

RADIO REPORT FCC 47 CFR Part 15C ISED Canada RSS-247 Digital transmission systems operating within the 2400 – 2483.5 MHz band	
Report Reference No	G0M-1801-7163-TFC247ZB-V02
Testing Laboratory	Eurofins Product Service GmbH
Address	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation	 A2LA Accredited Testing Laboratory, Certificate No.: 1983.01 FCC Test Firm Designation Number: DE0008 IC Testing Laboratory site: 3470A-2
Applicant	Virtenio GmbH
Address	Bismarckstraße 10-12 10625 Berlin GERMANY
Test Specification	According to FCC/ISED rules
Standard	47 CFR Part 15C RSS-247, Issue 2, 2017-02
Non-Standard Test Method	None
Test Scope	Full compliance test
Equipment under Test (EUT):	
Product Description	Wireless Module / 2.4 GHz / IEEE 802.15.4
Model(s)	Preon32
Additional Model(s)	None
Brand Name(s)	None
Hardware Version(s)	Rev. 1.5
Software Version(s)	Rev. 1.3
FCC-ID	2AOYVP32A
IC	N/A
Test Result	PASSED

Possible test case verdicts:		
required by standard but not tested	N/T	
not required by standard	N/R	
not applicable to EUT	N/A	
test object does meet the requirement	P(PASS)	
test object does not meet the requirement	F(FAIL)	
Testing:		
Test Lab Temperature	20 - 23 °C	
Test Lab Humidity	32 – 38 %	
Date of receipt of test item	2018-03-02	
Report:		
Compiled by	Sebastian Suckow	
Tested by (+ signature) (Responsible for Test)	Sebastian Suckow	
Approved by (+ signature) (Head of Lab)	Christian Weber	
Date of Issue	2018-03-26	
Total number of pages	99	
General Remarks:		
The test results presented in this report relate only to the object tested. The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.		
Additional Comments:		

VERSION HISTORY

Version History			
Version	Issue Date	Remarks	Revised By
01	2018-03-09	Initial Release	
02	2018-03-26	Software Version updated, Test Mode updated	S.Suckow

ABBREVIATIONS AND ACRONYMS

Acronyms	
Acronym	Description
DSSS	Direct Sequence Spread Spectrum
EUT	Equipment Under Test
FCC	Federal Communications Commission
IEEE 802.15.4	MAC and PHY Layer for Wireless Personal Area Networks
ISED	Innovation, Science and Economic Development Canada
O-QPSK	Offset-Quadrature Phase Shift Keying
QPSK	Quadrature Phase Shift Keying
RBW	Resolution bandwidth
RMS	Root mean square
VBW	Video bandwidth
V _{NOM}	Nominal supply voltage

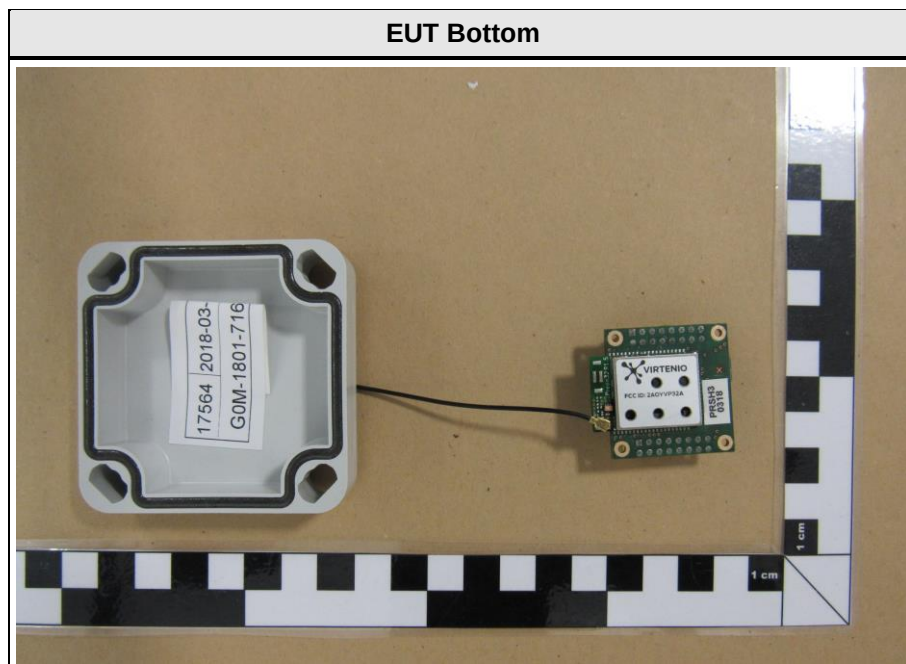
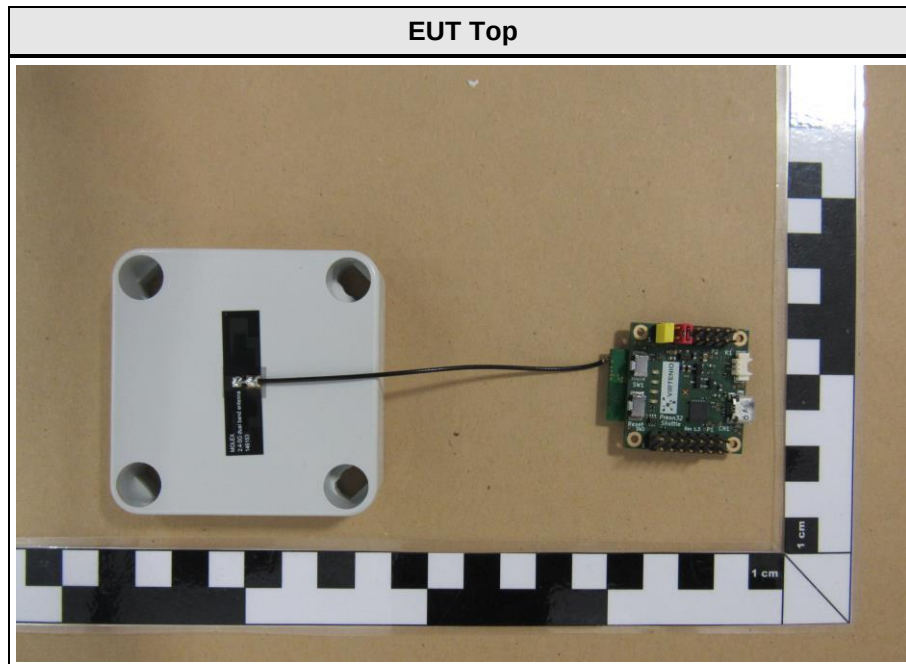
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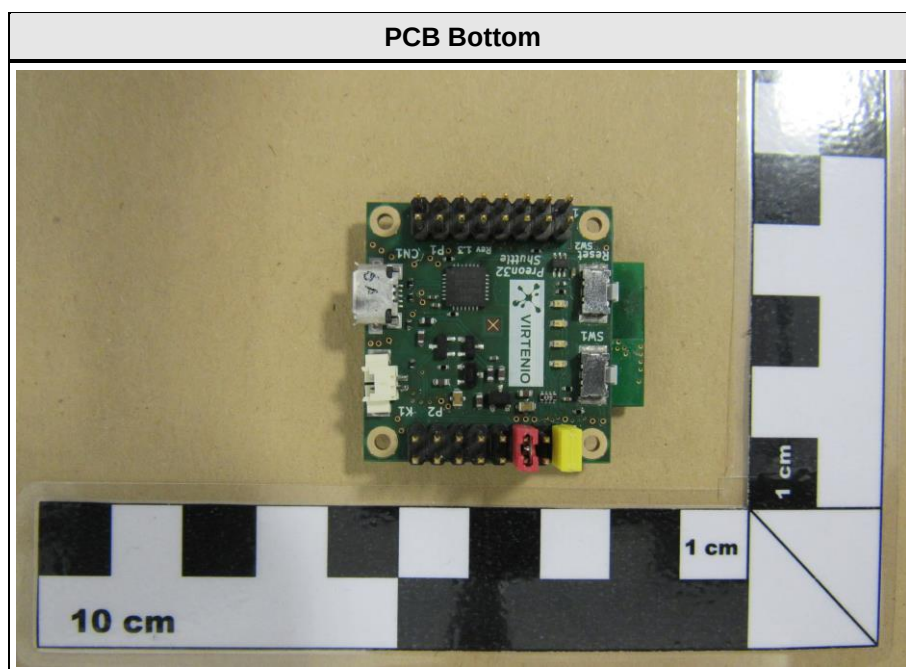
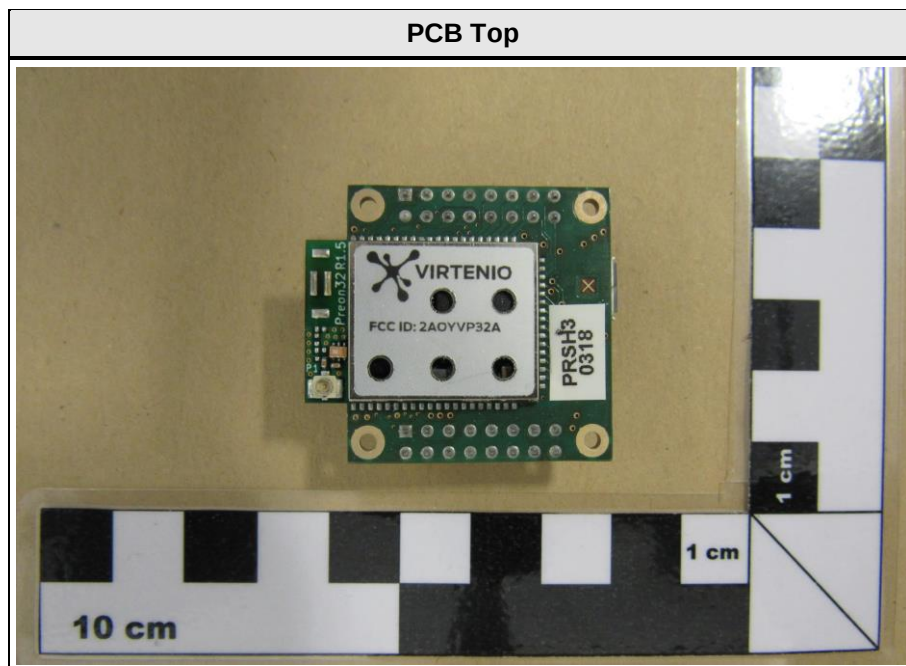
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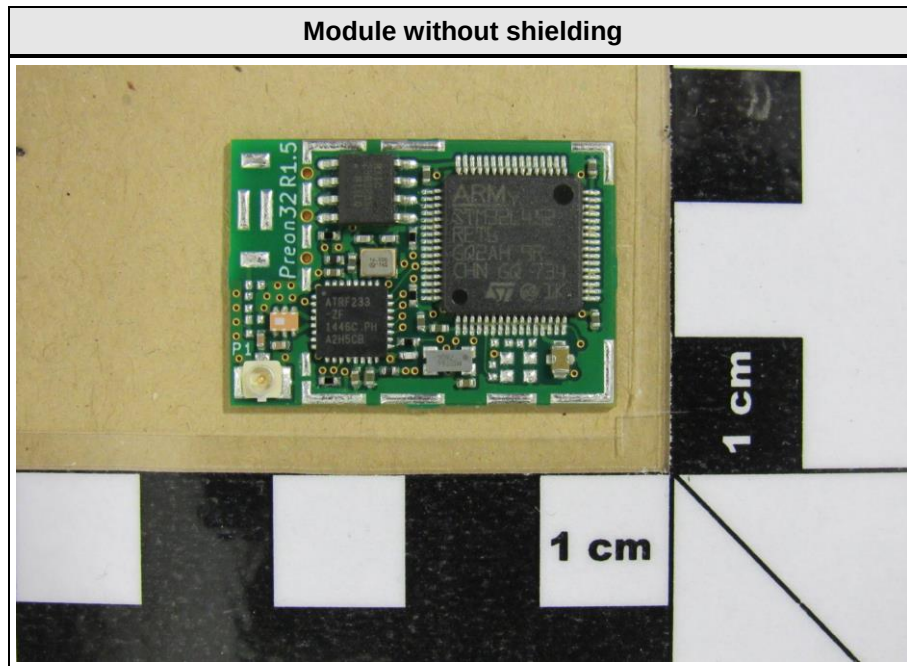
1 Equipment (Test Item) Under Test

Description	Wireless Module / 2.4 GHz / IEEE 802.15.4	
Model	Preon32	
Additional Model(s)	None	
Brand Name(s)	None	
Serial Number(s)	PRSH30318 (internal Eurofins ID 17556)	
Hardware Version(s)	Rev. 1.5	
Software Version(s)	Rev. 1.3	
PMN	N/A	
HVIN	N/A	
FVIN	N/A	
HMN	N/A	
FCC-ID	2AOYVP32A	
IC	N/A	
Equipment type	Radio Module	
Radio type	Transceiver	
Assigned frequency bands	2400 - 2483.5 MHz	
Radio technology	IEEE 802.15.4	
Modulation	O-QPSK	
Number of antenna ports	1	
Antenna	Type	External
	Model	146153-0100
	Manufacturer	Molex
	Gain	3.0 dBi
Supply Voltage	V _{NOM}	3.3 VDC
Operating Temperature	T _{NOM}	25 °C
Manufacturer	Virtenio GmbH Bismarckstraße 10-12 10625 Berlin GERMANY	

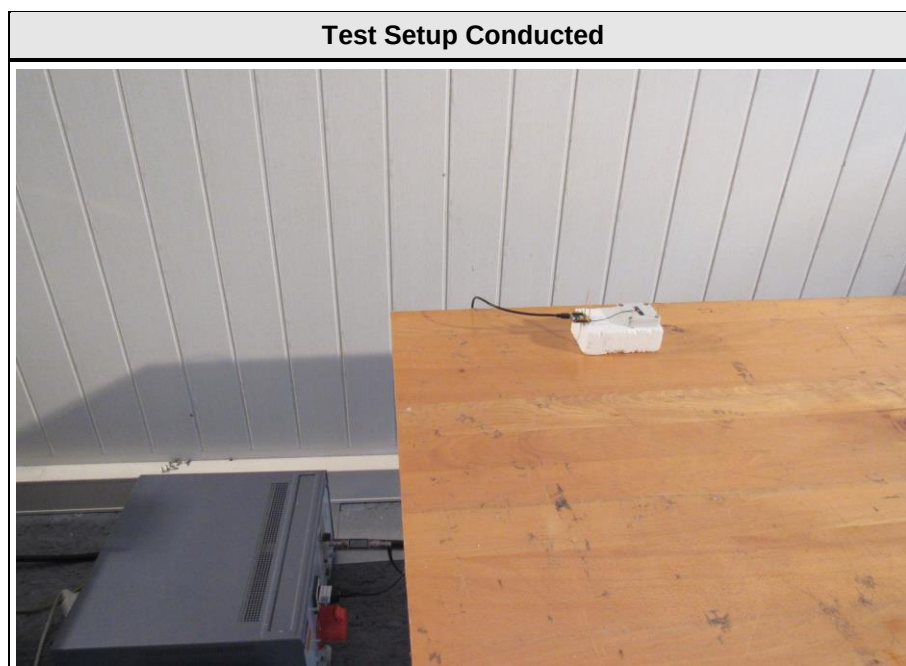
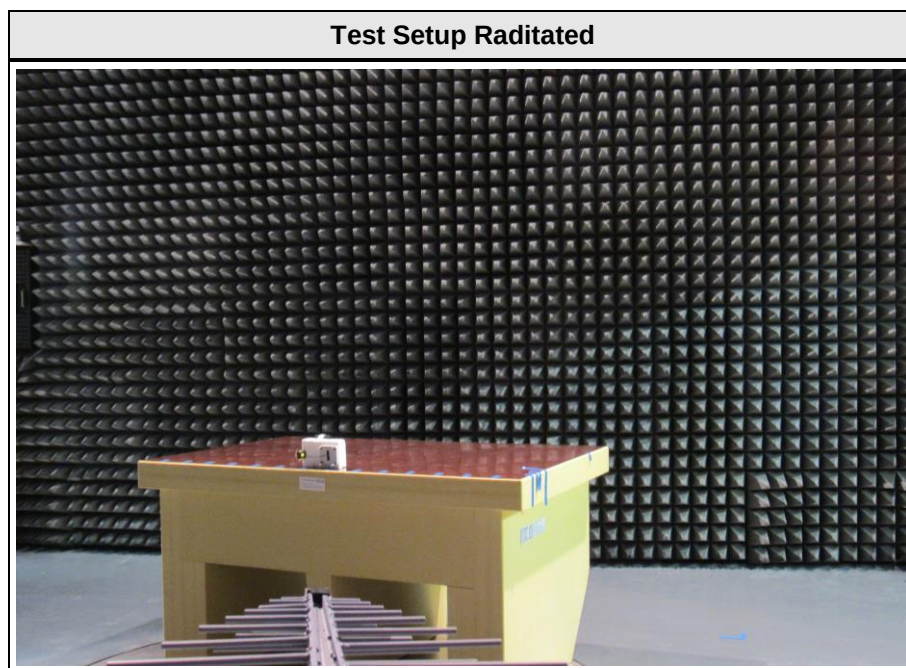
1.1 Photos – Equipment







1.2 Photos – Test Setup



1.3 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
AE	AC/DC adatpor	ARTESYN	DA5-050EU	Used for AC Powerline test
Description:				
AE	Auxillary Equipment			
SIM	Simulator			
CBL	Connecting Cable			
Comment:				

1.4 Test mode duty cycle

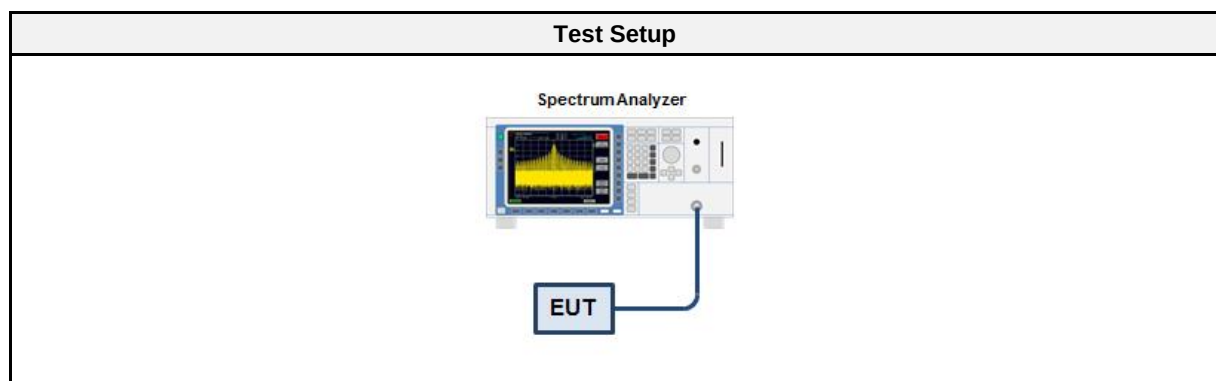
1.4.1 Information

Test Information	
Measurement Method	ANSI C63.10 11.6

1.4.2 Requirements

Requirements	
Duty cycle	Duty cycle correction
≥ 98 %	No correction required
< 98 %	Correction required ($10 \times \log_{10}(1/DC)$)

1.4.3 Setup



1.4.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSU 26	EF01003	2017-07	2018-07

1.4.5 Procedure

Test Procedure
- EUT set to test mode - Span is set to zero span - Detector set to peak - Sweep time is set long enough to capture at least 5 bursts - Envelope peak value of emission spectrum is selected - The maximum burst duration T_{ON} is measured using two markers set to the start and the end of the longest burst - The minimum idle duration T_{OFF} is measured using two markers set to the start and the end of the shortest idle period - The duty cycle is calculated by $DC = T_{ON} / (T_{ON} + T_{OFF})$ - The duty cycle correction is calculated by $DC = 10 \times \log_{10}(T_{ON} / (T_{ON} + T_{OFF}))$

1.4.6 Results

Duty Cycle Results		
Mode	Duty Cycle	Correction Factor [dB]
IEEE 802.15.4	100%	N/R

1.5 Test Modes

Mode	Description
DSSS O-QPSK	Mode = Transmit Modulation = O-QPSK Spreading = DSSS Data rate = 250 kbps Chip rate = 2000 kbps Duty cycle = 100%
Receive	Mode = Receive (Scan)
Comment:	

1.6 Test Frequencies

Designator	Mode	Channel	Frequency [MHz]
F1	Tx / Rx	11	2405
F2	Tx / Rx	18	2440
F3	Tx / Rx	26	2480

1.7 Sample emission level calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyzer in dBμV. Any external preamplifiers used are taken into account through internal analyzer settings.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strengths to voltages, which can be measured directly on the spectrum analyzer. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

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

Net:

This is the net field strength measurement (as shown above).

