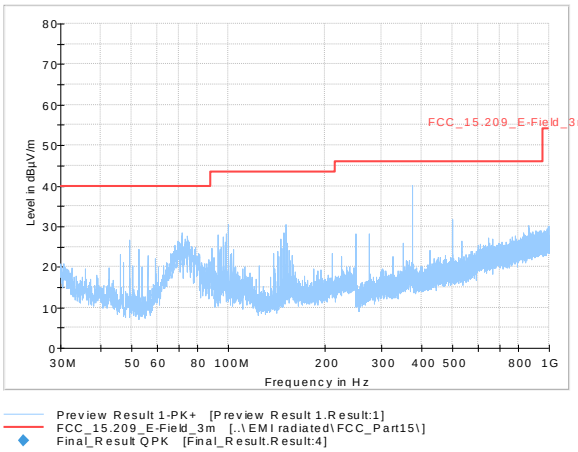
Radiated Emissions 30 – 1000 MHz
Channel: 3
Mode: HT40



Radiated Emissions 30 – 1000 MHz
Channel: 7
Mode: HT40



Radiated Emissions 30 – 1000 MHz
Channel: 9
Mode: HT40



7 RADIATED EMISSIONS 1 – 26 GHz

Test requirement: 47 CFR, §§ 15.109, 15.209, 15.247
RSS-247, 5.5; RSS-Gen, 8.9
Test procedure: ANSI C63.10

7.1 Regulation

§15.109 Radiated emission limits.
(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

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

§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 Dstance
[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.

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§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

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.

RSS-247, 5.5 Unwanted emissions
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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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
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
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
Band Reject Filter	ZYSEN / ZSBR2441.75-83.5U10CS	4993	2017-04	2019-04
High Pass Filter	dBd communications / DBD-FTR-13SH-U8000-O/O	5366	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

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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 – 26.5 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.

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7.6 Final Test Results

Radiated Spurious Emissions 1 – 26.5 GHz – Peak Results				
Frequency [MHz]	**Result [dBµV/m]**	**Limit * [dBµV/m]**	**Margin [dB]**	**Remarks**
3471.5	54.43	74	19.57	
3472.1	53.77	74	20.23	
3859.0	53.6	74	20.4	
3859.1	54.91	74	19.09	
3875.2	55.23	74	18.77	
3907.1	54.58	74	19.42	
3923.2	54.69	74	19.31	
3939.2	54.9	74	19.1	

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 – 26.5 GHz – Average Results				
Frequency [MHz]	**Result [dBµV/m]**	**Limit * [dBµV/m]**	**Margin [dB]**	**Remarks**
3471.5	47.53	54	6.47	
3471.7	48.23	54	5.77	
3471.8	48.43	54	5.57	
3471.9	47.88	54	6.12	
3472.1	47.07	54	6.93	
3472.2	46.65	54	7.35	
3859.0	51.15	54	2.85	
3859.1	52.78	54	1.22	
3875.2	52.99	54	1.01	
3907.1	52.53	54	1.47	
3907.3	52.2	54	1.8	
3923.2	52.63	54	1.37	
3939.2	52.9	54	1.1	

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.

Manufacturer:	SC Bitdefender SRL
Device:	Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No:	#6
Modification No:	1 – 3
Test date:	2017-09-07/13
Tested by:	L. Kraft / P. Reusch / M. Zenk

The EUT meets the requirements of this section.

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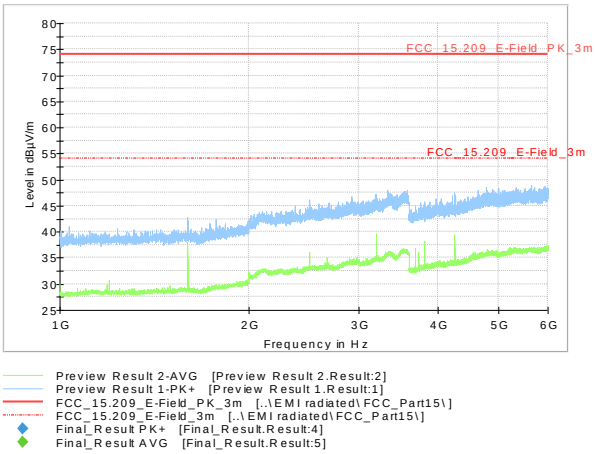
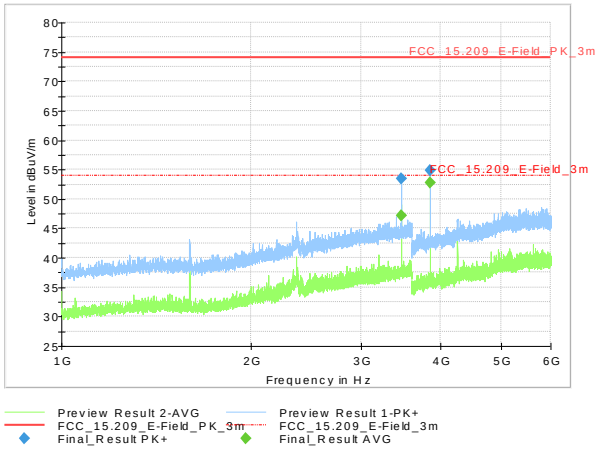
7.7 Detailed Measurement Data

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 3 m distance.

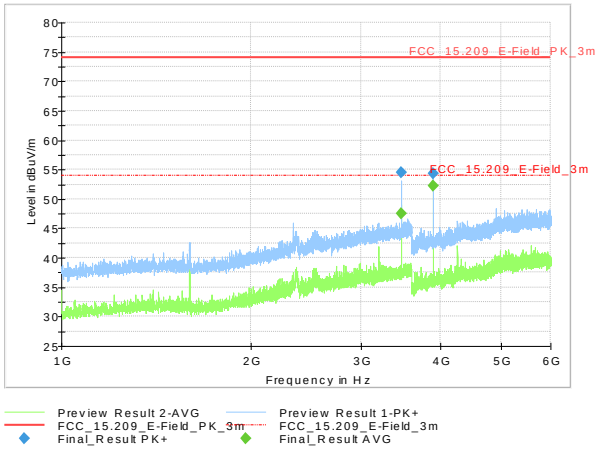
Radiated Emissions 1 – 6 GHz
Mode: Normal Operation/WiFi Off



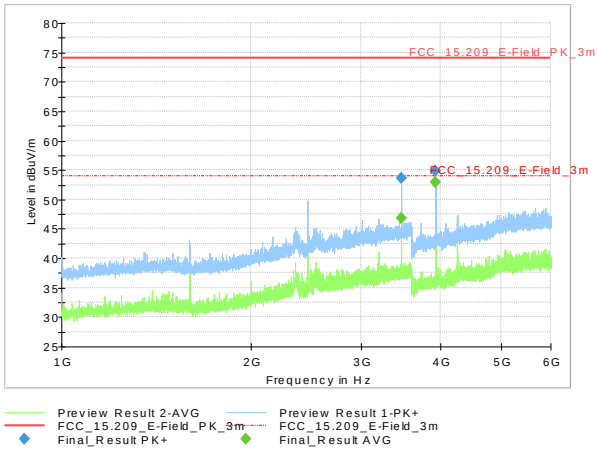
Radiated Emissions 1 – 6 GHz
Channel: 1
Mode: CCK