Limit:

This is the FCC Class B radiated emission limit (in units of dBμV/m). The FCC limits are given in units of μV/m. The following formula is used to convert the units of μV/m to dBμV/m:

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

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

Reading + AF	= Net Reading	:	Net reading	- FCC limit	= Margin
+21.5 dBμV	+ 26 dB = 47.5 dBμV/m	:	47.5 dBμV/m	- 57.0 dBμV/m	= -9.5 dB

2 Result Summary

FCC 47 CFR Part 15C, ISED RSS-247				
Product Standard Reference	Requirement	Reference Method	Result	Remarks
RSS-Gen 6.6	Occupied Bandwidth	ANSI C63.10	N/R	Informational only
FCC § 15.247(a)(2) ISED RSS-247 § 5.2	6 dB Bandwidth	ANSI C63.10	PASS	
FCC § 15.247(b)(3) ISED RSS-247 § 5.4	Maximum peak conducted power	ANSI C63.10	PASS	
FCC § 15.247(e) ISED RSS-247 § 5.2	Power spectral density	ANSI C63.10	PASS	
FCC § 15.207 ISED RSS-247 § 3.1	AC power line conducted emissions	ANSI C63.10	PASS	
FCC § 15.247(d) ISED RSS-247 § 5.5	Band edge compliance	ANSI C63.10	PASS	
FCC § 15.247(d) ISED RSS-247 § 5.5	Conducted spurious emissions	ANSI C63.10	PASS	
FCC § 15.247(d) FCC § 15.209 ISED RSS-GEN § 8.9	Transmitter radiated spurious emissions	ANSI C63.10	PASS	
ISED RSS-247 § 3.1	Receiver radiated spurious emissions	ANSI C63.10	PASS	
Comment:				

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

3 Test Conditions and Results

3.1 Test Conditions and Results - Occupied bandwidth

3.1.1 Information

Test Information	
Reference	ISED RSS-Gen 6.6
Measurement Method	ANSI C63.10 6.9.3
Operator	Sebastian Suckow
Date	2018-03-02

3.1.2 Limits

Limits
None (Informational only)

3.1.3 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSU 26	EF01003	2017-07	2018-07

3.1.4 Procedure

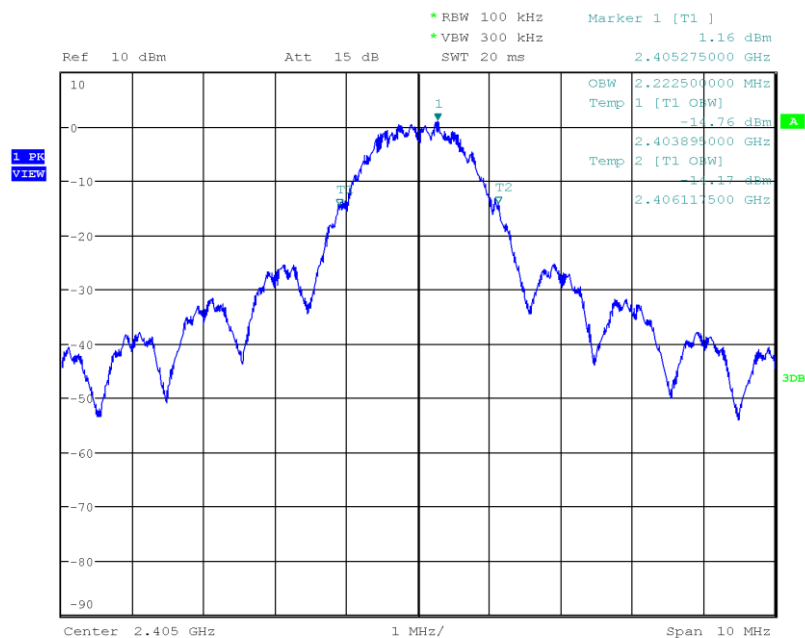
Test Procedure
1. EUT transmitter is activated in test mode under normal conditions 2. The spectrum analyzer is set to peak detection and maximum hold with a span twice the emission spectrum 3. The resolution bandwidth is set to 1 % of the bandwidth 4. The occupied bandwidth is measured with the build-in analyzer function

3.1.5 Results

Test Results		
Mode	Frequency [MHz]	Bandwidth [MHz]
O-QPSK	2405	2.223
O-QPSK	2440	2.265
O-QPSK	2480	2.300

Occupied Bandwidth

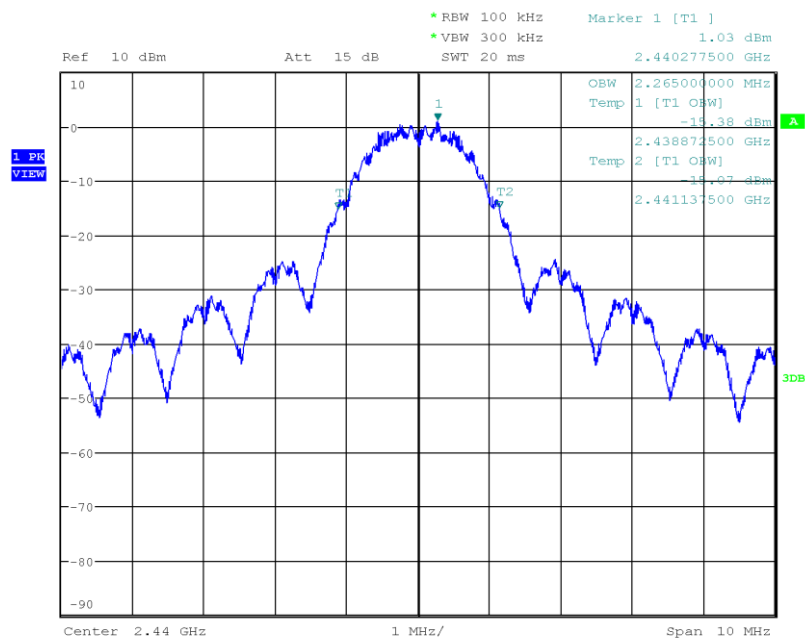
Project Number: G0M-1801-7163
 Applicant: Virtenio GmbH
 Model Description: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Sample ID: 17556
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 6.9.3
 Operational Mode: IEEE 802.15.4 (DSSS/250 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: S. Suckow
 Test Site: Eurofins Product Service GmbH
 Test Date: 2018-03-02
 Occupied Bandwidth [MHz]: 2.223



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Occupied Bandwidth

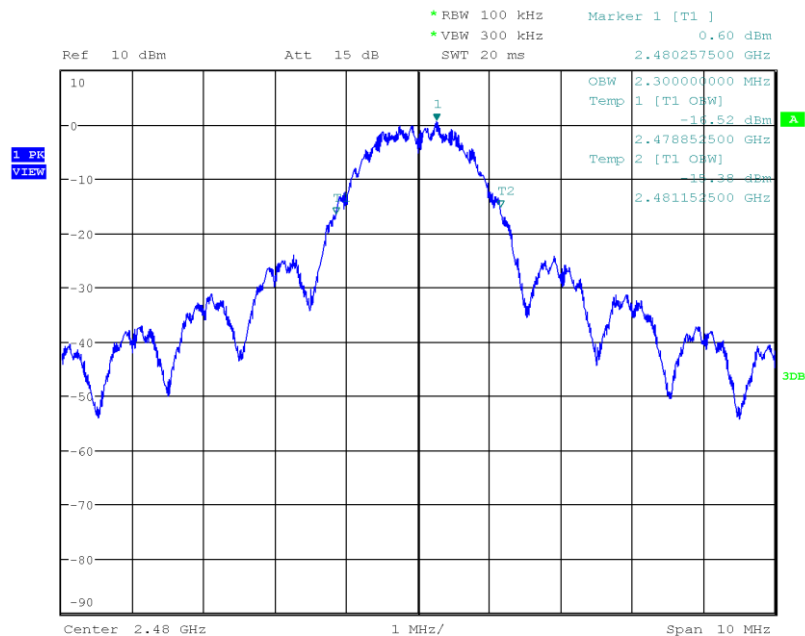
Project Number: G0M-1801-7163
 Applicant: Virtenio GmbH
 Model Description: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Sample ID: 17556
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 6.9.3
 Operational Mode: IEEE 802.15.4 (DSSS/250 kbps), Channel: 18, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: S. Suckow
 Test Site: Eurofins Product Service GmbH
 Test Date: 2018-03-02
 Occupied Bandwidth [MHz]: 2.265



Date: 2.MAR.2018 11:42:19

Occupied Bandwidth

Project Number: G0M-1801-7163
 Applicant: Virtenio GmbH
 Model Description: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Sample ID: 17556
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 6.9.3
 Operational Mode: IEEE 802.15.4 (DSSS/250 kbps), Channel: 26, 2480 MHz
 Operating Conditions: Tnom/Vnom
 Operator: S. Suckow
 Test Site: Eurofins Product Service GmbH
 Test Date: 2018-03-02
 Occupied Bandwidth [MHz]: 2.300



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3.2 Test Conditions and Results - 6 dB bandwidth

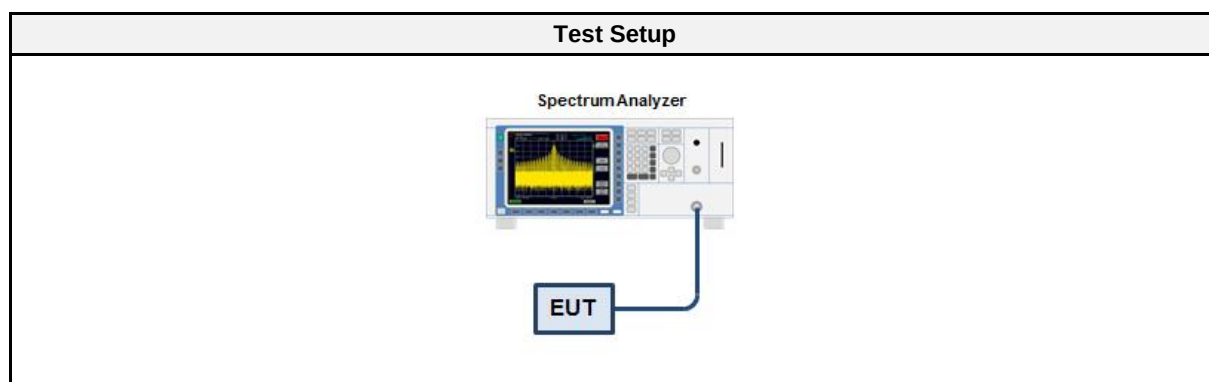
3.2.1 Information

Test Information	
Reference	FCC 15.247(a)(2) / ISSED RSS-247 5.2
Measurement Method	ANSI C63.10 11.8
Operator	Sebastian Suckow
Date	2018-03-02

3.2.2 Limits

Limits
≥ 500kHz

3.2.3 Setup



3.2.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSU 26	EF01003	2017-07	2018-07

3.2.5 Procedure

Test Procedure
1. EUT set to test mode 2. Span set to at least twice the emission spectrum 3. Detector set to peak and max hold and RBW is set to 100 kHz 4. Envelope peak value of emission spectrum is selected 5. Marker on envelope of spectrum is set to level of -6 dB to the left of the peak 6. Marker on envelope of spectrum is set to level of -6 dB to the right of the peak 7. 6 dB Bandwidth is determined by marker frequency separation

3.2.6 Results

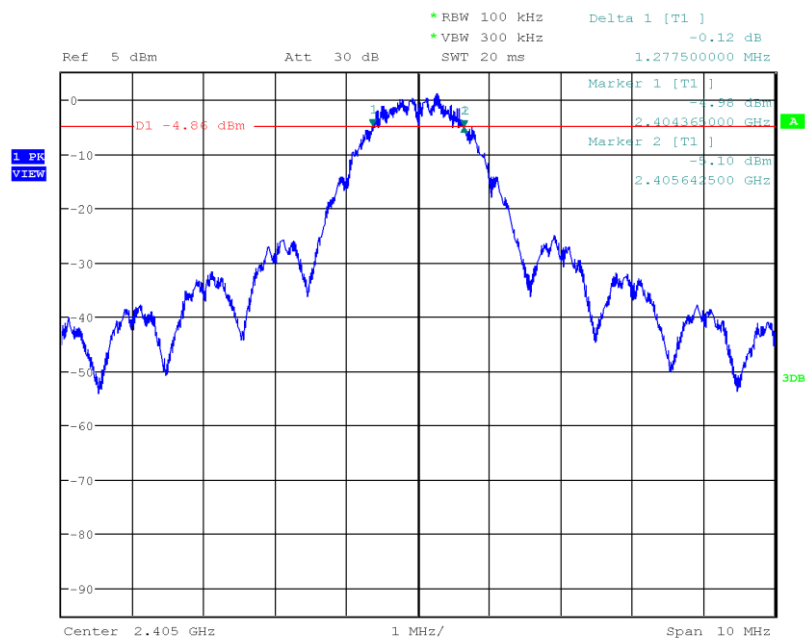
Test Results				
Mode	Frequency [MHz]	Bandwidth [kHz]	Limit [kHz]	Verdict
O-QPSK	2405	1277.5	500	PASS
O-QPSK	2440	1502.5	500	PASS
O-QPSK	2480	1525.0	500	PASS

Test Report No.: G0M-1801-7163-TFC247ZB-V02

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

DTS (6 dB) Bandwidth

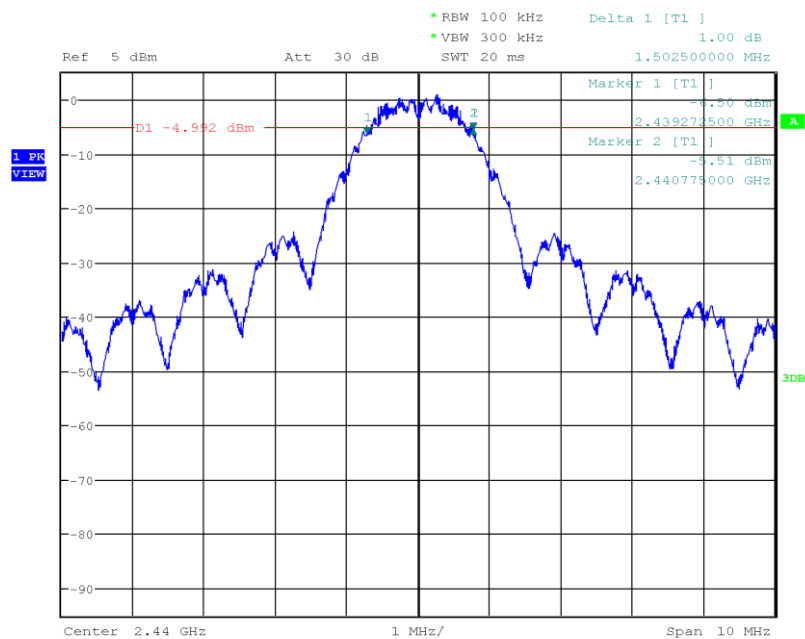
Project Number: G0M-1801-7163
 Applicant: Virtenio GmbH
 Model Description: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Sample ID: 17556
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: IEEE 802.15.4 (DSSS/250 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: S. Suckow
 Test Site: Eurofins Product Service GmbH
 Test Date: 2018-03-02
 Lower Frequency [MHz]: 2404.365
 Upper Frequency [MHz]: 2405.642
 6 dB Bandwidth [kHz]: 1277.5



Date: 2.MAR.2018 11:47:17

DTS (6 dB) Bandwidth

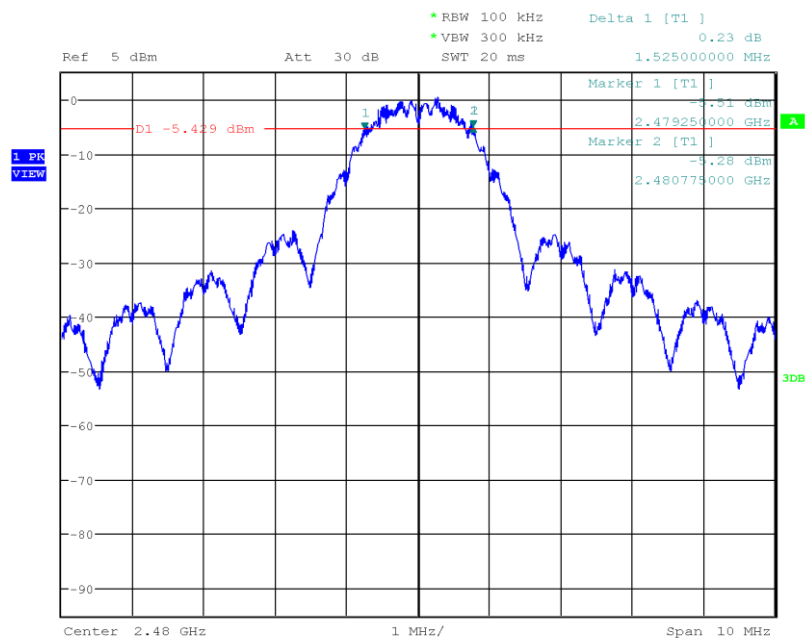
Project Number: G0M-1801-7163
 Applicant: Virtenio GmbH
 Model Description: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Sample ID: 17556
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: IEEE 802.15.4 (DSSS/250 kbps), Channel: 18, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: S. Suckow
 Test Site: Eurofins Product Service GmbH
 Test Date: 2018-03-02
 Lower Frequency [MHz]: 2439.273
 Upper Frequency [MHz]: 2440.775
 6 dB Bandwidth [kHz]: 1502.5



Date: 2.MAR.2018 11:48:20

DTS (6 dB) Bandwidth

Project Number: G0M-1801-7163
 Applicant: Virtenio GmbH
 Model Description: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Sample ID: 17556
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: IEEE 802.15.4 (DSSS/250 kbps), Channel: 26, 2480 MHz
 Operating Conditions: Tnom/Vnom
 Operator: S. Suckow
 Test Site: Eurofins Product Service GmbH
 Test Date: 2018-03-02
 Lower Frequency [MHz]: 2479.250
 Upper Frequency [MHz]: 2480.775
 6 dB Bandwidth [kHz]: 1525.0