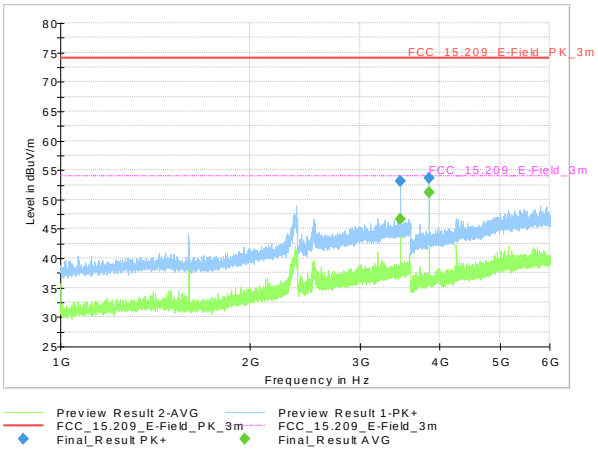
Radiated Emissions 1 – 6 GHz
Channel: 7
Mode: CCK



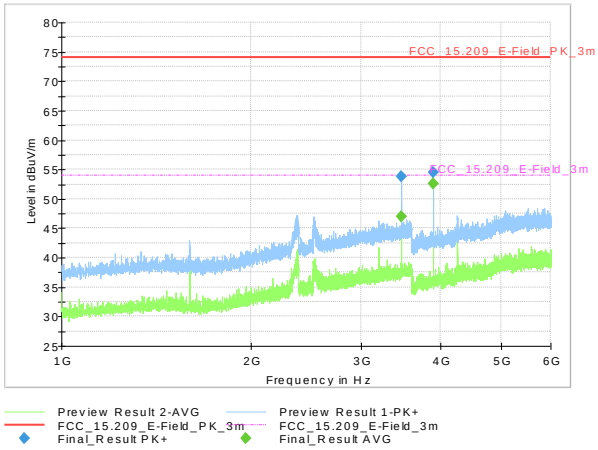
Radiated Emissions 1 – 6 GHz
Channel: 11
Mode: CCK



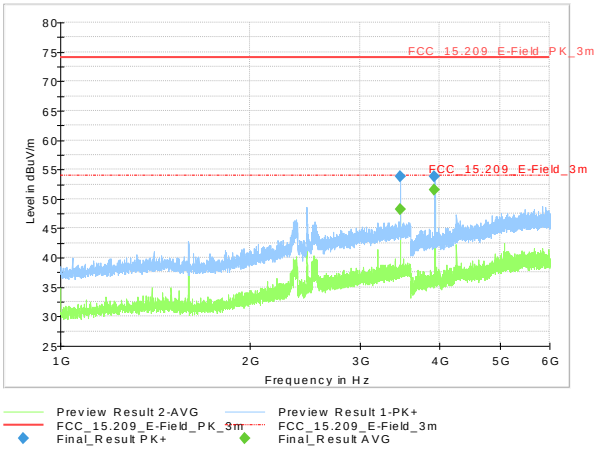
Radiated Emissions 1 – 6 GHz
Channel: 1
Mode: OFDM



Radiated Emissions 1 – 6 GHz
Channel: 7
Mode: ODFM



Radiated Emissions 1 – 6 GHz
Channel: 11
Mode: OFDM



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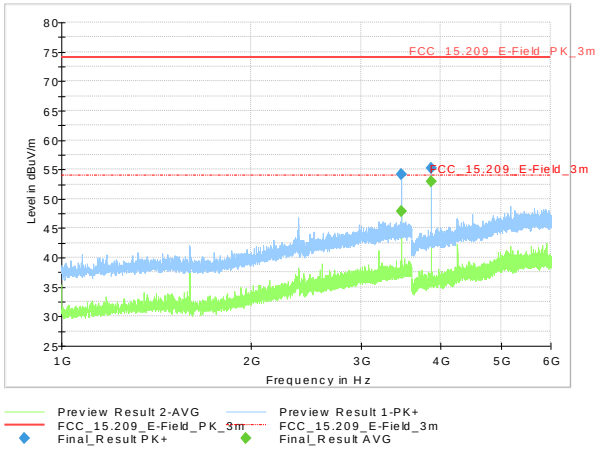
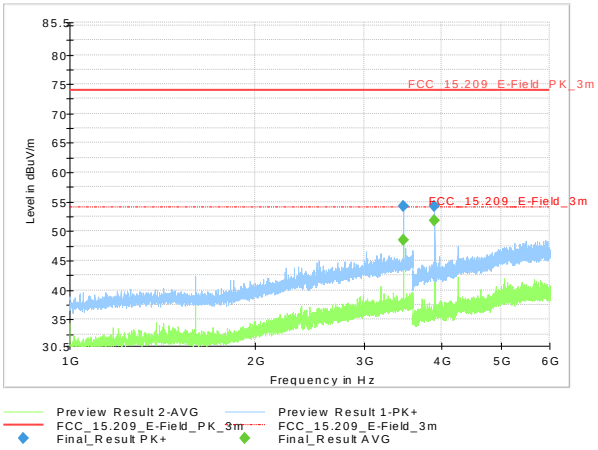
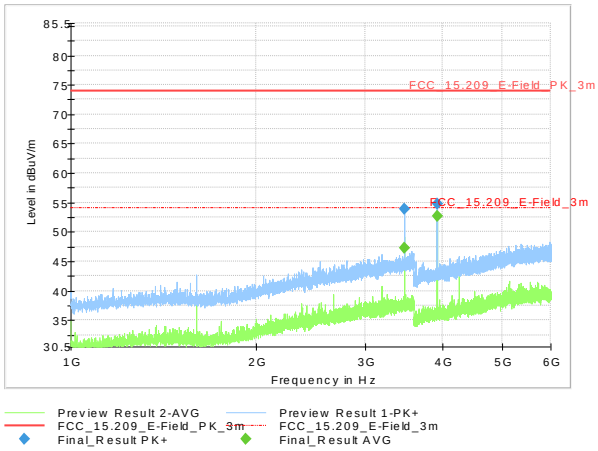
Radiated Emissions 1 – 6 GHz
Channel: 3
Mode: HT40



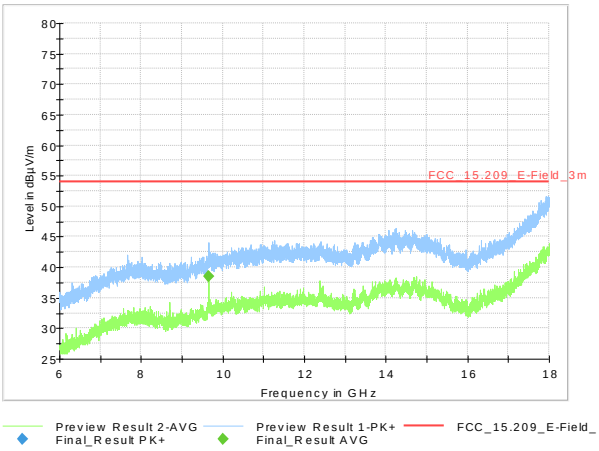
Radiated Emissions 1 – 6 GHz
Channel: 7
Mode: HT40



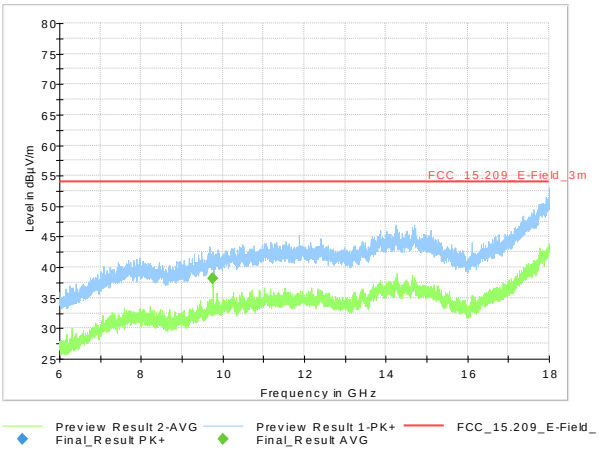
Radiated Emissions 1 – 6 GHz
Channel: 9
Mode: HT40