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3.3 Test Conditions and Results - Maximum peak conducted output power

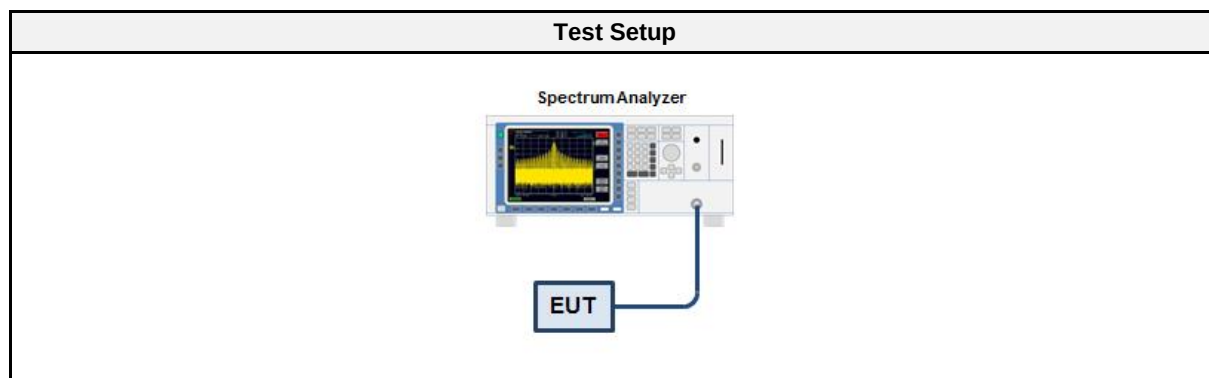
3.3.1 Information

Test Information	
Reference	FCC 15.247(b)(1) / ISED RSS-247 5.4
Measurement Method	ANSI C63.10 11.9.1
Operator	Sebastian Suckow
Date	2018-03-02

3.3.2 Limits

Limits
1 W (30 dBm)
The conducted output power limit specified above is based on the use of antennas with directional gains that do not exceed 6 dBi. 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 the table, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.3.3 Setup



3.3.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSU 26	EF01003	2017-07	2018-07

3.3.5 Procedure

Test Procedure
1. EUT set to test hopping mode (Communication tester is used if needed) 2. Analyzer resolution bandwidth is set $\geq$ DTS bandwidth 3. Detector set to peak and max hold 4. Sweep time is set to auto 5. After the trace has stabilized a marker is set to peak of envelope

3.3.6 Results

Test Results				
Channel [MHz]	Power [dBm]	Power [W]	Limit [W]	Verdict
2405	4.577	0.002869	1.0	PASS
2440	4.701	0.002952	1.0	PASS
2480	4.401	0.002755	1.0	PASS

3.4 Test Conditions and Results - Power spectral density

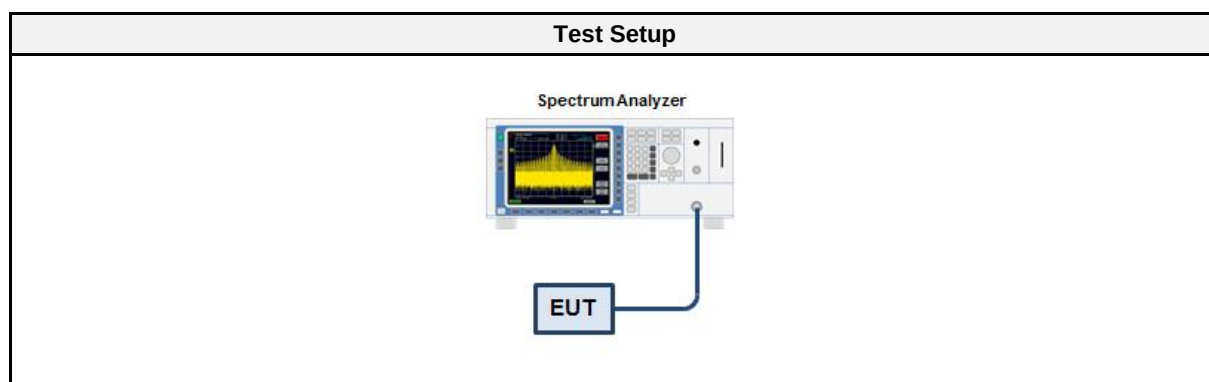
3.4.1 Information

Test Information	
Reference	FCC 15.247(e) / ISED RSS-247 5.2
Measurement Method	ANSI C63.10 11.10.2, 14.3.2
Operator	Sebastian Suckow
Date	2018-03-02

3.4.2 Limits

Limits
8 dBm / 3 kHz

3.4.3 Setup



3.4.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSU 26	EF01003	2017-07	2018-07

3.4.5 Procedure

Test Procedure
1. EUT set to test mode 2. The analyzer is set to DTS channel center frequency with a span of 1.5 times the DTS bandwidth 3. The RBW is set to 100 kHz with VBW $\geq$ RBW and the detector is set to peak with max hold 4. After the trace has stabilized a marker is set to the envelope maximum 5. If the power spectral density is above the limit the RBW is reduced (not lower than 3 kHz) and the measurement is repeated 6. If the EUT has more than one transmit chain the procedure is repeated for each transmit chain

3.4.6 Results

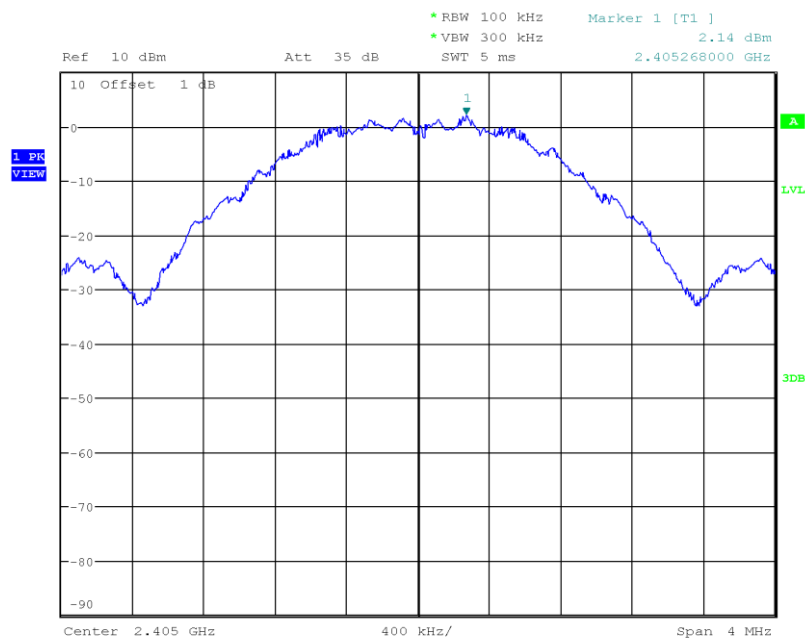
Test Results			
Channel [MHz]	PSD [dBm/RBW]	Limit [dBm/3kHz]	Verdict
2405	2.142	8.0	PASS
2440	2.051	8.0	PASS
2480	1.681	8.0	PASS
RBW = 100 kHz			

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

Peak Power Spectral Density

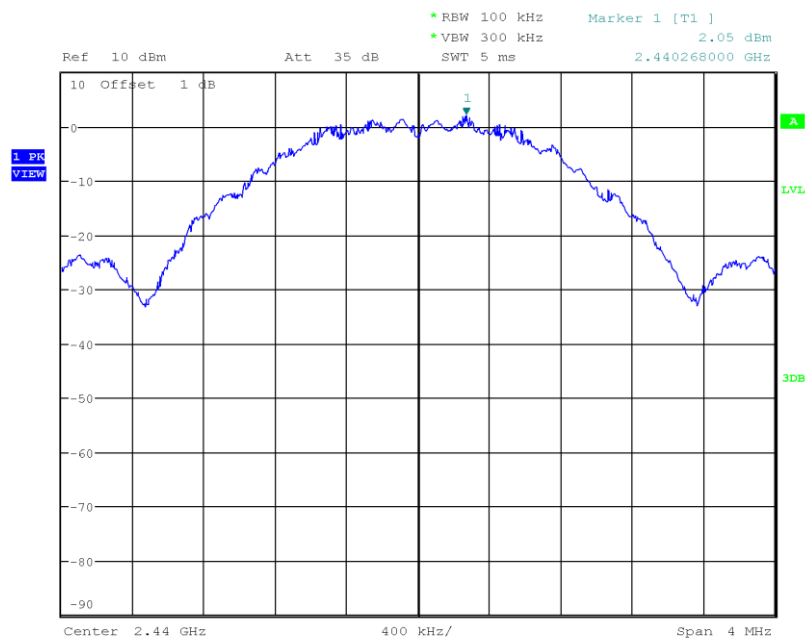
Project Number:	G0M-1801-7163
Applicant:	Virtenio GmbH
Model Description:	Wireless Module / 2.4 GHz / IEEE 802.15.4
Model:	Preon32
Test Sample ID:	17556
Reference Standards:	FCC 15.247, RSS-247
Reference Method:	ANSI C63.10:2013, Section 11.10.2
Operational Mode:	IEEE 802.15.4 (DSSS/250 kbps), Channel: 11, 2405 MHz
Operating Conditions:	Tnom/Vnom
Operator:	S. Suckow
Test Site:	Eurofins Product Service GmbH
Test Date:	2018-03-02
Peak Frequency [MHz]:	2405.268
Spectral Density [dBm/RBW]:	2.142
Resolution Bandwidth [kHz]:	100 kHz



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Peak Power Spectral Density

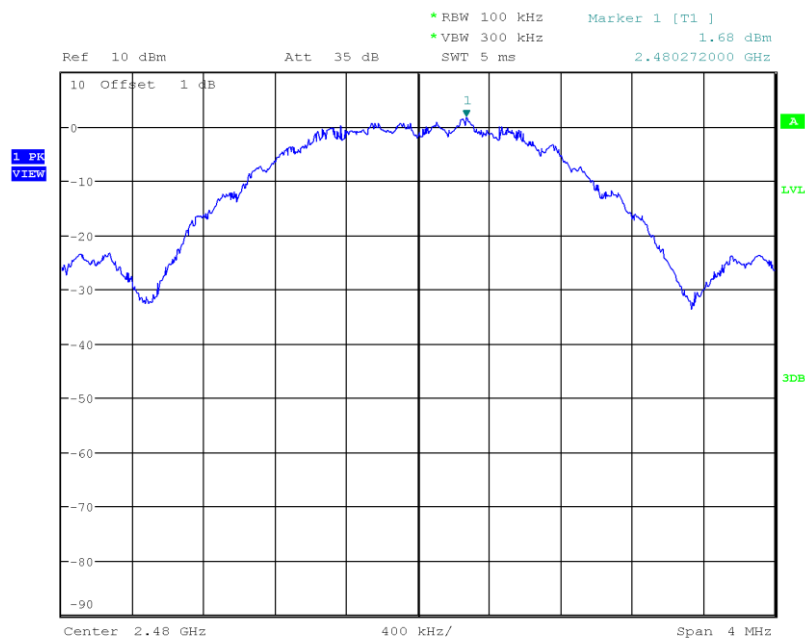
Project Number: G0M-1801-7163
 Applicant: Virtenio GmbH
 Model Description: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Sample ID: 17556
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.10.2
 Operational Mode: IEEE 802.15.4 (DSSS/250 kbps), Channel: 18, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: S. Suckow
 Test Site: Eurofins Product Service GmbH
 Test Date: 2018-03-02
 Peak Frequency [MHz]: 2440.268
 Spectral Density [dBm/RBW]: 2.051
 Resolution Bandwidth [kHz]: 100 kHz



Date: 2.MAR.2018 11:54:19

Peak Power Spectral Density

Project Number: G0M-1801-7163
 Applicant: Virtenio GmbH
 Model Description: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Sample ID: 17556
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.10.2
 Operational Mode: IEEE 802.15.4 (DSSS/250 kbps), Channel: 26, 2480 MHz
 Operating Conditions: Tnom/Vnom
 Operator: S. Suckow
 Test Site: Eurofins Product Service GmbH
 Test Date: 2018-03-02
 Peak Frequency [MHz]: 2480.272
 Spectral Density [dBm/RBW]: 1.681
 Resolution Bandwidth [kHz]: 100 kHz



Date: 2.MAR.2018 11:55:05

3.5 Test Conditions and Results - AC powerline conducted emissions

3.5.1 Information

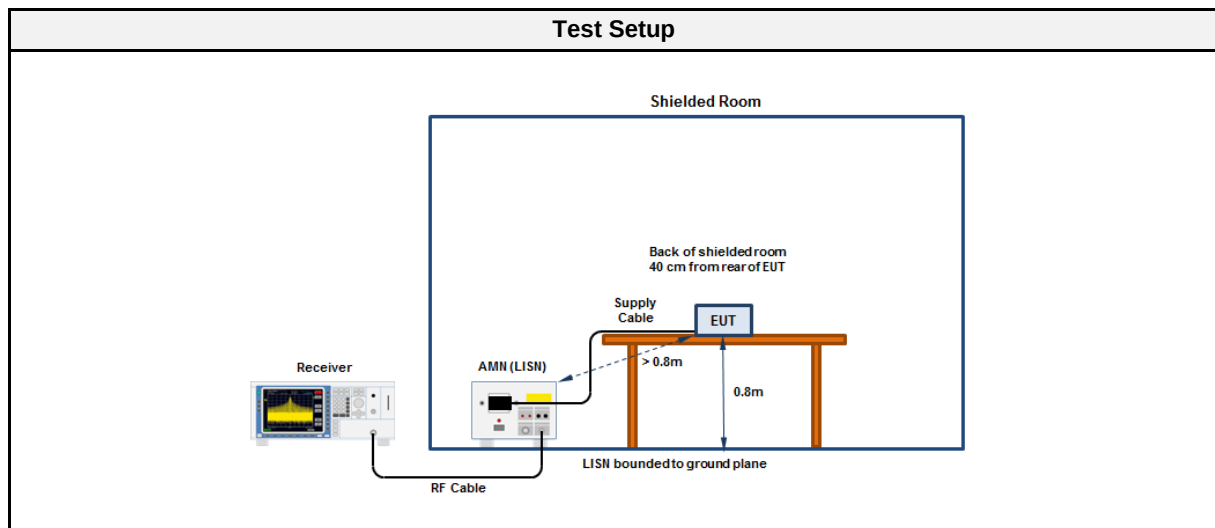
Test Information	
Reference	FCC 15.207
Measurement Method	ANSI C63.10 6.2
Operator	Sebastian Suckow
Date	2018-03-02

3.5.2 Limits

Limits		
Frequency [MHz]	Quasi-Peak [dBμV]	Average [dBμV]
0.15 - 0.5	66 - 56*	56 - 46*
0.5 - 5	56	46
5 - 30	60	50

* Limit decreases linearly with the logarithm of the frequency

3.5.3 Setup



3.5.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
EMI Receiver	R&S	ESU 26	EF00241	2017-07	2019-07
LISN	R&S	ESH2-Z5	EF00182	2017-01	2019-01

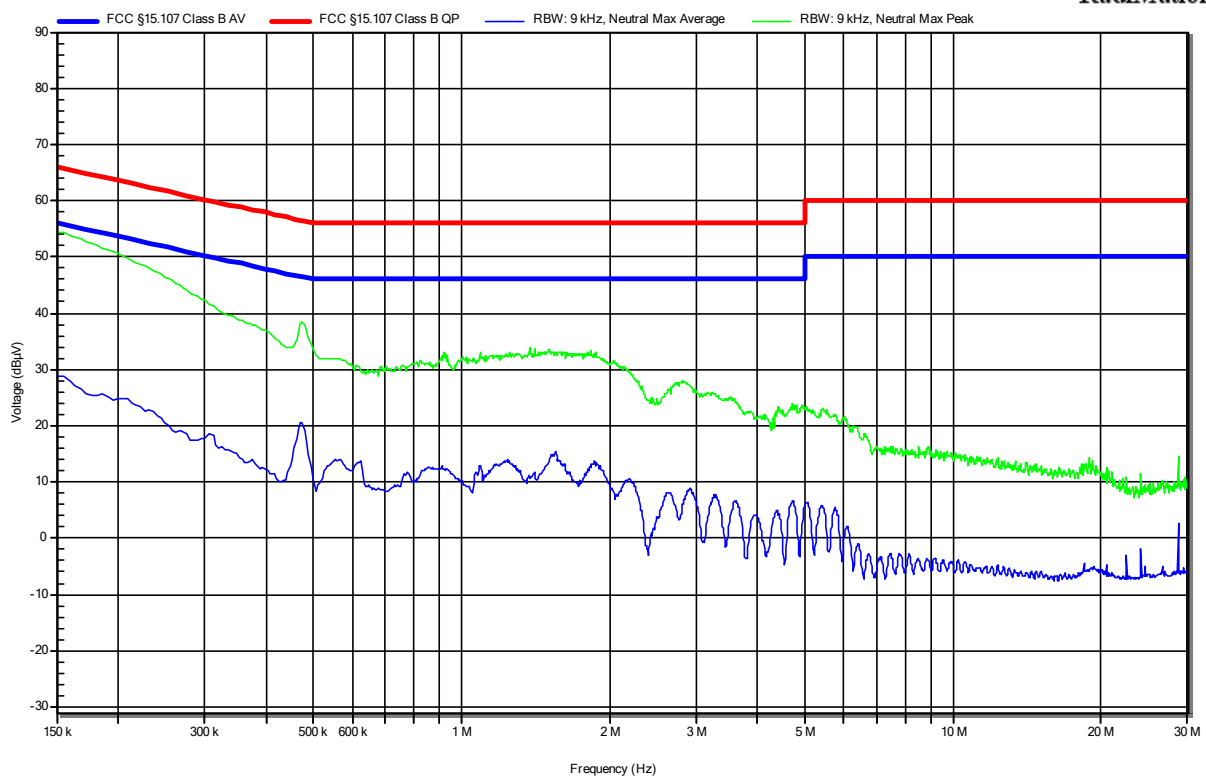
EMI voltage test in the ac-mains according to 15B

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Mr. Suckow
Test Conditions: Tnom: 24°C, Unom: 3.3 VDC
LISN: ESH2-Z5 N
Mode: IEEE 802.15.4, 2440 MHz
Test Date: 2018-03-05
Note:

Index 1

RadiMation



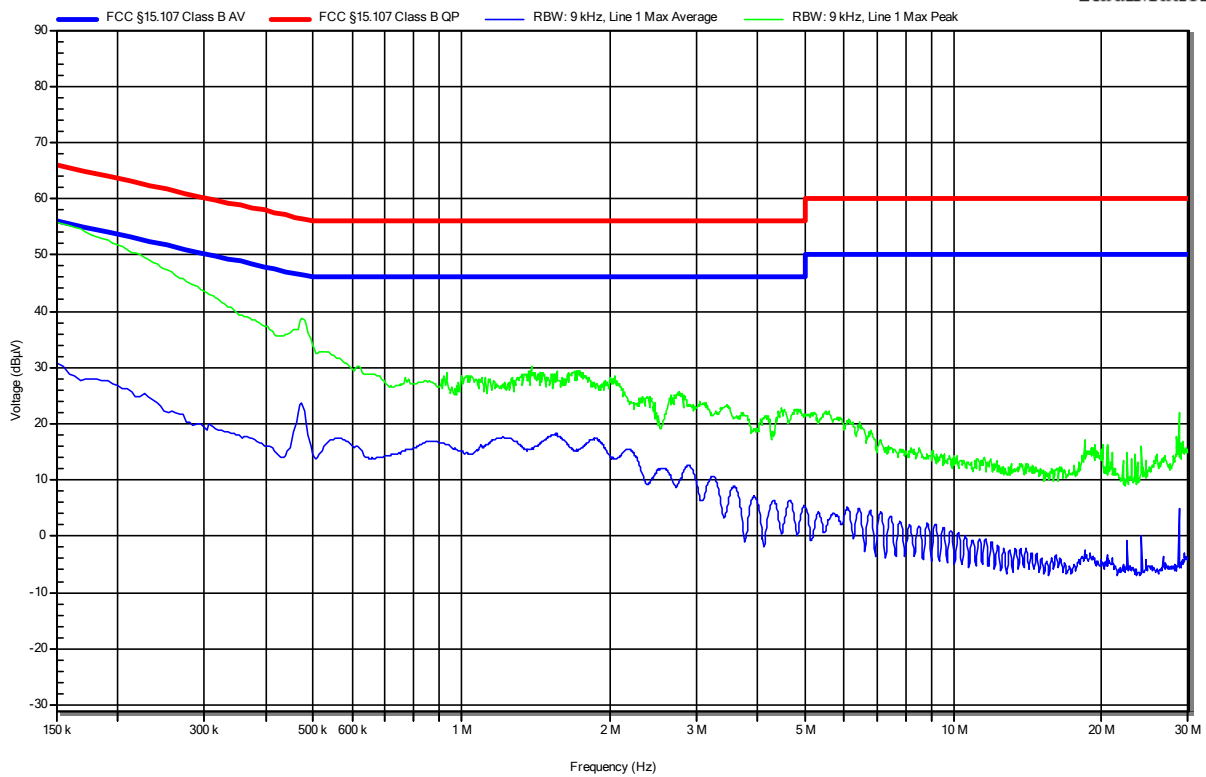
EMI voltage test in the ac-mains according to 15B

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Mr. Suckow
Test Conditions: Tnom: 24°C, Unom: 3.3 VDC
LISN: ESH2-Z5 L
Mode: IEEE 802.15.4, 2440 MHz
Test Date: 2018-03-05
Note:

Index 2

RadiMation



3.6 Test Conditions and Results - Band-edge compliance

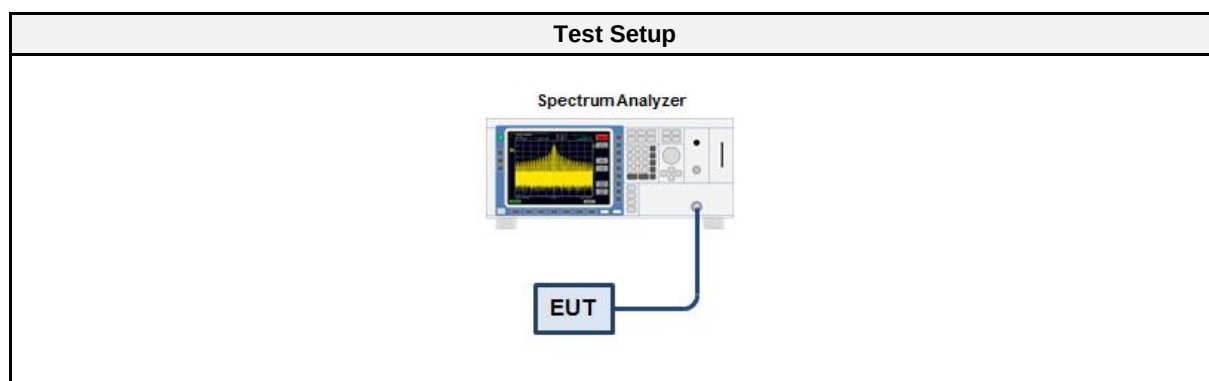
3.6.1 Information

Test Information	
Reference	FCC 15.247(d) / ISSED RSS-247 5.5
Measurement Method	ANSI C63.10 11.13
Operator	Sebastian Suckow
Date	2018-03-02

3.6.2 Limits

Limits	
Power Measurement	Out-of-band attenuation [dB]
Peak	20
RMS	30

3.6.3 Setup



3.6.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSU 26	EF01003	2017-07	2018-07

3.6.5 Procedure

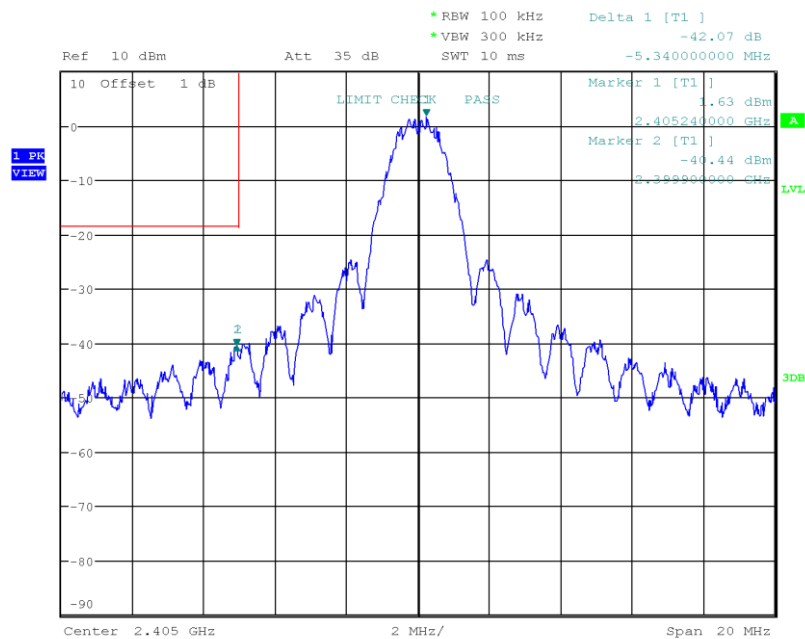
Test Procedure
1. EUT set to test mode (Communication tester is used if needed) 2. Span set around lower band edge and detector is set to peak and max hold 3. Resolution bandwidth is set to 100 kHz 4. Markers are set to peak emission levels within frequency band and outside frequency band 5. Band edge attenuation is determined from level difference

3.6.6 Results

Test Results				
Mode	Channel [MHz]	Out-of-band Attenuation [dB]	Limit [dB]	Verdict
O-QPSK	2405	-42.07	-20	PASS
O-QPSK	2480	-35.89	-20	PASS

Band-edge Compliance

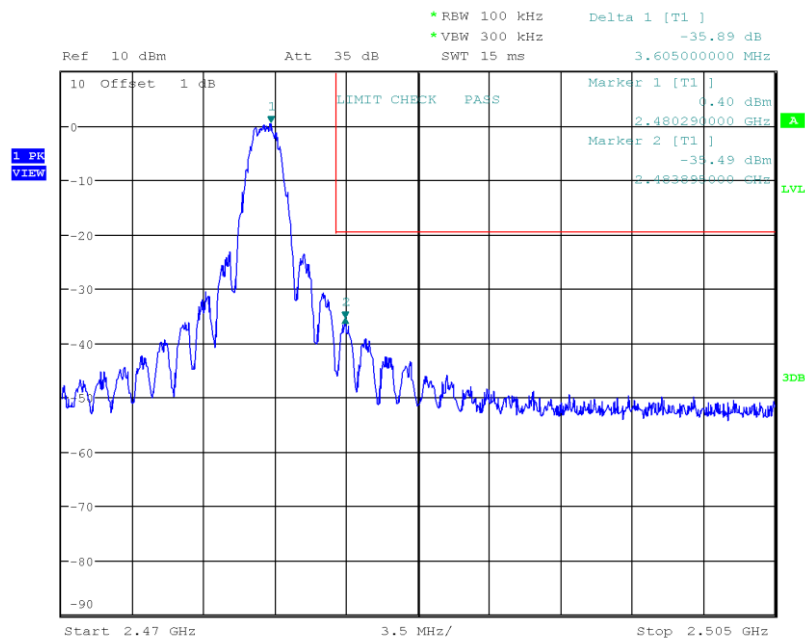
Project Number: G0M-1801-7163
 Applicant: Virtenio GmbH
 Model Description: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Sample ID: 17556
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (DSSS/250 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: S. Suckow
 Test Site: Eurofins Product Service GmbH
 Test Date: 2018-03-02
 Band-edge: Lower
 In-band Frequency [MHz]: 2405.24
 Max. in-band Level [dBm/100 kHz]: 1.632
 Out-of-band Frequency [MHz]: 2399.9
 Max. out-of-band Level [dBm/100 kHz]: -40.44
 Attenuation [dB]: -42.07



Date: 2.MAR.2018 11:46:11

Band-edge Compliance

Project Number: G0M-1801-7163
 Applicant: Virtenio GmbH
 Model Description: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Sample ID: 17556
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (DSSS/250 kbps),
 Channel: 26, 2480 MHz
 Operating Conditions: Tnom/Vnom
 Operator: S. Suckow
 Test Site: Eurofins Product Service GmbH
 Test Date: 2018-03-02
 Band-edge: Upper
 In-band Frequency [MHz]: 2480.29
 Max. in-band Level [dBm/100 kHz]: 0.398
 Out-of-band Frequency [MHz]: 2483.895
 Max. out-of-band Level [dBm/100 kHz]: -35.49
 Attenuation [dB]: -35.89



Date: 2.MAR.2018 11:44:54

3.7 Test Conditions and Results - Conducted spurious emissions

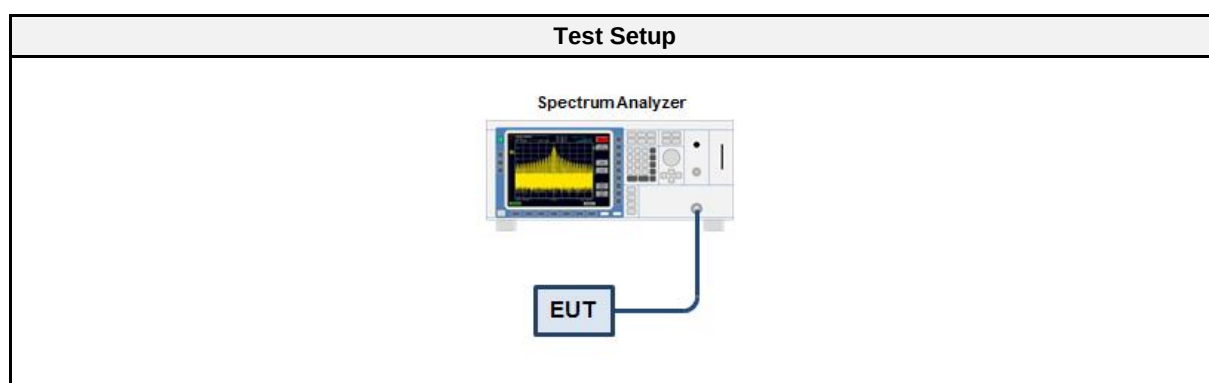
3.7.1 Information

Test Information	
Reference	FCC 15.247(d) / ISSED RSS-247 5.5
Measurement Method	ANSI C63.10 11.11
Operator	Sebastian Suckow
Date	2018-03-02

3.7.2 Limits

Limits	
Power Measurement	Out-of-band attenuation [dB]
Peak	20
RMS	30

3.7.3 Setup



3.7.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSU 26	EF01003	2017-07	2018-07

3.7.5 Procedure

Test Procedure
1. EUT set to test mode (Communication tester is used if needed) 2. Span set around lower band edge and detector is set to peak and max hold 3. Resolution bandwidth is set to 100 kHz 4. Markers are set to peak emission levels within frequency band and outside frequency band 5. Band edge attenuation is determined from level difference

3.7.6 Results

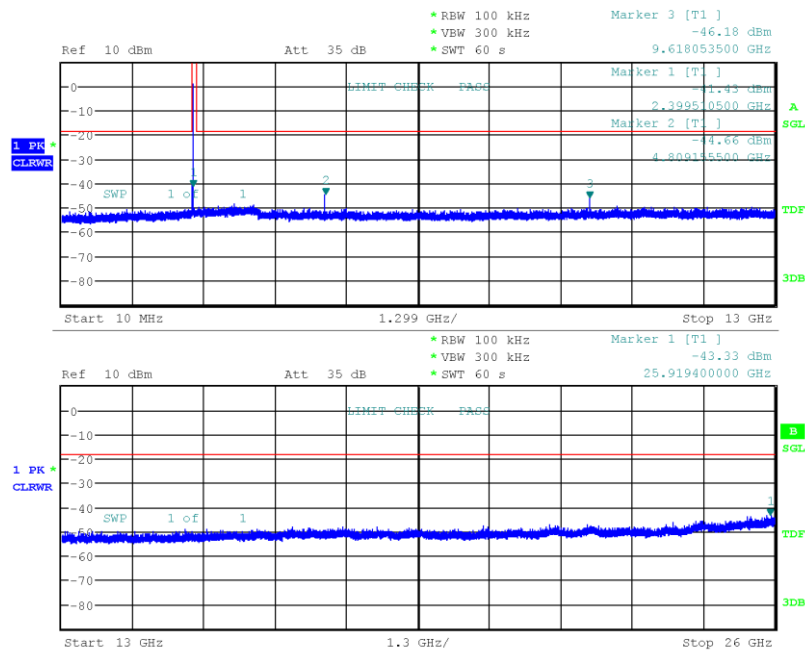
Test Results		
Mode	Channel [MHz]	Verdict
O-QPSK	2405	PASS
O-QPSK	2440	PASS
O-QPSK	2480	PASS

Test Report No.: G0M-1801-7163-TFC247ZB-V02

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

Conducted Spurious Emissions

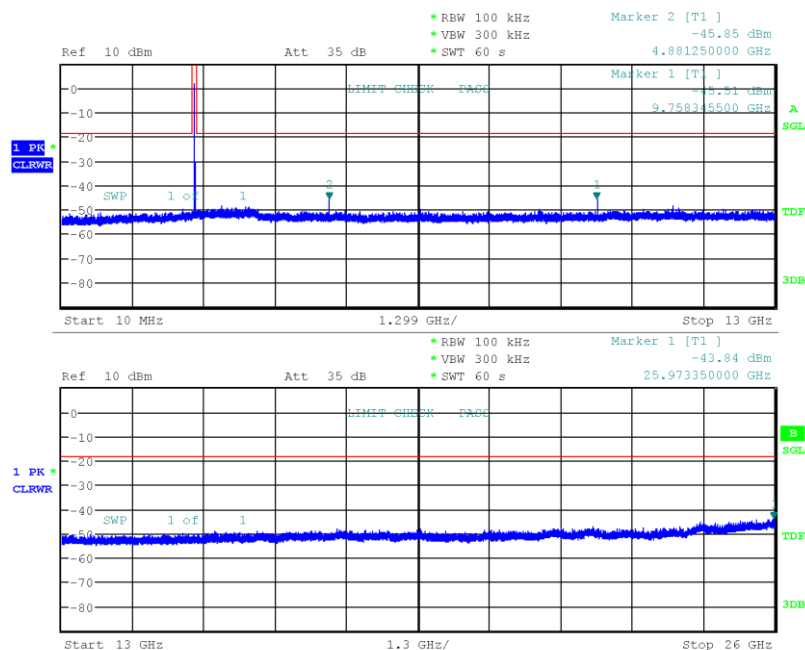
Project Number: G0M-1801-7163
 Applicant: Virtenio GmbH
 Model Description: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Sample ID: 17556
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (DSSS/250 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: S. Suckow
 Test Site: Eurofins Product Service GmbH
 Test Date: 2018-03-02
 Max. in-band Frequency [MHz]: 2405.3
 Max. in-band Level [dBm/100 kHz]: 1.8
 Out-of-band Limit [dBm/100 kHz]: -18.2



Date: 2.MAR.2018 12:36:33

Conducted Spurious Emissions

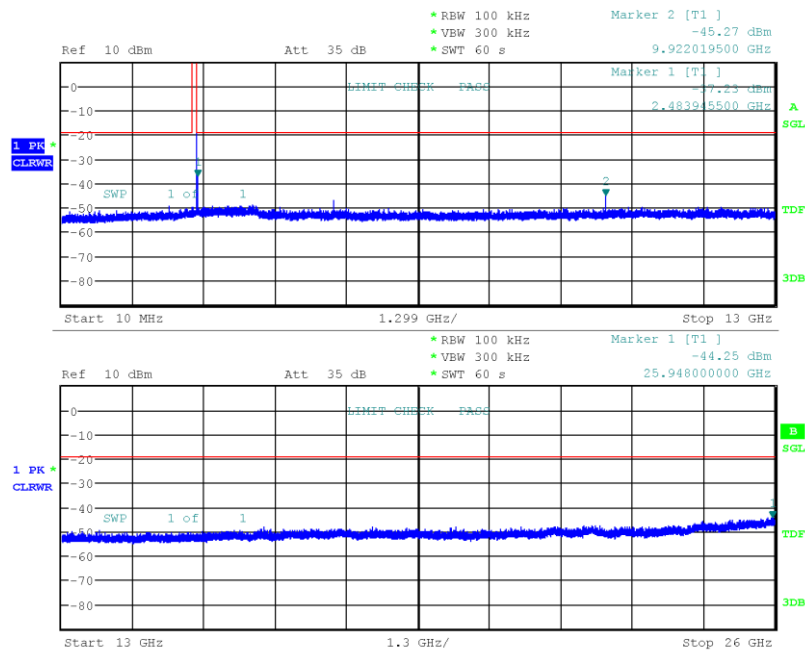
Project Number: G0M-1801-7163
 Applicant: Virtenio GmbH
 Model Description: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Sample ID: 17556
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (DSSS/250 kbps), Channel: 18, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: S. Suckow
 Test Site: Eurofins Product Service GmbH
 Test Date: 2018-03-02
 Max. in-band Frequency [MHz]: 2440.2
 Max. in-band Level [dBm/100 kHz]: 1.7
 Out-of-band Limit [dBm/100 kHz]: -18.3



Date: 2.MAR.2018 12:04:06

Conducted Spurious Emissions

Project Number: G0M-1801-7163
 Applicant: Virtenio GmbH
 Model Description: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Sample ID: 17556
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (DSSS/250 kbps), Channel: 26, 2480 MHz
 Operating Conditions: Tnom/Vnom
 Operator: S. Suckow
 Test Site: Eurofins Product Service GmbH
 Test Date: 2018-03-02
 Max. in-band Frequency [MHz]: 2480.3
 Max. in-band Level [dBm/100 kHz]: 0.8
 Out-of-band Limit [dBm/100 kHz]: -19.2