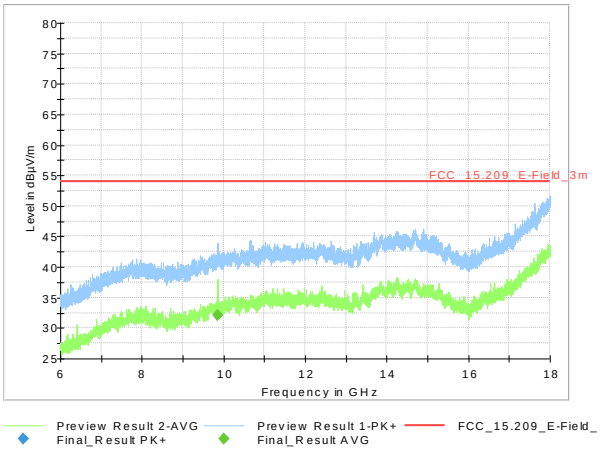
Radiated Emissions 6 – 18 GHz
Channel: 1
Mode: CCK



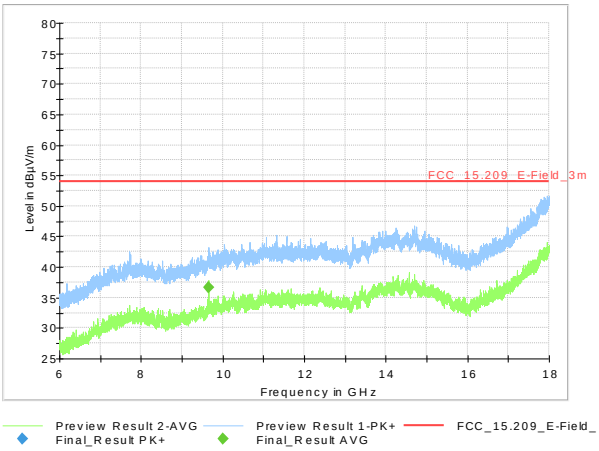
Radiated Emissions 6 – 18 GHz
Channel: 7
Mode: CCK



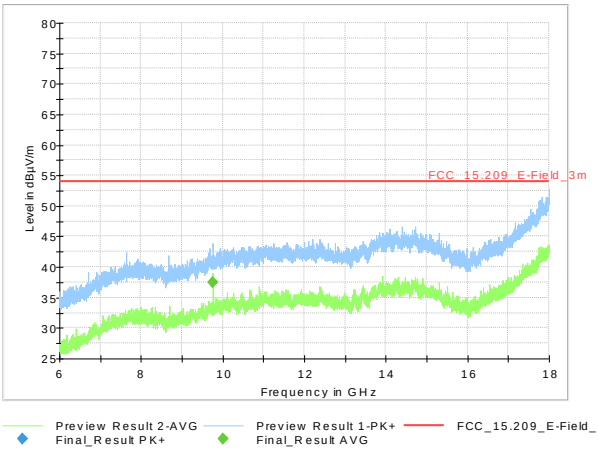
Radiated Emissions 6 – 18 GHz
Channel: 11
Mode: CCK



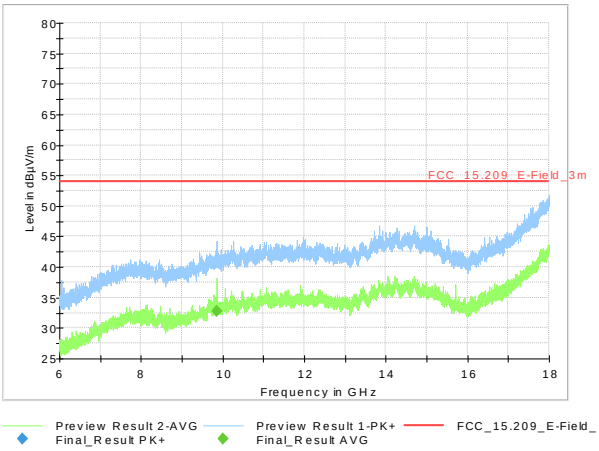
Radiated Emissions 6 – 18 GHz
Channel: 1
Mode: OFDM



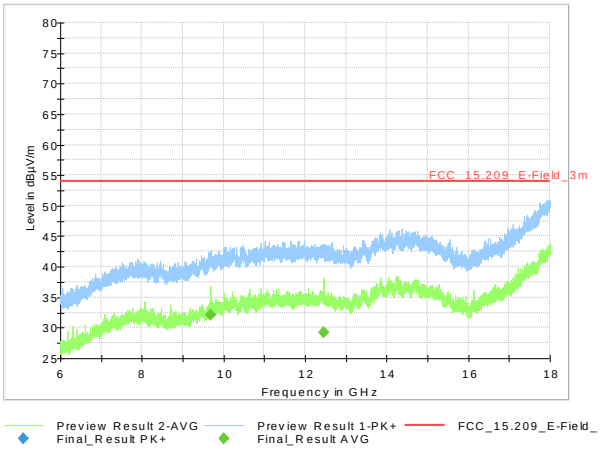
Radiated Emissions 6 – 18 GHz
Channel: 7
Mode: ODFM



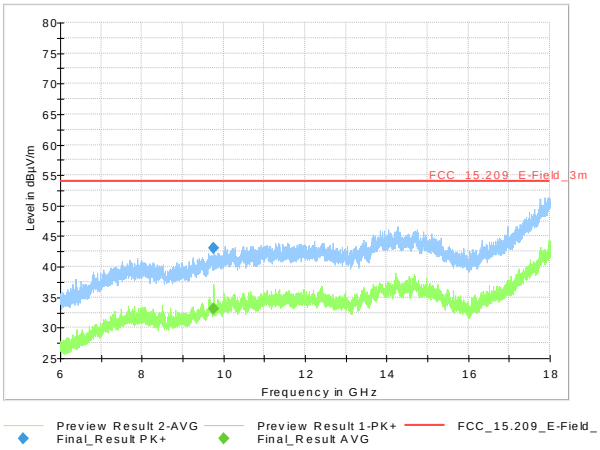
Radiated Emissions 6 – 18 GHz
Channel: 11
Mode: OFDM



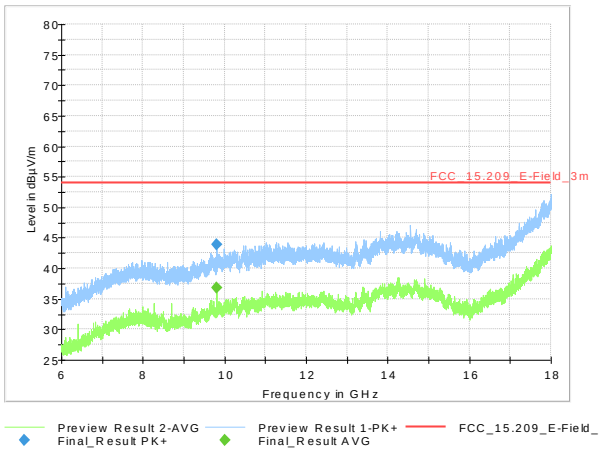
Radiated Emissions 6 – 18 GHz
Channel: 3
Mode: HT40



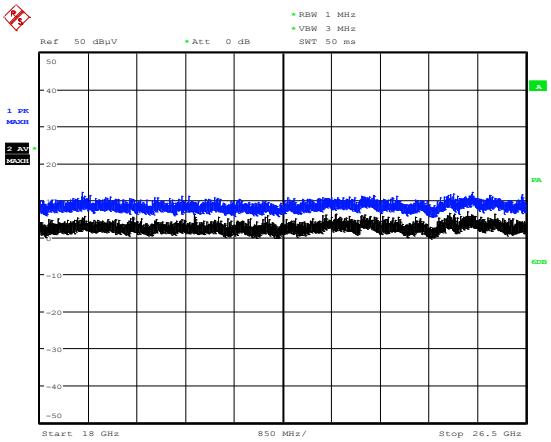
Radiated Emissions 6 – 18 GHz
Channel: 7
Mode: HT40



Radiated Emissions 6 – 18 GHz
Channel: 9
Mode: HT40

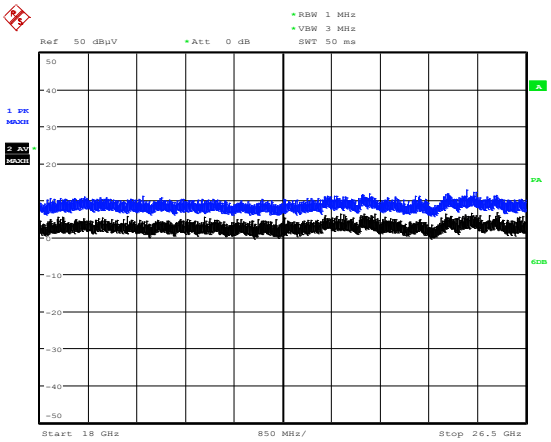


Radiated Emissions 18 – 26.5 GHz
Channel: 1
Mode: CCK



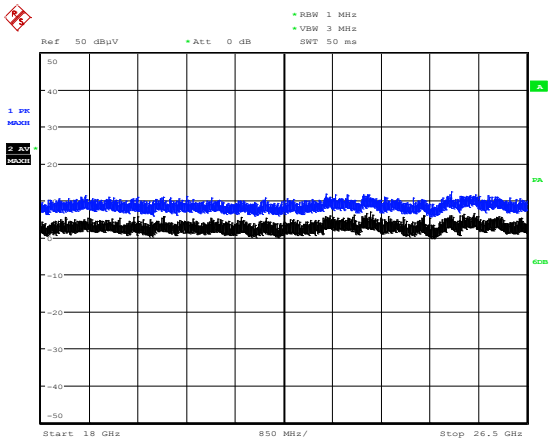
Date: 13.SEP.2017 14:51:32

Radiated Emissions 18 – 26.5 GHz
Channel: 7
Mode: CCK



Date: 13.SEP.2017 14:52:56

Radiated Emissions 18 – 26.5 GHz
Channel: 11
Mode: CCK



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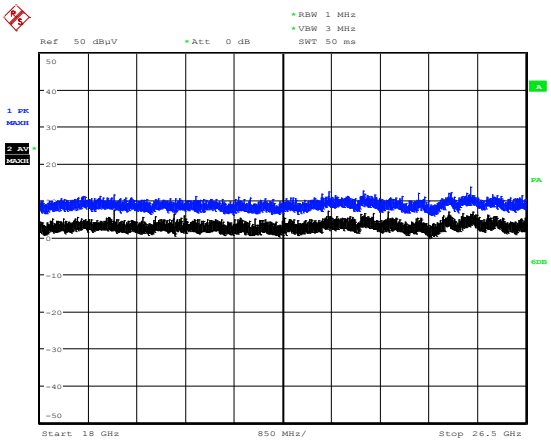
Radiated Emissions 18 – 26.5 GHz
Channel: 1
Mode: OFDM



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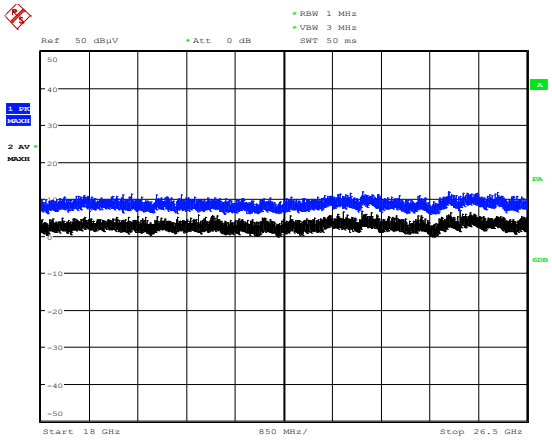
Radiated Emissions 18 – 26.5 GHz
Channel: 7
Mode: ODFM



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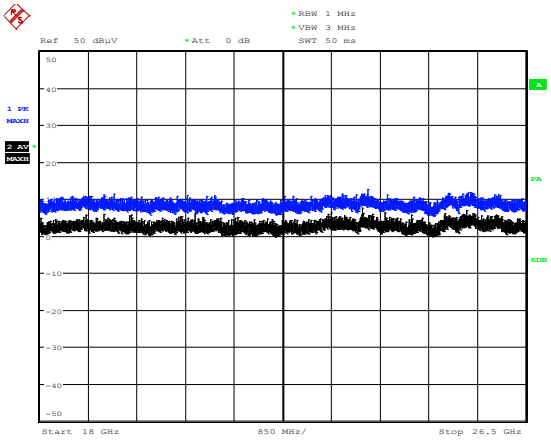
Radiated Emissions 18 – 26.5 GHz
Channel: 11
Mode: OFDM



Date: 13.SEP.2017 14:50:09

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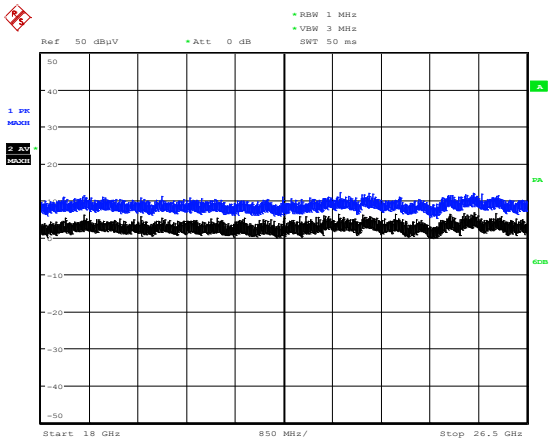
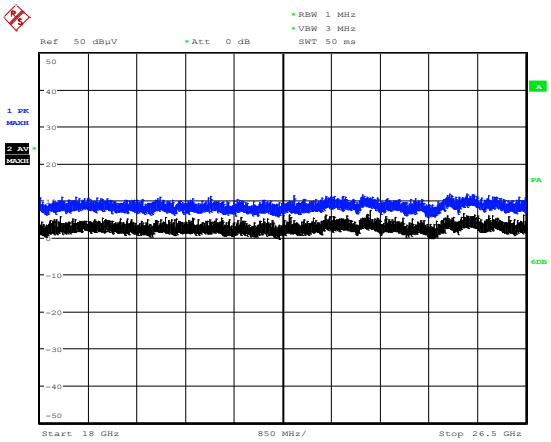
Radiated Emissions 18 – 26.5 GHz
Channel: 3
Mode: HT40



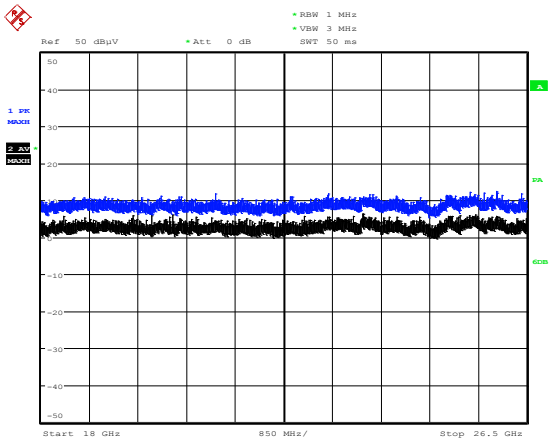
Date: 13.SEP.2017 14:56:09

Radiated Emissions 18 – 26.5 GHz
Channel: 7
Mode: HT40



Date: 13.SEP.2017 14:57:24

Radiated Emissions 18 – 26.5 GHz
Channel: 9
Mode: HT40



Date: 13.SEP.2017 14:58:41

8 BANDEDGE COMPLIANCE

Test Requirement: 47 CFR, §§ 15.209, 15.247
RSS-247, 5.5; RSS-Gen 8.9
Test Procedure: 558074 D01 DTS Meas Guidance
ANSI C63.10

8.1 Regulation

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

§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]
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46.0	3
Above 960	500	54	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.