Date: 2.MAR.2018 12:00:35

3.8 Test Conditions and Results - Transmitter radiated emissions

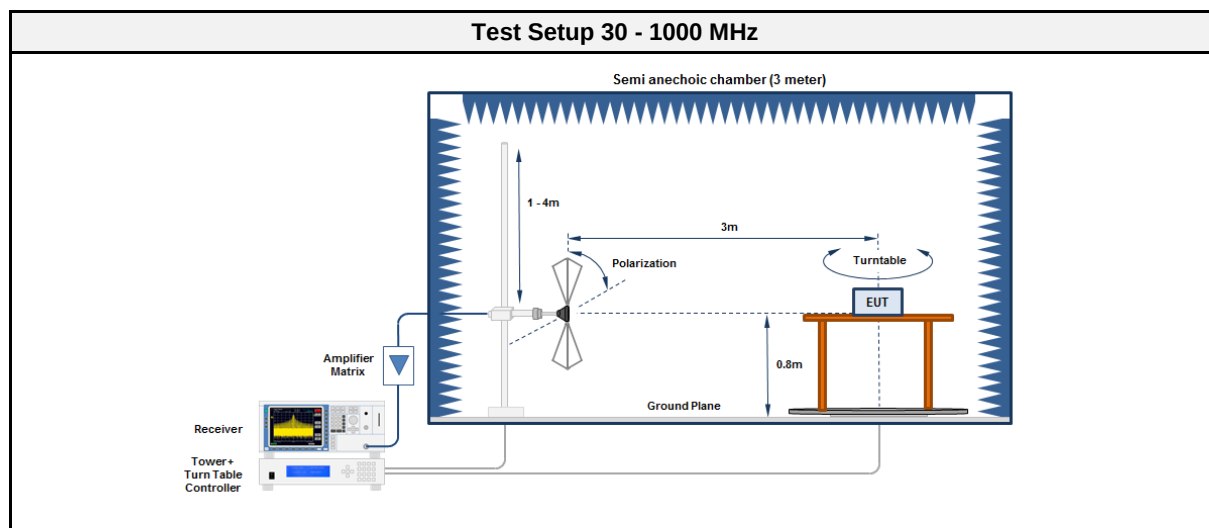
3.8.1 Information

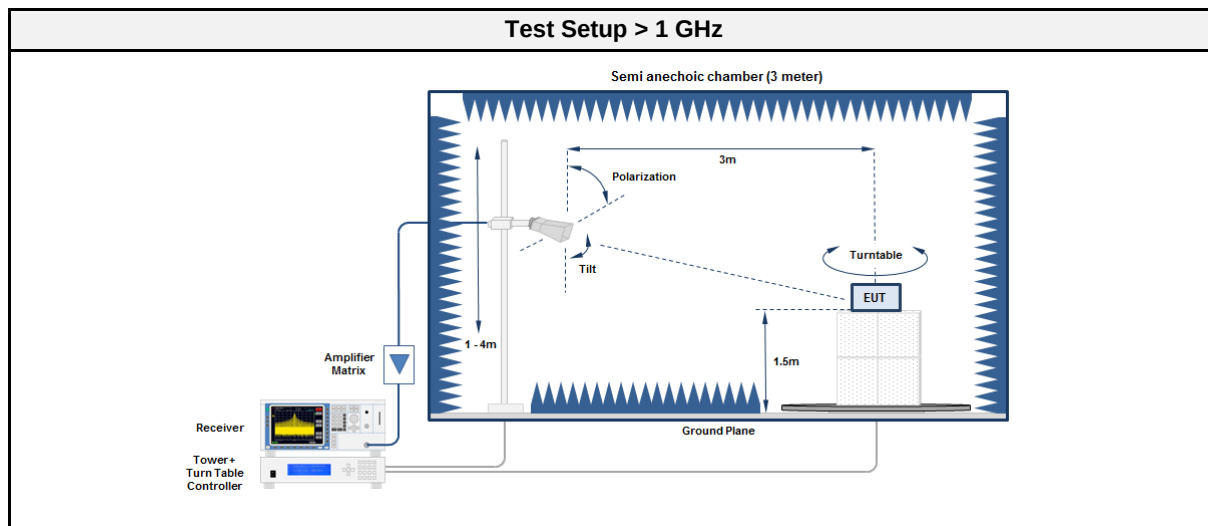
Test Information	
Reference	FCC 15.247(d) / ISSED RSS-GEN 8.9
Measurement Method	ANSI C63.10 6.4, 6.5, 6.6, 11.12
Operator	Sebastian Suckow
Date	2018-03-02 – 2018-03-05

3.8.2 Limits

Limits			
Frequency [MHz]	Detector	Field strength [dB μ V/m]	Measurement distance [m]
0.009 - 0.09	Average	2400/F[kHz]	300
0.09 - 0.110	Quasi-Peak	2400/F[kHz]	300
0.110 - 0.490	Average	2400/F[kHz]	300
0.490 - 1.705	Quasi-Peak	24000/F[kHz]	30
1.705 - 30.0	Quasi-Peak	30	30
30 - 88	Quasi-Peak	100	3
88 - 216	Quasi-Peak	150	3
216 - 960	Quasi-Peak	200	3
960 - 1000	Quasi-Peak	500	3
>1000	Average	500	3

3.8.3 Setup





3.8.4 Equipment

Test Equipment 30 - 1000 MHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	-	-
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2017-08	2018-08
Antenna	R&S	HK 116	EF00203	2016-06	2018-06
Antenna	R&S	HL 223	EF00212	2016-04	2019-04

Test Equipment > 1 GHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	-	-
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2017-08	2018-08
Antenna	R&S	BBHA 9120D	EF01153	2017-08	2018-08
Antenna	Amplifier Research	AT4560	EF01152	2017-10	2018-10

3.8.5 Procedure

Test Procedure 30 - 1000 MHz
1. EUT is placed on a non conducting support at the center of a turn table 0.8 m above the ground 2. EUT set to test mode 3. The receiver is set to peak detection with max hold 4. The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m 5. All significant emissions are measured again using the corresponding final detector

Test Procedure > 1 GHz
1. EUT is placed on a non conducting support at the center of a turn table 1.5 m above the ground 2. EUT set to test mode 3. The receiver is set to peak detection with max hold 4. The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m 5. All significant emissions are measured again using the corresponding final detector

3.8.6 Results

Test Results						
Channel [MHz]	Emission [MHz]	Level [dBμV/m]	Det.	Pol.	Limit [dBμV/m]	Margin [dB]
2405	4811	53.52	pk	hor	74.00	-20.48
2405	4811	50.36	RMS	hor	54.00	-03.64
2405	4811	54.17	pk	ver	74.00	-19.83
2405	4811	51.02	RMS	ver	54.00	-02.98
2440	4879	55.74	pk	ver	74.00	-18.26
2440	4879	52.79	RMS	ver	54.00	-01.21
2440	4881	54.04	pk	hor	74.00	-19.96
2440	4881	50.86	RMS	hor	54.00	-03.14
2480	2483.5	62.23	pk	hor	74.00	-11.77
2480	2483.5	46.13	RMS	hor	54.00	-07.87
2480	2483.5	71.22	pk	ver	74.00	-02.78
2480	2483.5	53.19	RMS	ver	54.00	-00.71
2480	4959	54.01	pk	ver	74.00	-19.99
2480	4959	50.86	RMS	ver	54.00	-03.14
2480	4961	52.92	pk	hor	74.00	-21.08
2480	4961	49.66	RMS	hor	54.00	-04.34

3.9 Test Conditions and Results - Receiver radiated emissions

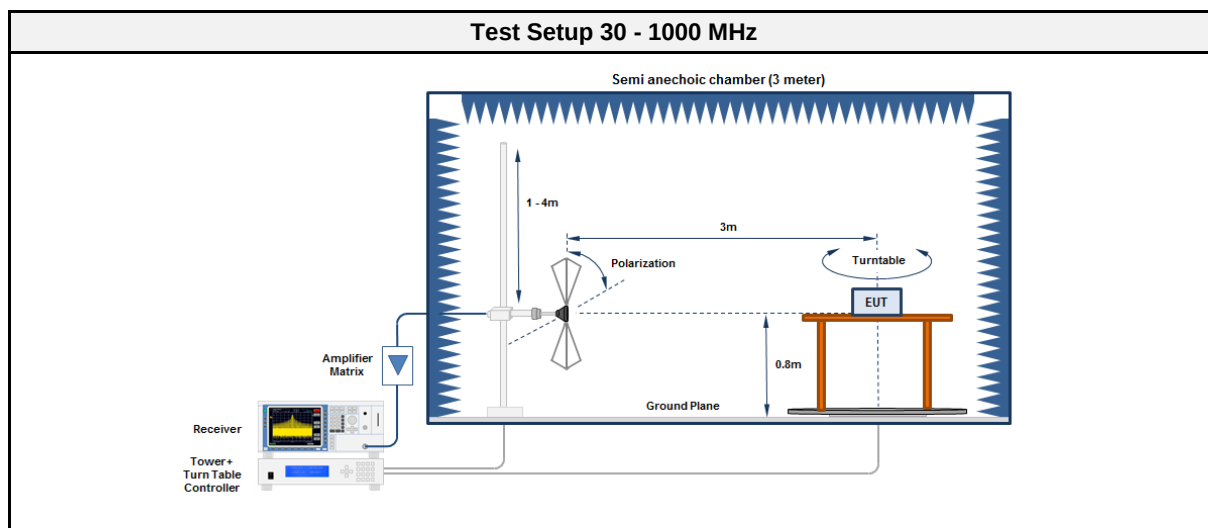
3.9.1 Information

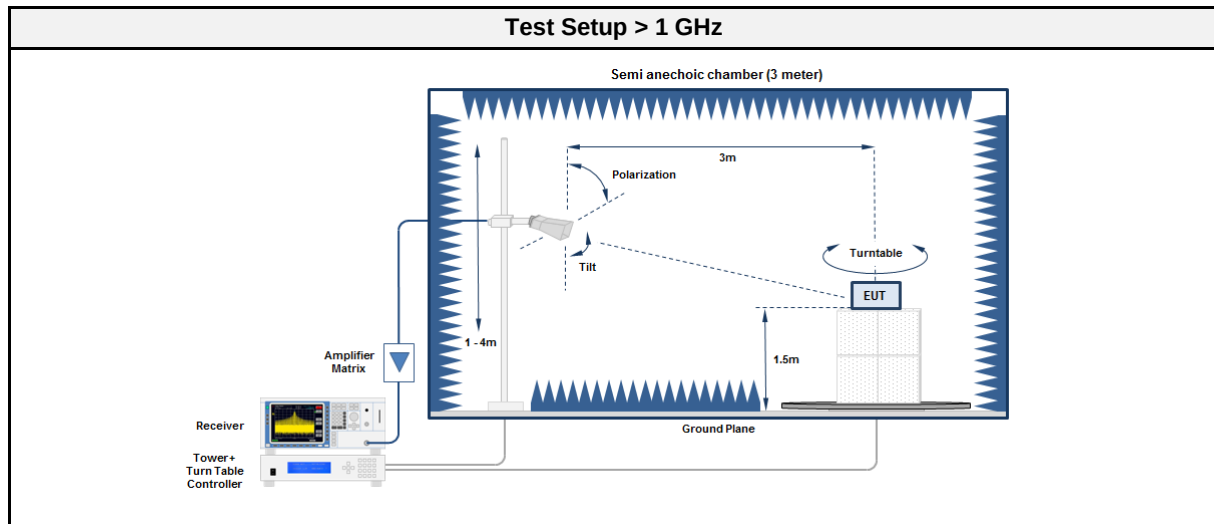
Test Information	
Reference	ISED RSS-247 3.1
Measurement Method	ANSI C63.10 6.5, 6.6, 11.12
Operator	Sebastian Suckow
Date	2018-03-05

3.9.2 Limits

Limits			
Frequency [MHz]	Detector	Field strength [dB μ V/m]	Measurement distance [m]
30 - 88	Quasi-Peak	100	3
88 - 216	Quasi-Peak	150	3
216 - 960	Quasi-Peak	200	3
960 - 1000	Quasi-Peak	500	3
>1000	Average	500	3

3.9.3 Setup





3.9.4 Equipment

Test Equipment 30 - 1000 MHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	-	-
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2017-08	2018-08
Antenna	R&S	HK 116	EF00203	2016-06	2018-06
Antenna	R&S	HL 223	EF00187	2016-05	2019-05

Test Equipment > 1 GHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	-	-
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2017-08	2018-08
Antenna	R&S	BBHA 9120D	EF01153	2017-08	2018-08
Antenna	Amplifier Research	AT4560	EF01152	2017-10	2018-10

3.9.5 Procedure

Test Procedure 30 - 1000 MHz	
1. EUT is placed on a non conducting support at the center of a turn table 0.8 m above the ground 2. EUT set to test mode 3. The receiver is set to peak detection with max hold 4. The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m 5. All significant emissions are measured again using the corresponding final detector	

Test Procedure > 1 GHz	
1. EUT is placed on a non conducting support at the center of a turn table 1.5 m above the ground 2. EUT set to test mode 3. The receiver is set to peak detection with max hold 4. The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m 5. All significant emissions are measured again using the corresponding final detector	

3.9.6 Results

Test Results						
Channel [MHz]	Emission [MHz]	Level [dBμV/m]	Det.	Pol.	Limit [dBμV/m]	Margin [dB]
2440	7952	51.42	pk	ver	53.98	-02.56

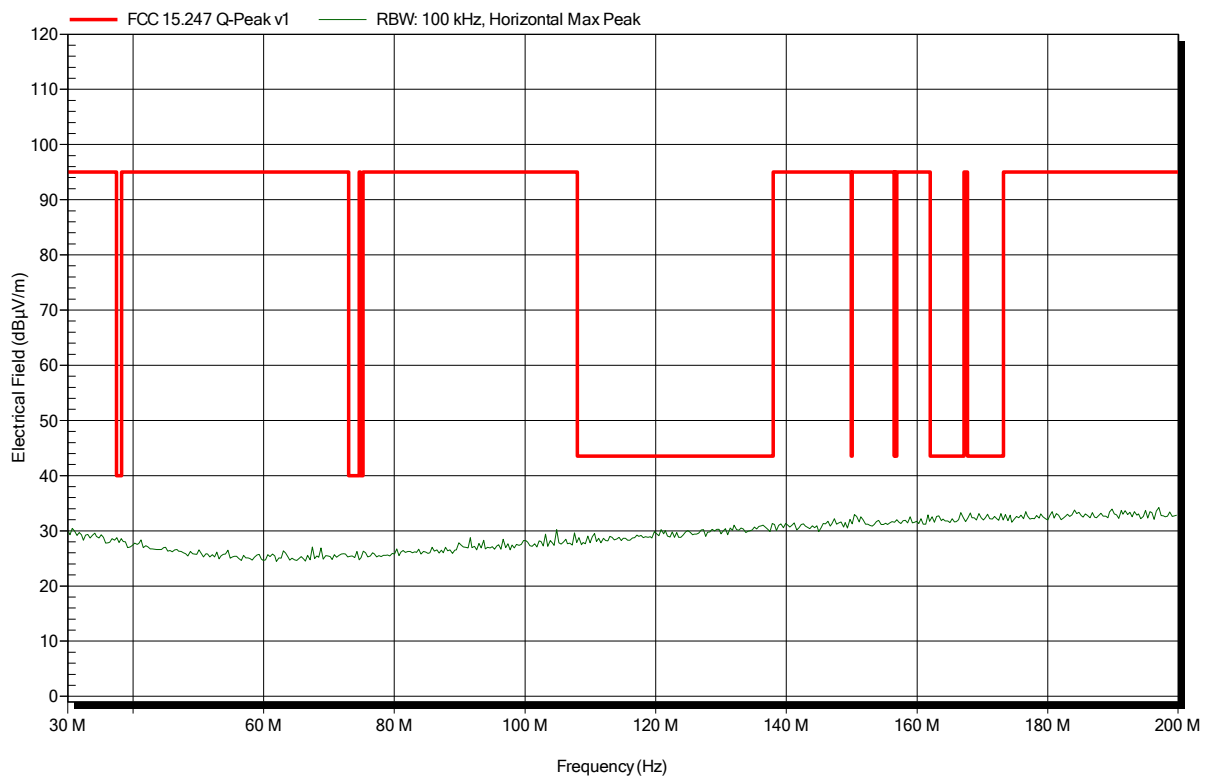
ANNEX A Transmitter spurious emissions

Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Rohde & Schwarz HK 116, Horizontal
Measurement distance: 3 m
Mode: TX; IEEE 802.15.4, 2405 MHz
Test Date: 2018-03-05
Note:

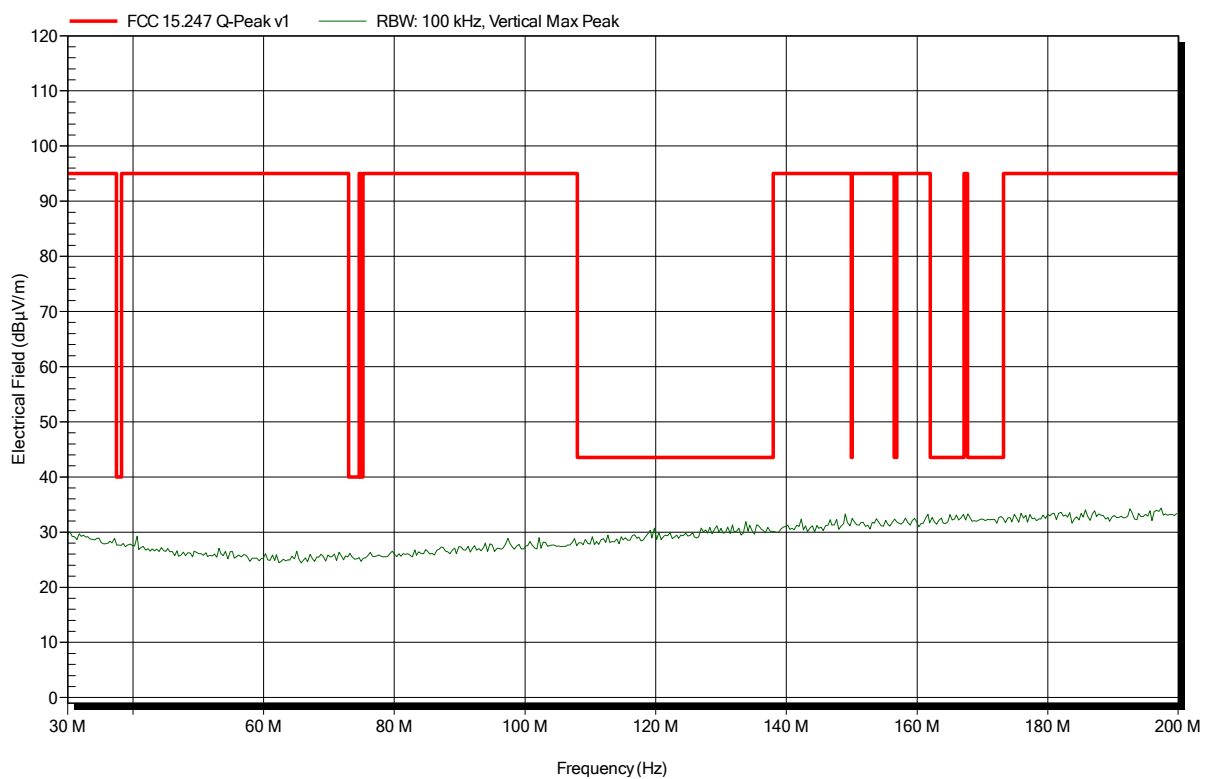
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Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163
 Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Rohde & Schwarz HK 116, Vertical
 Measurement distance: 3 m
 Mode: TX; IEEE 802.15.4, 2405 MHz
 Test Date: 2018-03-05
 Note:

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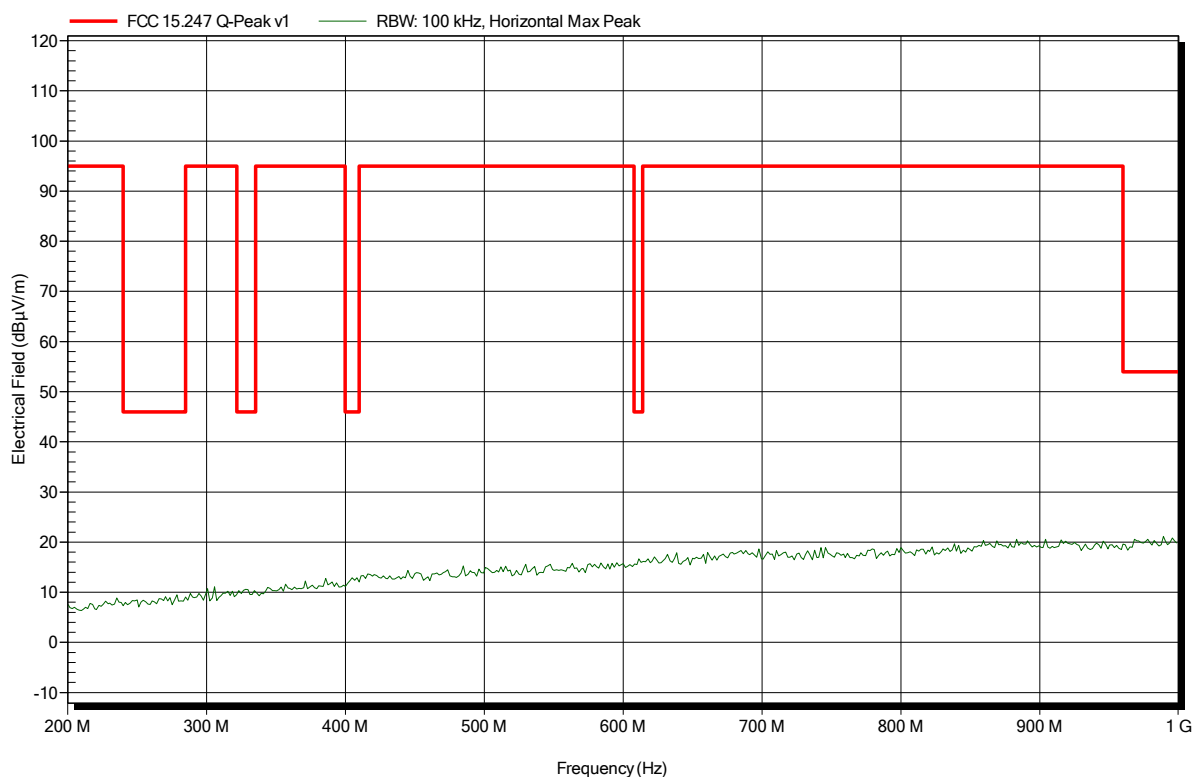


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Rohde & Schwarz HL 223, Horizontal
 Measurement distance: 3 m
 Mode: TX; IEEE 802.15.4, 2405 MHz
 Test Date: 2018-03-05
 Note:

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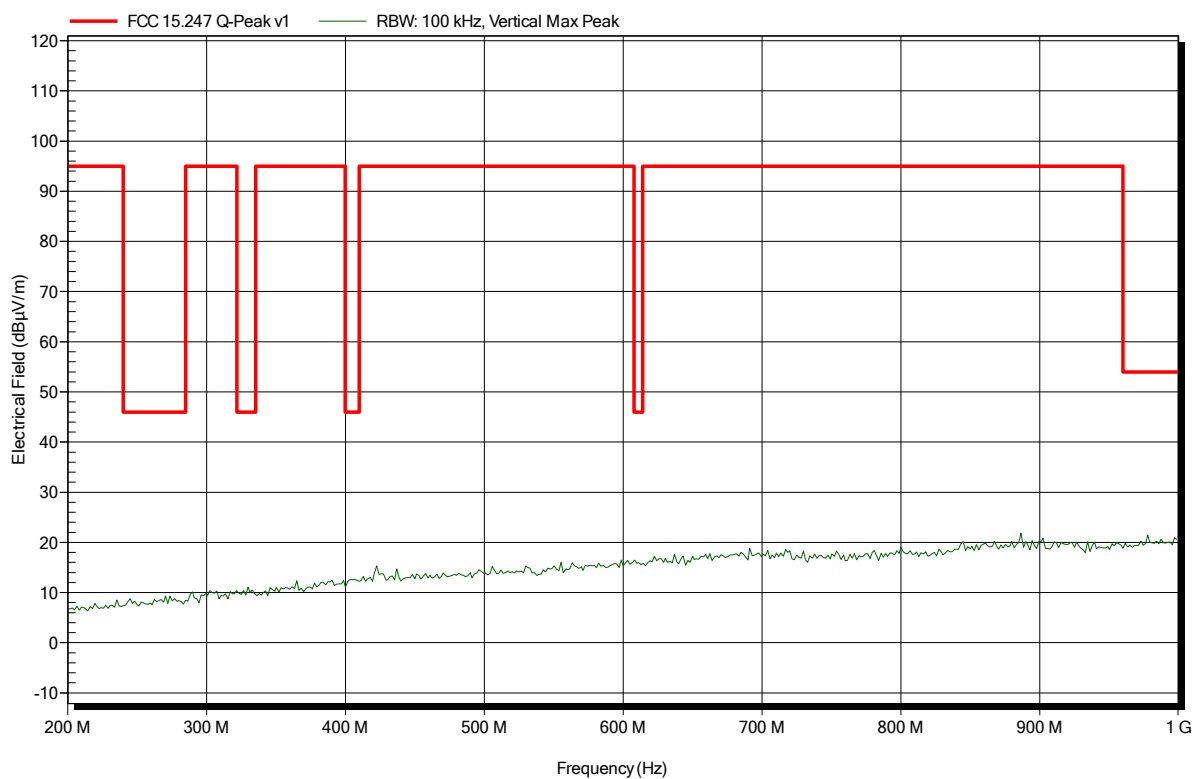


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Rohde & Schwarz HL 223, Vertical
Measurement distance: 3 m
Mode: TX; IEEE 802.15.4, 2405 MHz
Test Date: 2018-03-05
Note:

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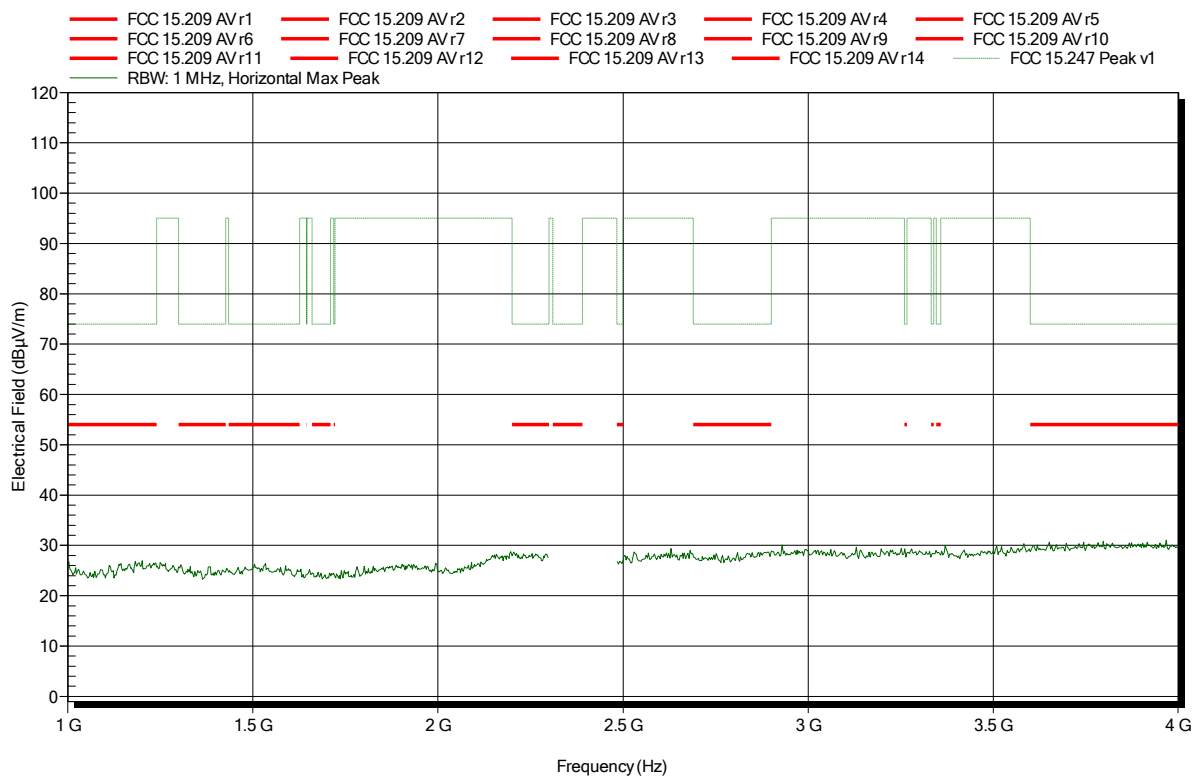


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2405 MHz
Test Date: 2018-03-05
Note:

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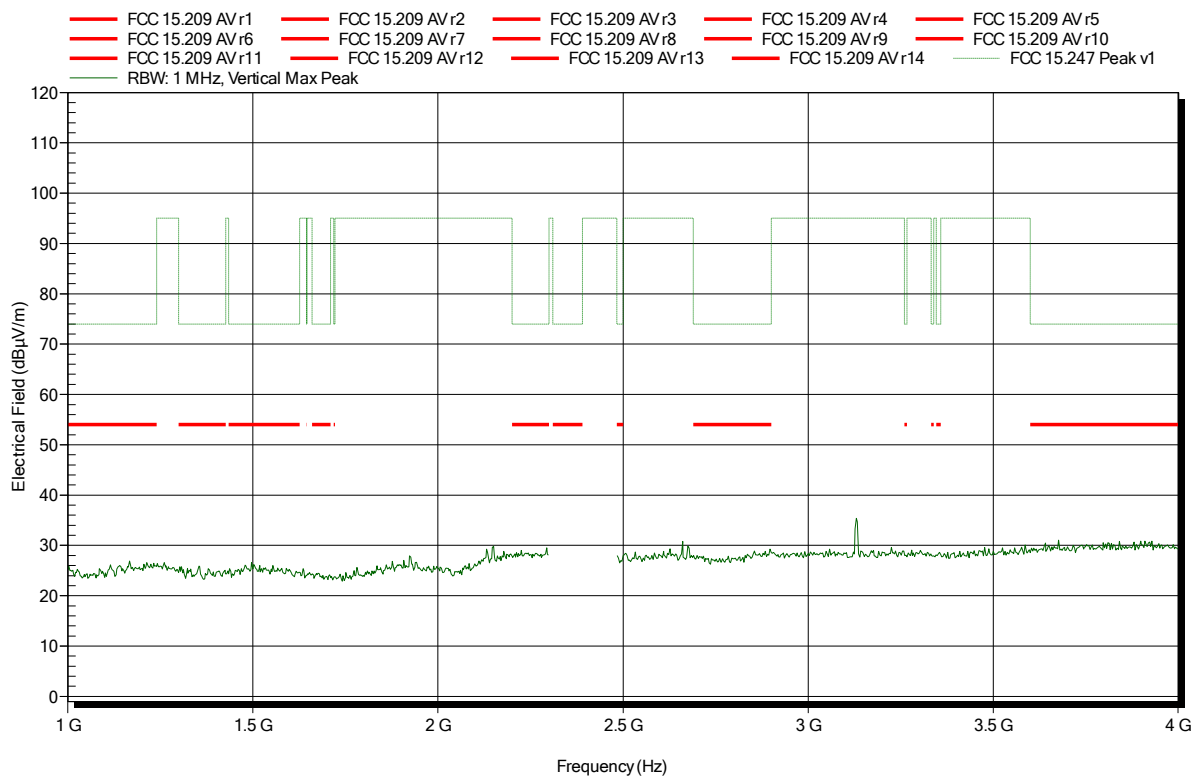


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2405 MHz
Test Date: 2018-03-05
Note:

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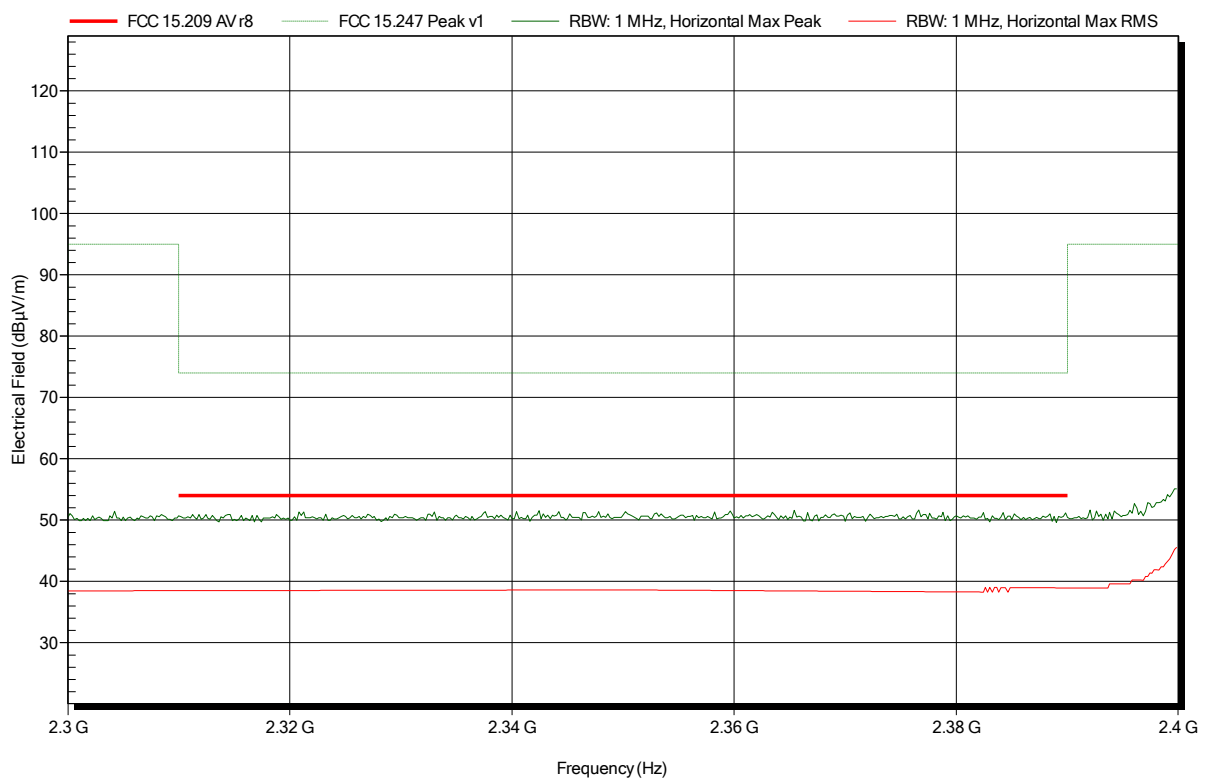


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2405 MHz
Test Date: 2018-03-05
Note: lower bandedge

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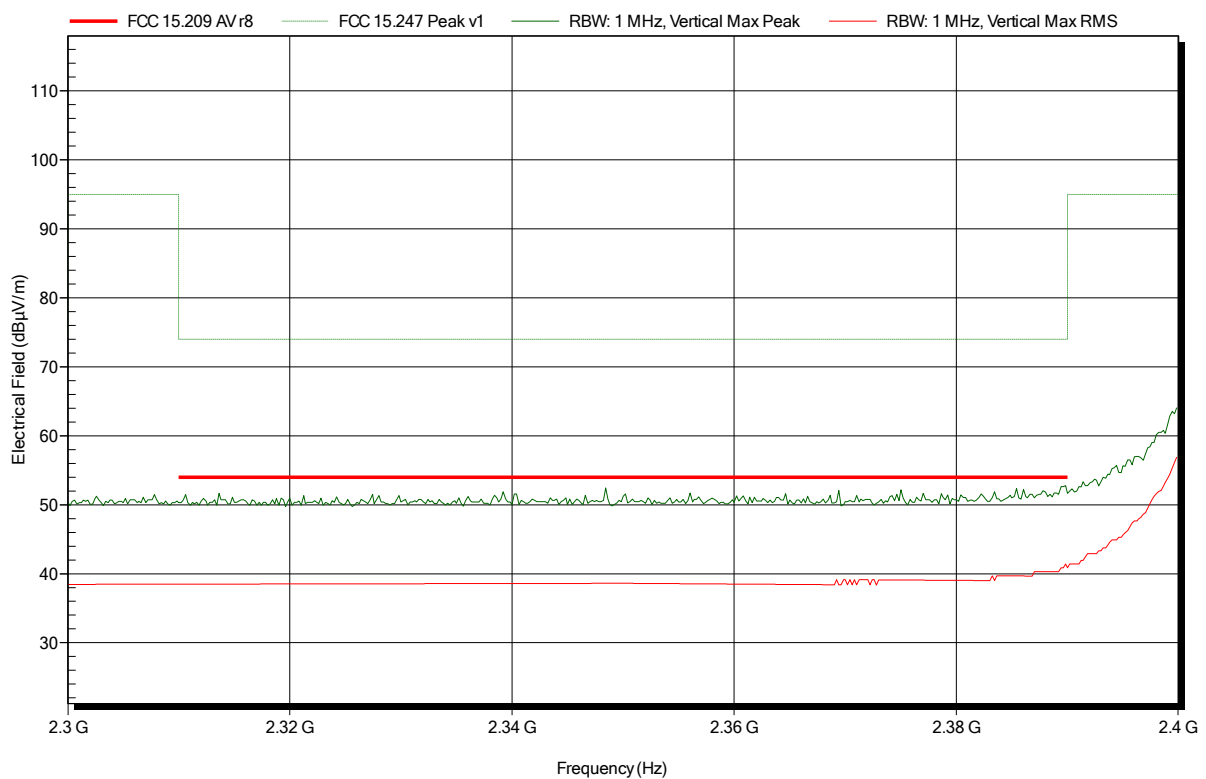


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2405 MHz
Test Date: 2018-03-05
Note: lower bandedge

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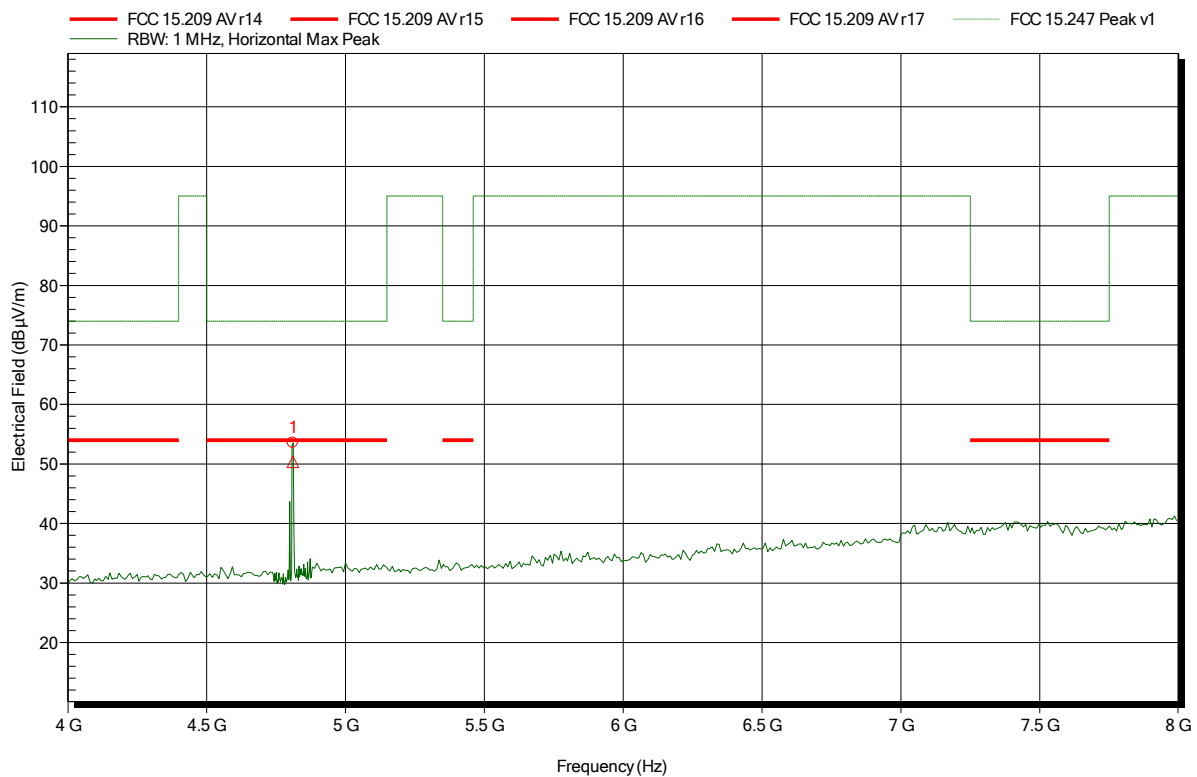