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RSS-247, 5.5 Unwanted emissions
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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.

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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
RF cable assembly	Rosenberger / LA2-025-7000	5616	2017-09	2018-09

8.3 Test Procedures

558074 D01 DTS Meas Guidance, 12.0 Emissions in restricted frequency bands

The DTS rules specify that emissions which fall into restricted frequency bands shall comply with the general radiated emission limits.

12.1 Radiated emission measurements
Since the emission limits are specified in terms of radiated field strength levels, measurements performed to demonstrate compliance have traditionally relied on a radiated test configuration. Radiated measurements remain the principal method for demonstrating compliance to the specified limits; however antenna-port conducted measurements are also now acceptable to demonstrate compliance (see below for details). When radiated measurements are utilized, test site requirements and procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 shall be followed.

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8.4 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.

8.5 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 19.4 dBµV is obtained. The Antenna Factor of 27.6 dB(1/m) and a Cable Factor of 1.6 dB are added, giving a field strength of 48.6 dBµV/m. The 48.6 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 19.4 + 27.6 + 1.6 = 48.6 [dBµV/m]
Level in µV/m = Common Antilogarithm (48.6/20) = 269

All emission measurements described in this chapter performed using the EMI receiver's transducer factor setting capability, i.e. the peak 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 additionally 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 48.6 dBµV/m, the value for the average field strength with a Duty Cycle correction factor DCF of -10.5 dB corresponds with 38.1 dBµV/m.

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8.6 Test Result

Band-edge Emissions – Lower Edge					
Mode	**Freq. [MHz]**	**Detector**	**Result [dBµV/m]**	**Limit [dBµV/m]**	**Remark**
HT40	2389.5	AV	52.5	54	

Band-edge Emissions – Upper Edge					
Mode	**Freq. [MHz]**	**Detector**	**Result [dBµV/m]**	**Limit [dBµV/m]**	**Remark**
OFDM	2484.0	AV	53.5	54	
HT40	2483.8	AV	51.7	54	

Manufacturer: SC Bitdefender SRL
Device: Bitdefender BOX 2 Smart Home Cybersecurity Hub
Serial No: #6
Modification No: 1 – 5, refer to “Detailed Measurement Data” hereafter for details
Test date: 2017-10-05/06
Tested by: M. Zenk

The EUT meets the requirements of this section.

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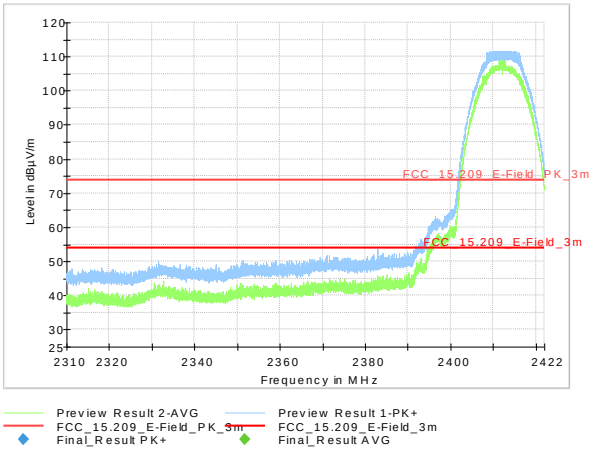
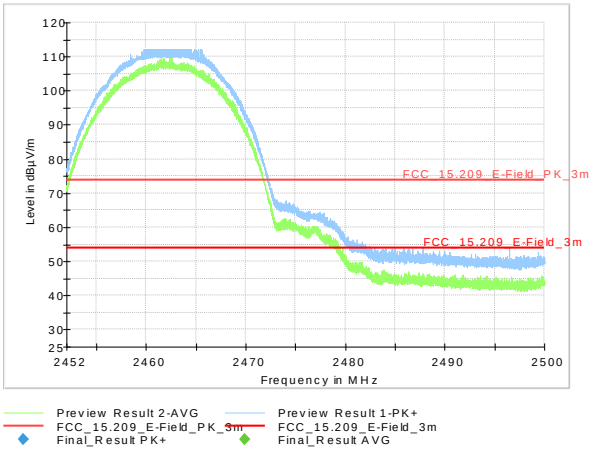
8.7 Detailed Measurement Data

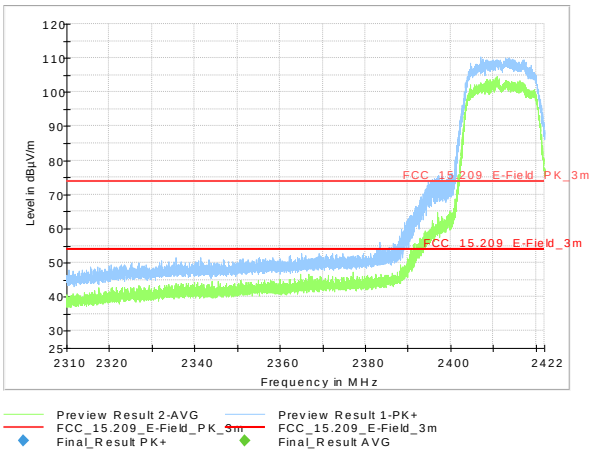
Band-Edge Compliance – Lower Edge
Mode: CCK
Channel: 1
Mod.: 1 – 3, 5



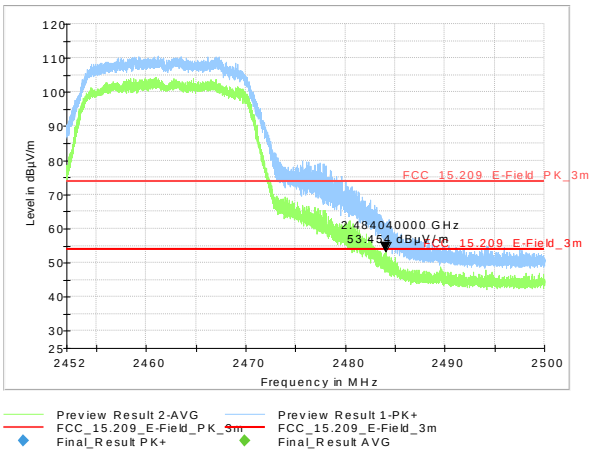
Band-Edge Compliance – Upper Edge
Mode: CCK
Channel: 11
Mod.: 1 – 4

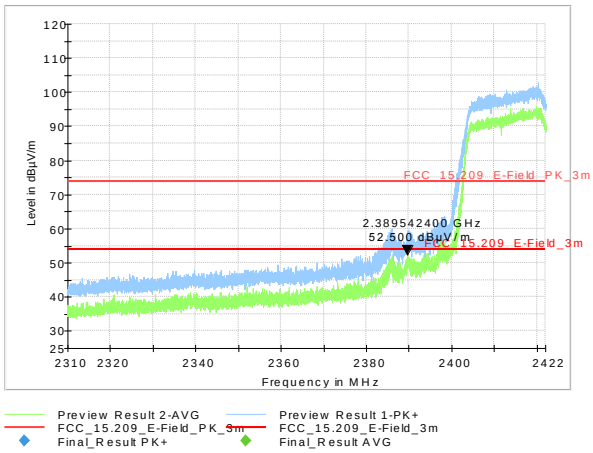
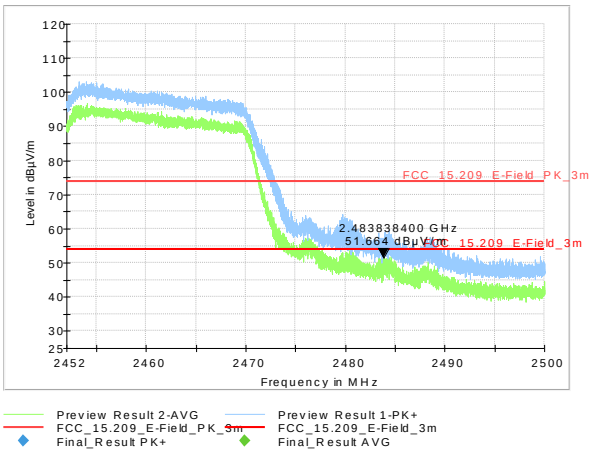


Band-Edge Compliance – Lower Edge
Mode: OFDM
Channel: 1
Mod.: 1 – 3, 5



Band-Edge Compliance – Upper Edge
Mode: OFDM
Channel: 11
Mod.: 1 – 4



Band-Edge Compliance – Lower Edge Mode: HT40 Channel: 3 Mod.: 1 – 3, 5	Band-Edge Compliance – Upper Edge Mode: HT40 Channel: 9 Mod.: 1 – 4
	

9 OCCUPIED BANDWIDTH

Test Requirement: 47 CFR, § 15.247
RSS-247, 5.2
Test Procedure: 558074 D01 DTS Meas Guidance v04
RSS-Gen, 6.6

9.1 Regulation

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

RSS-247, 5.2 Digital transmission systems
DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902‑928 MHz and 2400-2483.5 MHz:
a) The minimum 6 dB bandwidth shall be 500 kHz.

9.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
2 W Attenuator 10 dB	Weinschel / 54A-10	1745	2016-06	2018-06
DC Power Supply	Sorensen / DCS33-33EM15	3031	n/a	n/a
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

558074 D01 DTS Meas Guidance:

8.0 DTS bandwidth

The following procedure was used to determine the modulated DTS bandwidth:

8.1 Option 1
a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 × 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.

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RSS-Gen, 6.6 Occupied Bandwidth

The emission bandwidth (×dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated × dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3× the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3×RBW**.**

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9.4 Test Result

6 dB Bandwidth				
Mode	**Operating Channel**	**Nominal Tx Frequency [MHz]**	**6 dB Bandwidth [MHz]**	**Limit [MHz]**
CCK	1	2412	9.8	≥ 0.5
	7	2442	10.3	≥ 0.5
	11	2462	10.3	≥ 0.5
OFDM	1	2412	16.5	≥ 0.5
	7	2442	16.2	≥ 0.5
	11	2462	16.5	≥ 0.5
HT40	3	2422	35.1	≥ 0.5
	7	2442	35.1	≥ 0.5
	9	2452	35.1	≥ 0.5

99 % Bandwidth				
Mode	**Operating Channel**	**Nominal Tx Frequency [MHz]**	**99 % Bandwidth [MHz]**	**Limit [MHz]**
CCK	1	2412	13.4	≥ 0.5
	7	2442	13.5	≥ 0.5
	11	2462	13.5	≥ 0.5
OFDM	1	2412	16.9	≥ 0.5
	7	2442	17.0	≥ 0.5
	11	2462	17.0	≥ 0.5
HT40	3	2422	37.0	≥ 0.5
	7	2442	37.1	≥ 0.5
	9	2452	37.1	≥ 0.5

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

The EUT meets the requirements of this section.

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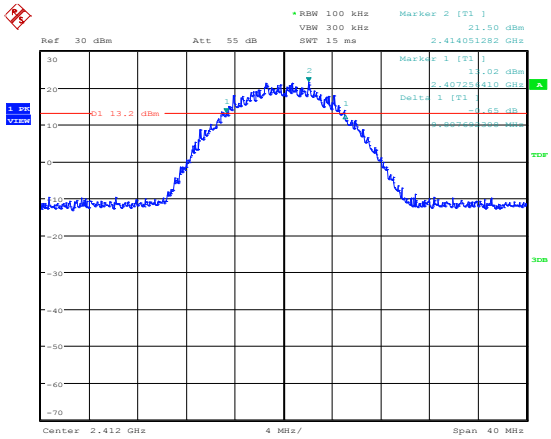
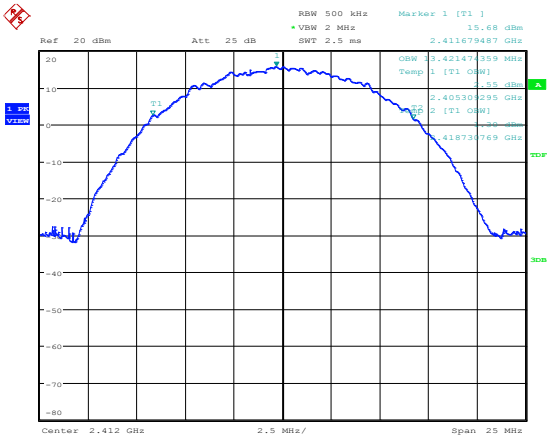
9.5 Detailed Measurement Data

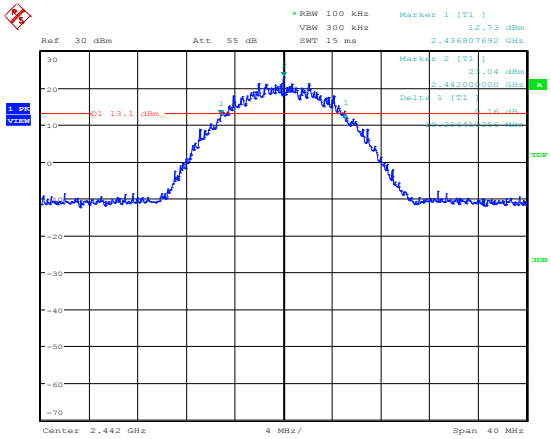
6dB Bandwidth
Channel: 1
Mode: CCK



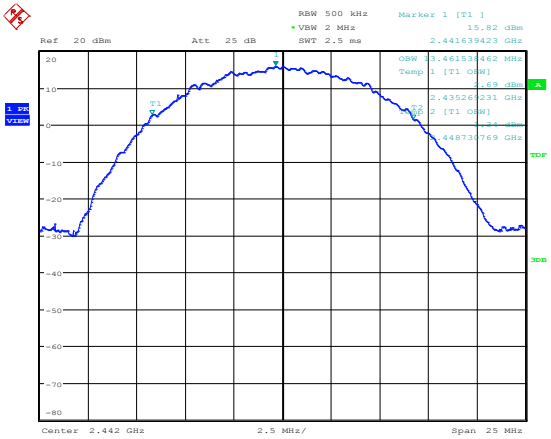
99% Bandwidth
Channel: 1
Mode: CCK



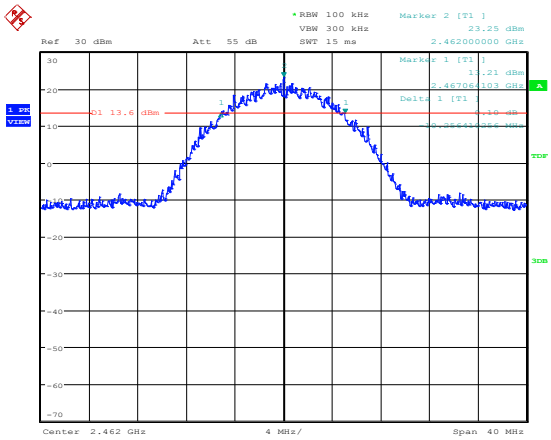
6dB Bandwidth
Channel: 7
Mode: CCK



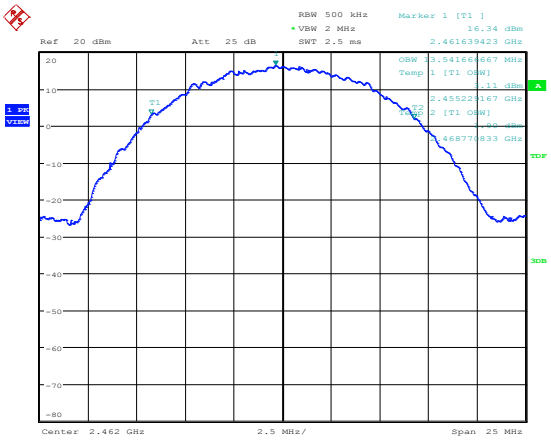
99% Bandwidth
Channel: 7
Mode: CCK



6dB Bandwidth
Channel: 11
Mode: CCK



99% Bandwidth
Channel: 11
Mode: CCK



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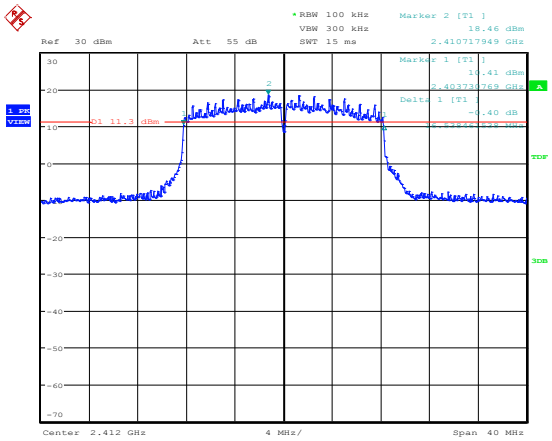
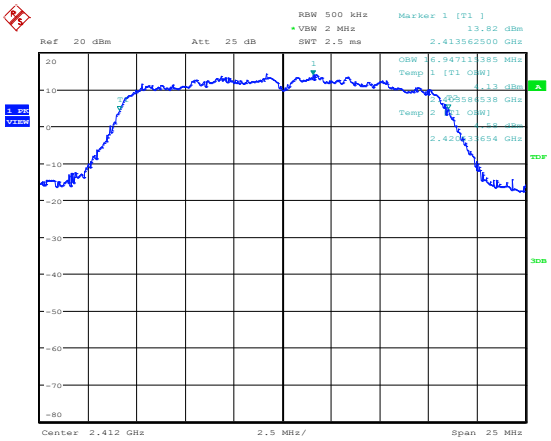
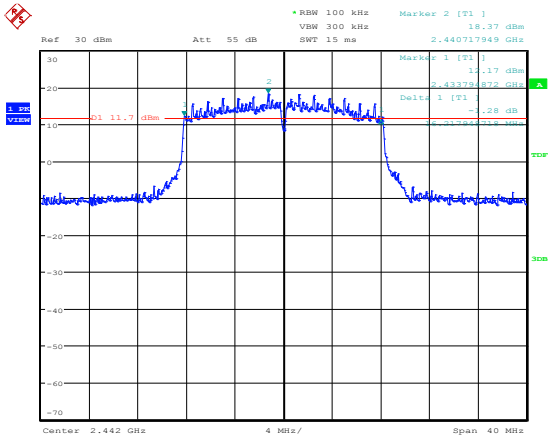
6dB Bandwidth
Channel: 1
Mode: OFDM



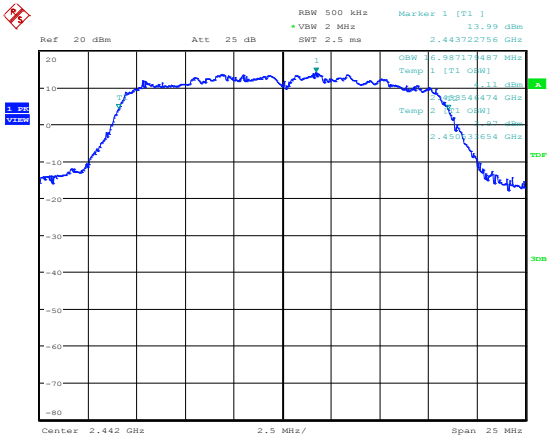
99% Bandwidth
Channel: 1
Mode: OFDM



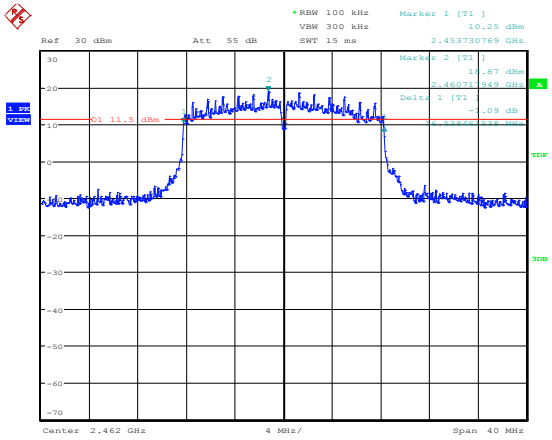
6dB Bandwidth
Channel: 7
Mode: OFDM



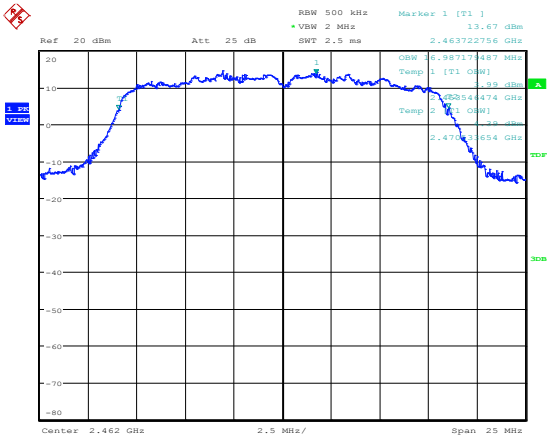
99% Bandwidth
Channel: 7
Mode: OFDM



6dB Bandwidth
Channel: 11
Mode: OFDM



99% Bandwidth
Channel: 11
Mode: OFDM



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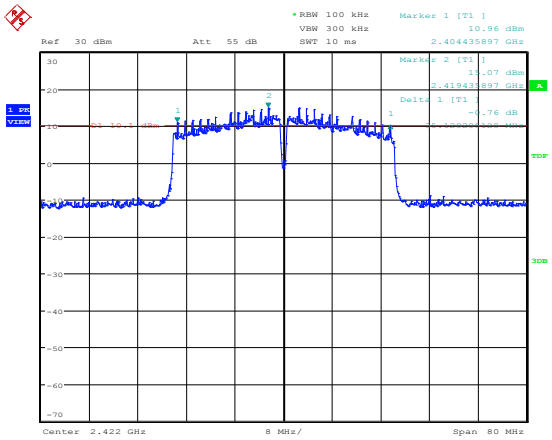
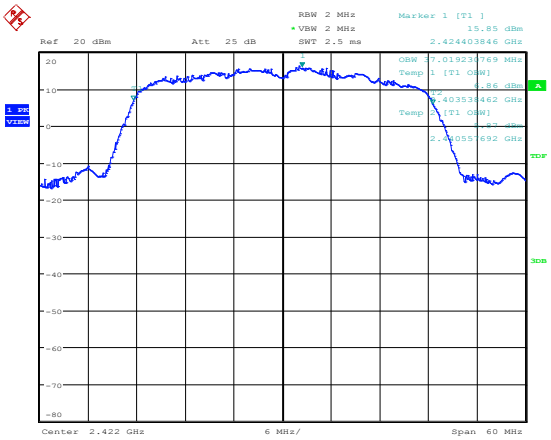
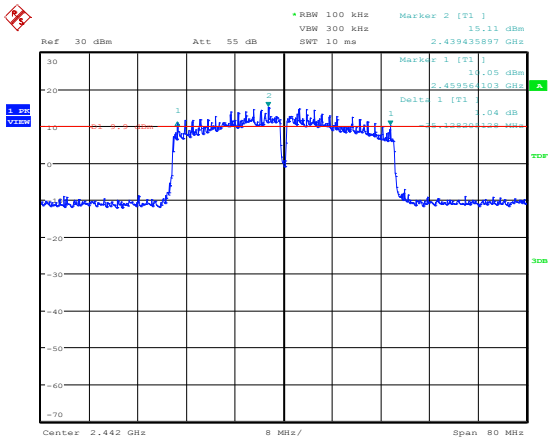
6dB Bandwidth
Channel: 3
Mode: HT40



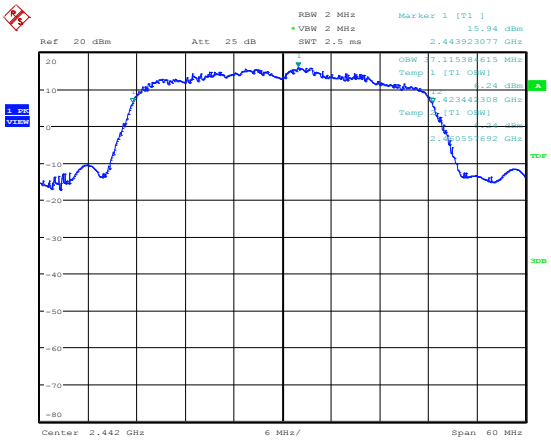
99% Bandwidth
Channel: 3
Mode: HT40



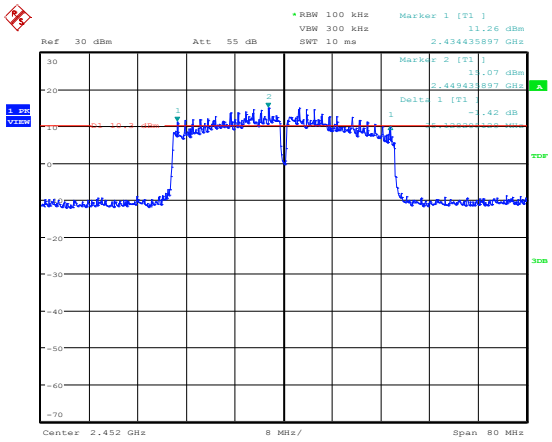
6dB Bandwidth
Channel: 7
Mode: HT40



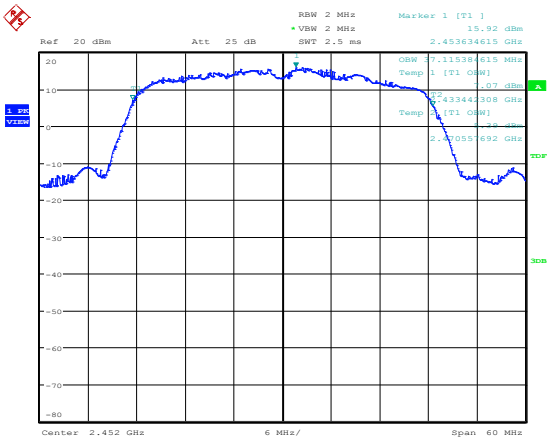
99% Bandwidth
Channel: 7
Mode: HT40



6dB Bandwidth
Channel: 9
Mode: HT40



99% Bandwidth
Channel: 9
Mode: HT40



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10 FUNDAMENTAL EMISSION OUTPUT POWER

Test Requirement: 47 CFR, § 15.247
RSS-247, 5.4
Test Procedure: 558074 D01 DTS Meas Guidance v04

10.1 Regulation

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.
(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-247, 5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) requirements
Devices shall comply with the following requirements, where applicable:
d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).
As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

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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
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

10.3 Test Procedures

558074 D01 DTS Meas Guidance:

9.2.3.1 Method AVGPM (Measurement using an RF average-reading power meter)

a) As an alternative to spectrum analyzer or EMI receiver measurements, 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.
1) The EUT is configured to transmit continuously, or to transmit with a constant duty factor.
2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
b) If the transmitter does not transmit continuously, measure the duty cycle (x) of the transmitter output signal as described in Section 6.0.
c) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
d) Adjust the measurement in dBm by adding 10log (1/x), where x is the duty cycle to the measurement result

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10.4 Test Result

Conducted output power							
Mode	Operating Channel	Power at single port			Total Power		Limit [dBm]
		#1 [mW]	#2 [mW]	#3 [mW]	[mW]	[dBm]	
CCK	1	83.3	91.4	83.3	258.0	24.1	30
	7	83.3	91.4	81.4	256.1	24.1	30
	11	85.3	93.5	91.4	270.1	24.3	30
OFDM	1	57.5	58.0	53.2	168.8	22.3	30
	7	57.5	59.4	58.3	175.3	22.4	30
	11	58.9	59.4	55.7	174.0	22.4	30
HT40	3	42.6	42.6	40.7	126.0	21.0	30
	7	40.7	40.7	38.9	120.3	20.8	30
	9	41.7	42.6	42.6	126.9	21.0	30

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

The EUT meets the requirements of this section.

11 POWER SPECTRAL DENSITY

Test Requirement: 47 CFR, § 15.247
RSS-247, 5.2
Test Procedure: 558074 D01 DTS Meas Guidance v04

11.1 Regulation

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

RSS-247, 5.2 Digital transmission systems
DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902‑928 MHz and 2400-2483.5 MHz:
b) The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

11.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
2 W Attenuator 10 dB	Weinschel / 54A-10	1745	2016-06	2018-06
DC Power Supply	Sorensen / DCS33-33EM15	3031	n/a	n/a
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

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11.3 Test Procedures

558074 D01 DTS Meas Guidance:

10.0 Maximum power spectral density level in the fundamental emission

10.5 Method AVGPSD-2 (trace averaging across on- and off-times of the EUT transmissions, followed by duty cycle correction)
This procedure is applicable when the EUT cannot be configured to transmit continuously (i.e., duty cycle 98 %), and when sweep triggering/signal gating cannot be used to measure only when the EUT is transmitting at its maximum power control level, and when the transmission duty cycle is constant (i.e., duty cycle variations are less than ± 2 %):

a) Measure the duty cycle (x) of the transmitter output signal as described in Section 6.0.
b) Set instrument center frequency to DTS channel center frequency.
c) Set span to at least 1.5 x OBW.
d) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
e) Set VBW ≥3 x RBW.
f) Detector = power averaging (RMS) or sample detector (when RMS not available).
g) Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW.
h) Sweep time = auto couple.
i) Do not use sweep triggering. Allow sweep to “free run”.
j) Employ trace averaging (RMS) mode over a minimum of 100 traces.
k) Use the peak marker function to determine the maximum amplitude level.
l) Add 10 log (1/x), where x is the duty cycle measured in step (a, to the measured PSD to compute the average PSD during the actual transmission time.
m) If resultant value exceeds the limit, then reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

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11.4 Test Result

Power Spectral Density							
Mode	Operating Channel	PSD at single port			Total PSD		Limit [dBm / 3 kHz]
		#1 [µW / 3 kHz]	#2 [µW / 3 kHz]	#3 [µW / 3 kHz]	[µW / 3 kHz]	[dBm / 3 kHz]	
CCK	1	83.3	75.3	72.1	230.7	-6.4	8
	7	119.6	95.2	71.7	286.6	-5.4	8
	11	103.0	132.7	93.3	328.9	-4.8	8
OFDM	1	3.6	7.0	6.3	16.9	-17.7	8
	7	9.9	12.8	10.2	32.8	-14.8	8
	11	9.1	9.3	15.7	34.1	-14.7	8
HT40	3	2.3	2.0	2.4	6.6	-21.8	8
	7	5.2	8.8	3.0	17.0	-17.7	8
	9	0.4	2.5	2.9	5.8	-22.4	8

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

The EUT meets the requirements of this section.

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12 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

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.

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13 LIST OF ANNEXES

Following annexes are separated parts from this test report.

Description	Pages
Annex 1: Photographs of test set-up	5
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

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