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; IEEE 802.15.4, 2405 MHz
 Test Date: 2018-03-05
 Note:

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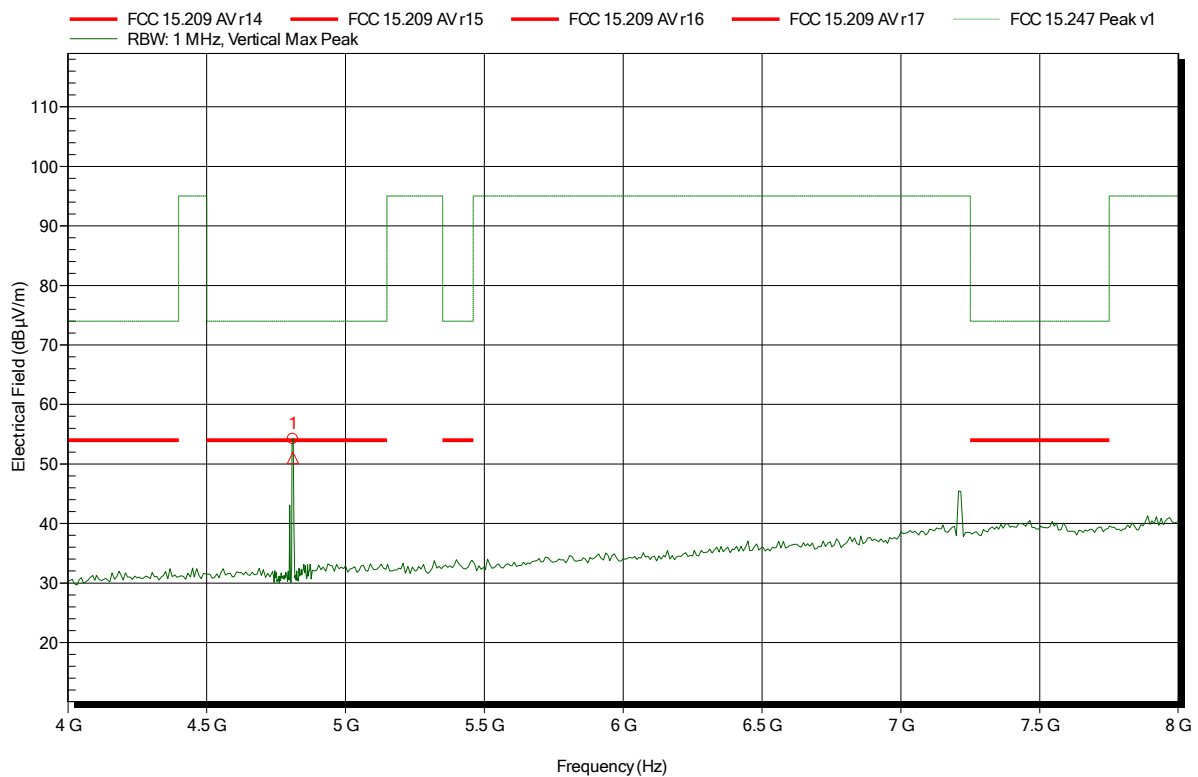
Frequency	Peak	Peak Limit	Peak Difference	Peak Status
4.811 GHz	53.52 dBµV/m	74 dBµV/m	-20.48 dB	Pass
Frequency	RMS	RMS Limit	RMS Difference	RMS Status
4.811 GHz	50.36 dBµV/m	54 dBµV/m	-3.64 dB	Pass

Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 1 m converted to 3m
 Mode: TX; IEEE 802.15.4, 2405 MHz
 Test Date: 2018-03-05
 Note:

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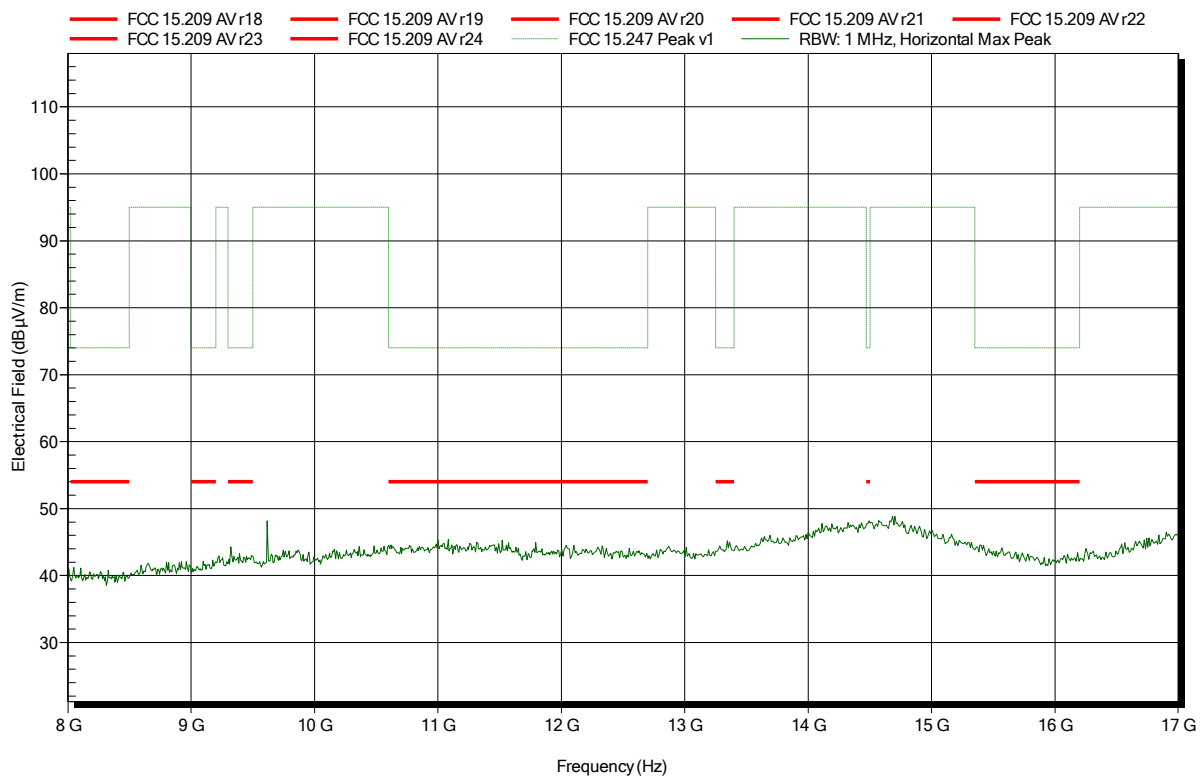
Frequency 4.811 GHz	Peak 54.17 dBµV/m	Peak Limit 74 dBµV/m	Peak Difference -19.83 dB	Peak Status Pass
Frequency 4.811 GHz	RMS 51.02 dBµV/m	RMS Limit 54 dBµV/m	RMS Difference -2.98 dB	RMS Status Pass

Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2405 MHz
Test Date: 2018-03-05
Note:

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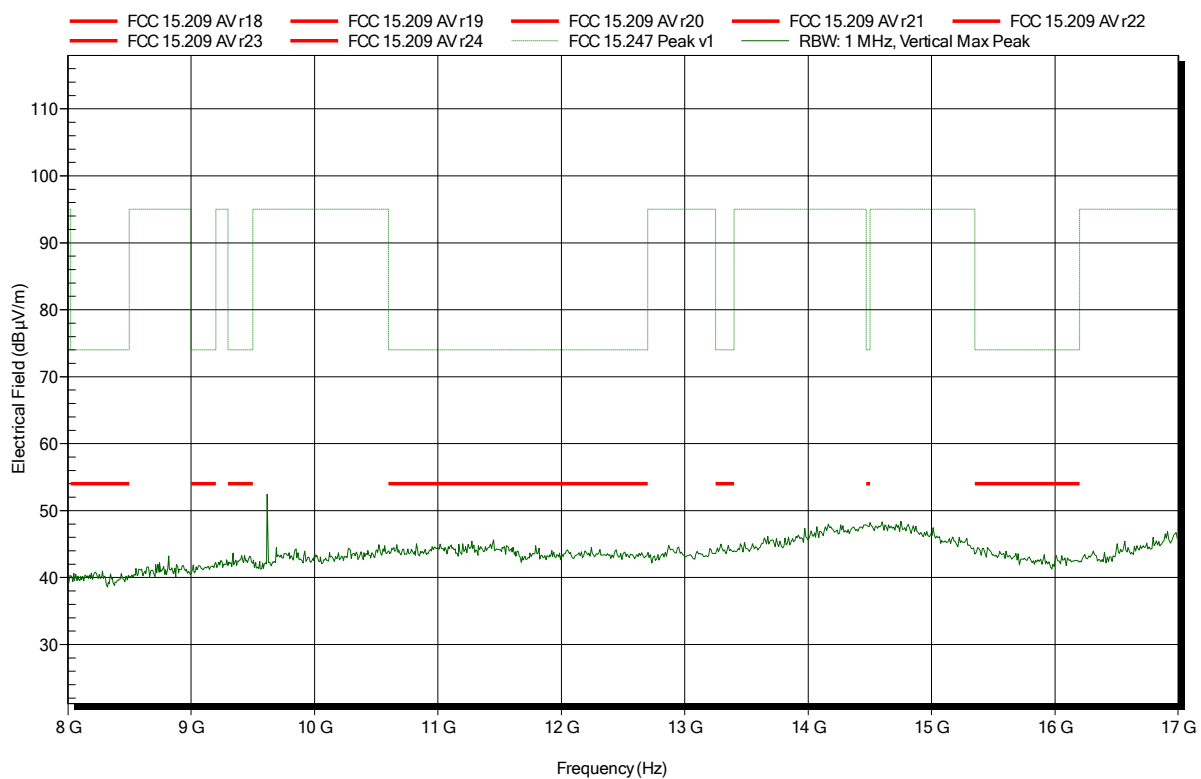


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2405 MHz
Test Date: 2018-03-05
Note:

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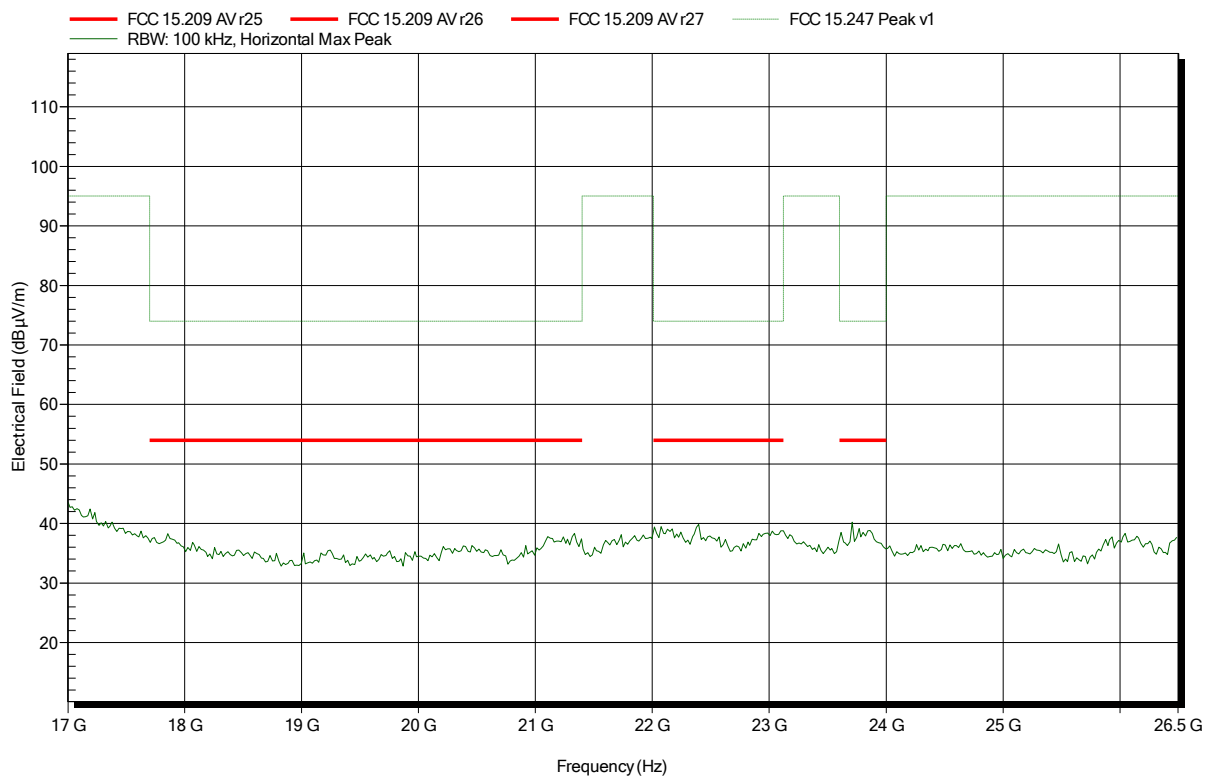


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Amplifier Research AT 4560, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2405 MHz
Test Date: 2018-03-05
Note:

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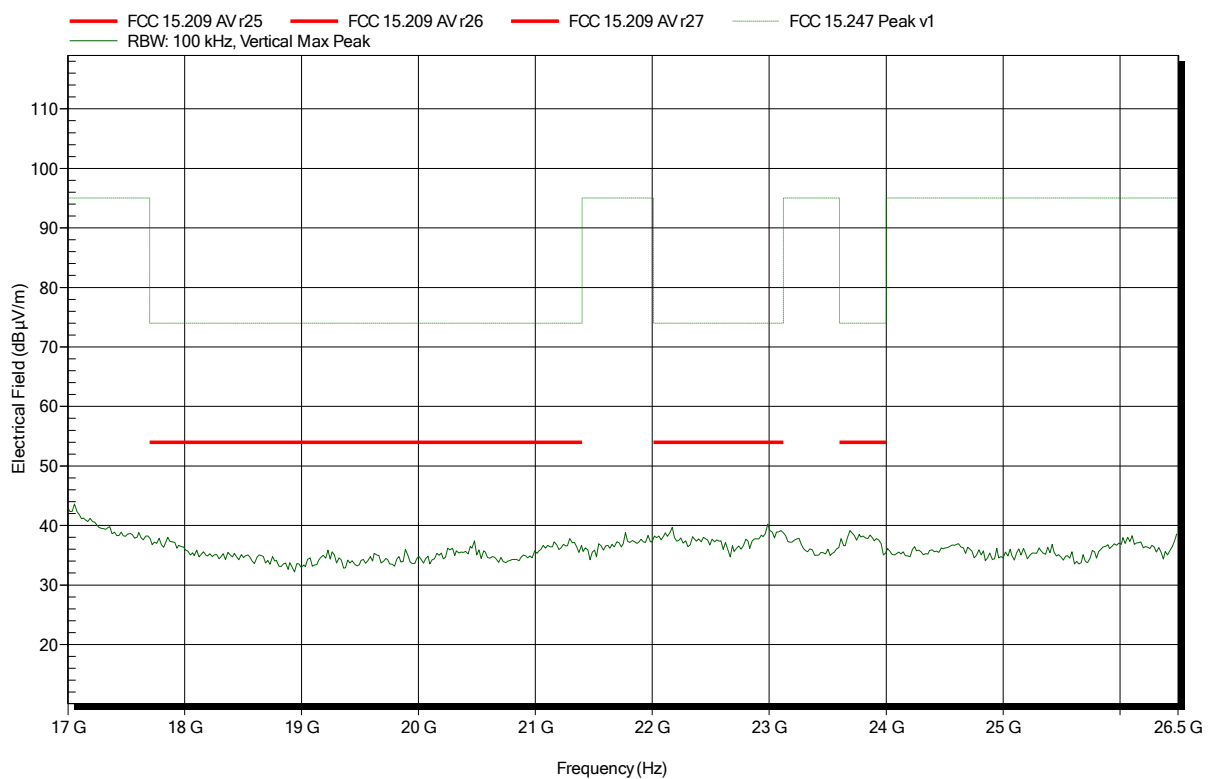


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Amplifier Research AT 4560, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2405 MHz
Test Date: 2018-03-05
Note:

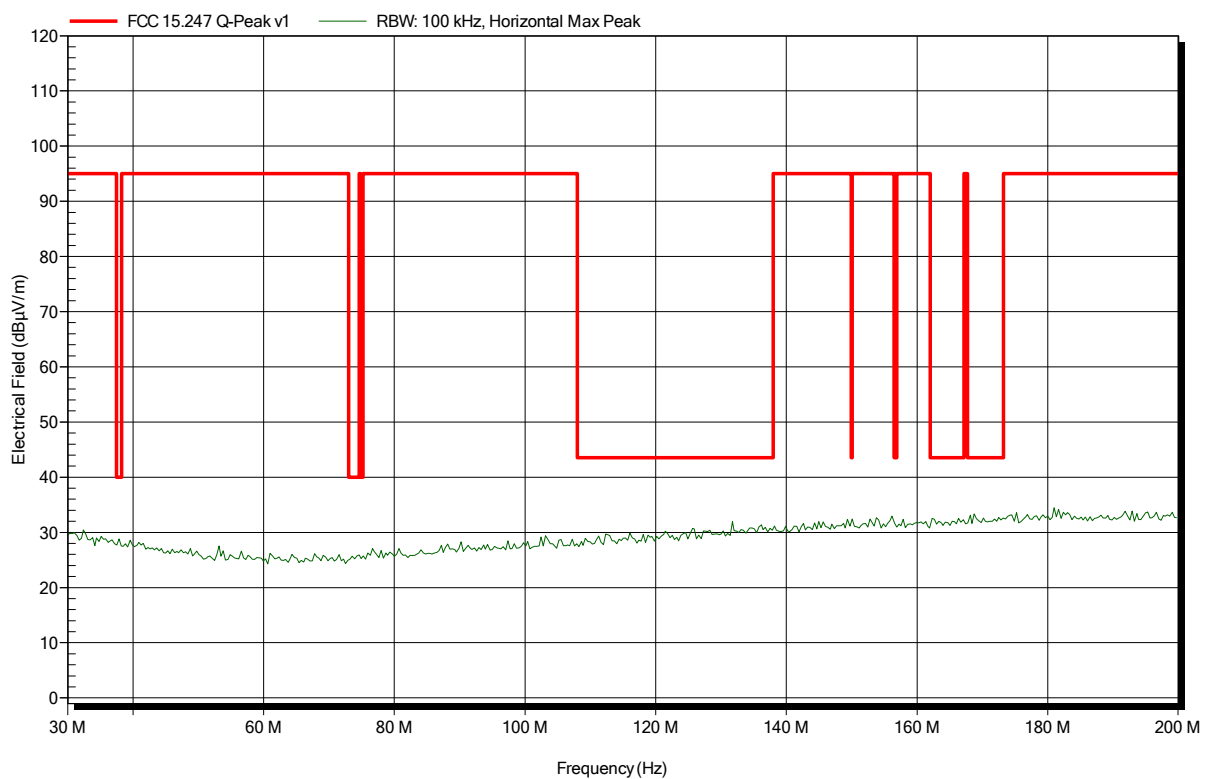
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Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163
 Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Rohde & Schwarz HK 116, Horizontal
 Measurement distance: 3 m
 Mode: TX; IEEE 802.15.4, 2440 MHz
 Test Date: 2018-03-05
 Note:

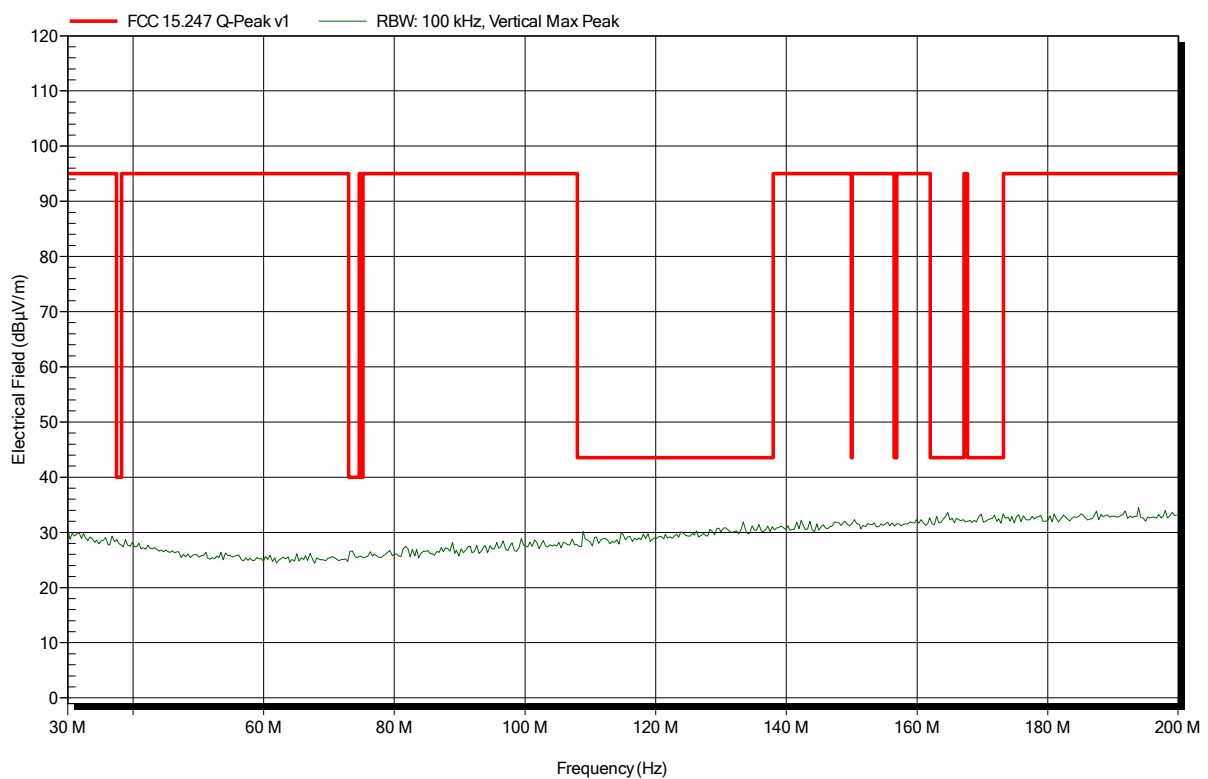
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Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163
 Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Rohde & Schwarz HK 116, Vertical
 Measurement distance: 3 m
 Mode: TX; IEEE 802.15.4, 2440 MHz
 Test Date: 2018-03-05
 Note:

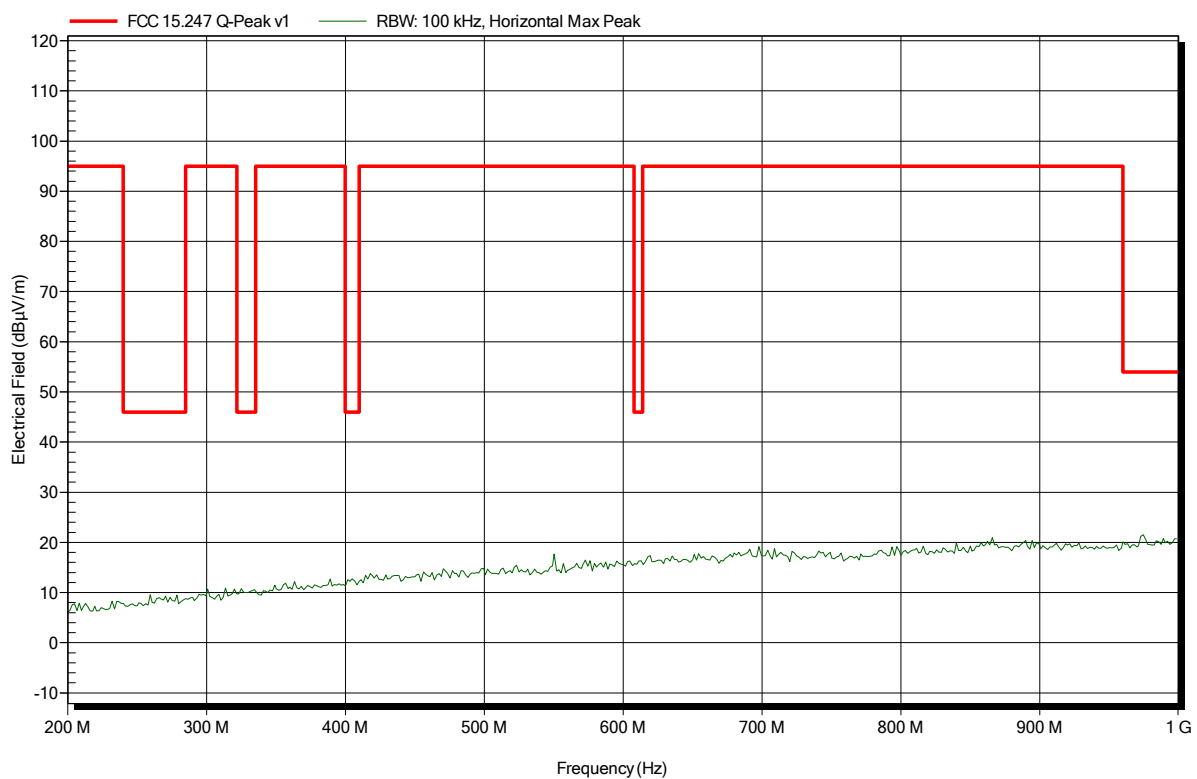
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Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163
 Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Rohde & Schwarz HL 223, Horizontal
 Measurement distance: 3 m
 Mode: TX; IEEE 802.15.4, 2440 MHz
 Test Date: 2018-03-05
 Note:

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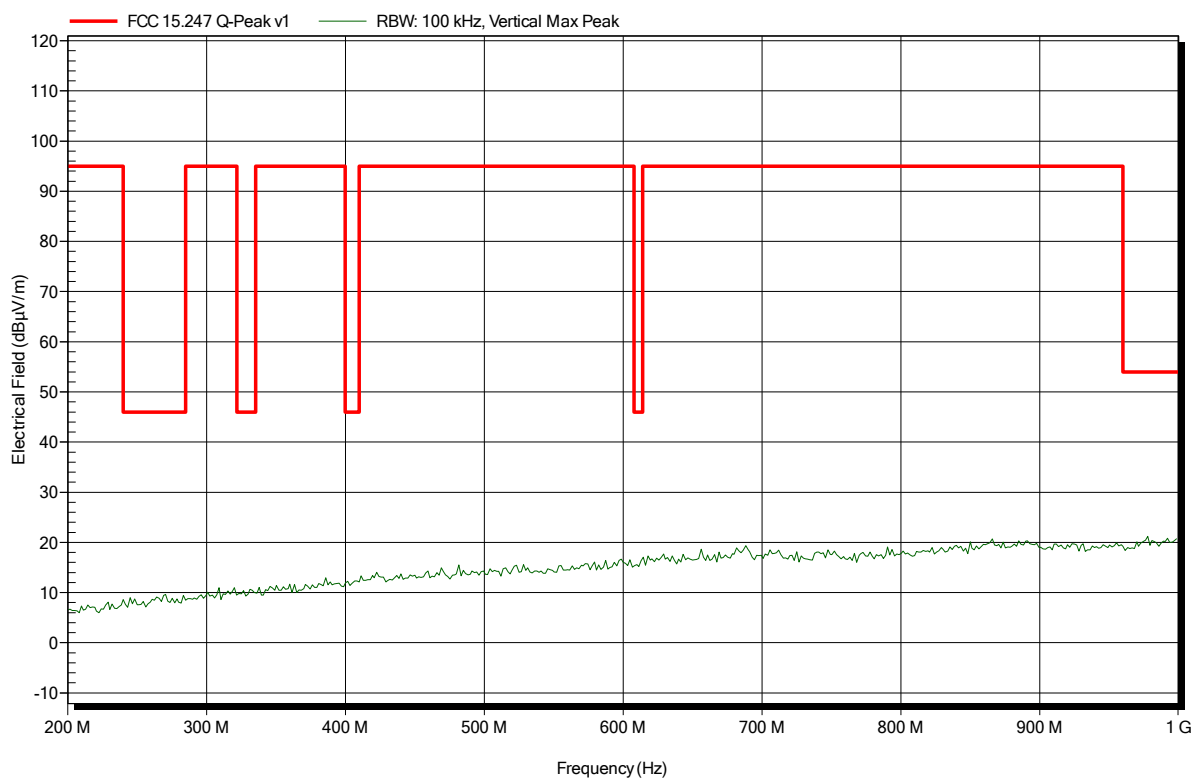


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Rohde & Schwarz HL 223, Vertical
Measurement distance: 3 m
Mode: TX; IEEE 802.15.4, 2440 MHz
Test Date: 2018-03-05
Note:

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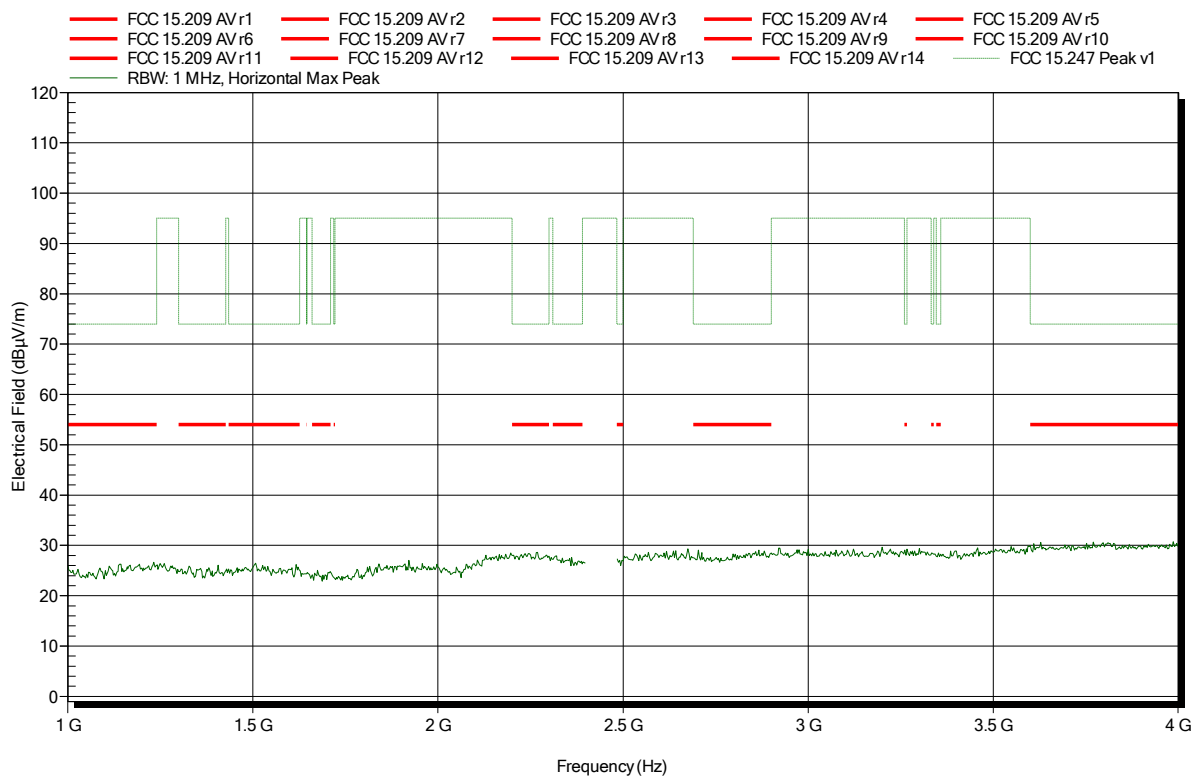


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2440 MHz
Test Date: 2018-03-05
Note:

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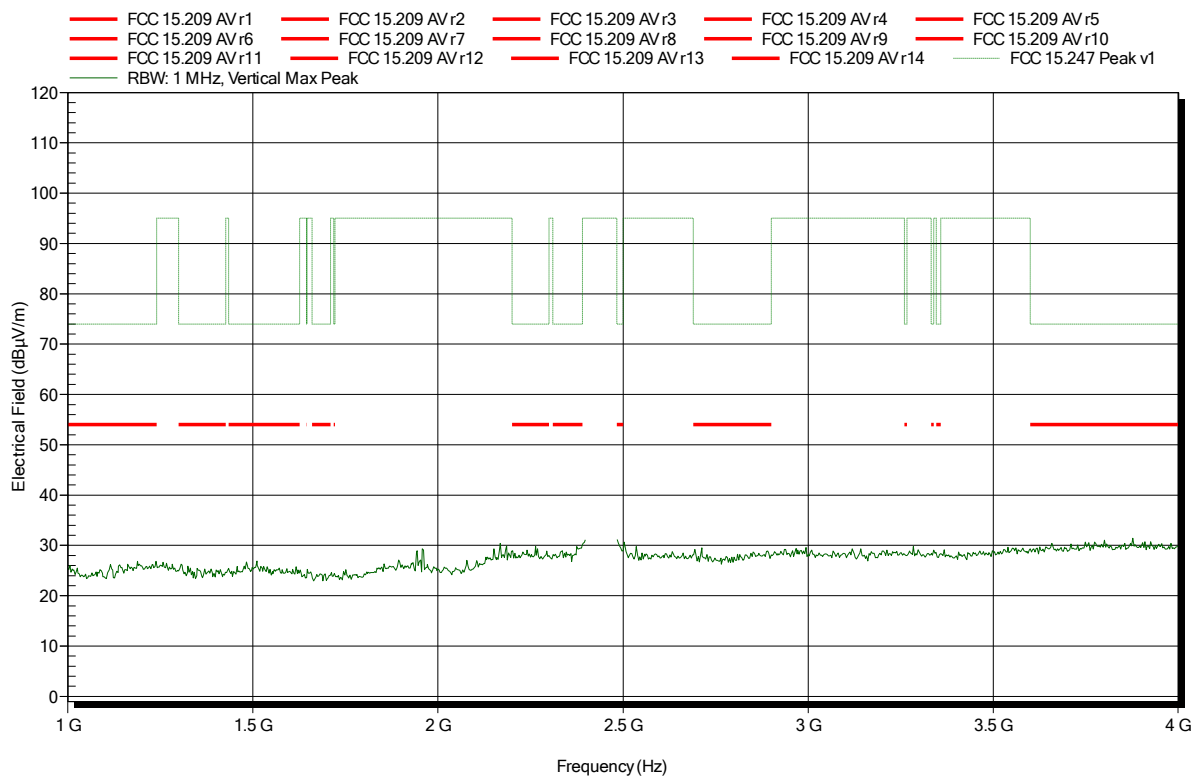


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 1 m converted to 3m
 Mode: TX; IEEE 802.15.4, 2440 MHz
 Test Date: 2018-03-05
 Note:

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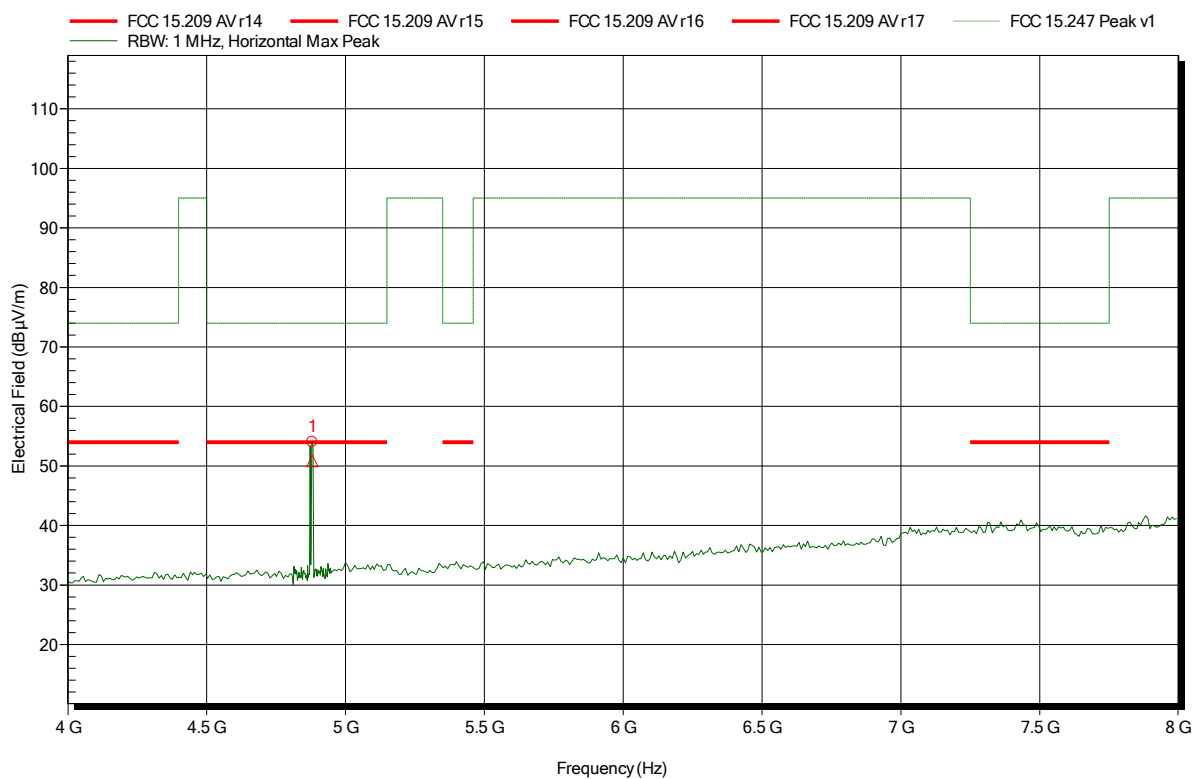


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2440 MHz
Test Date: 2018-03-05
Note:

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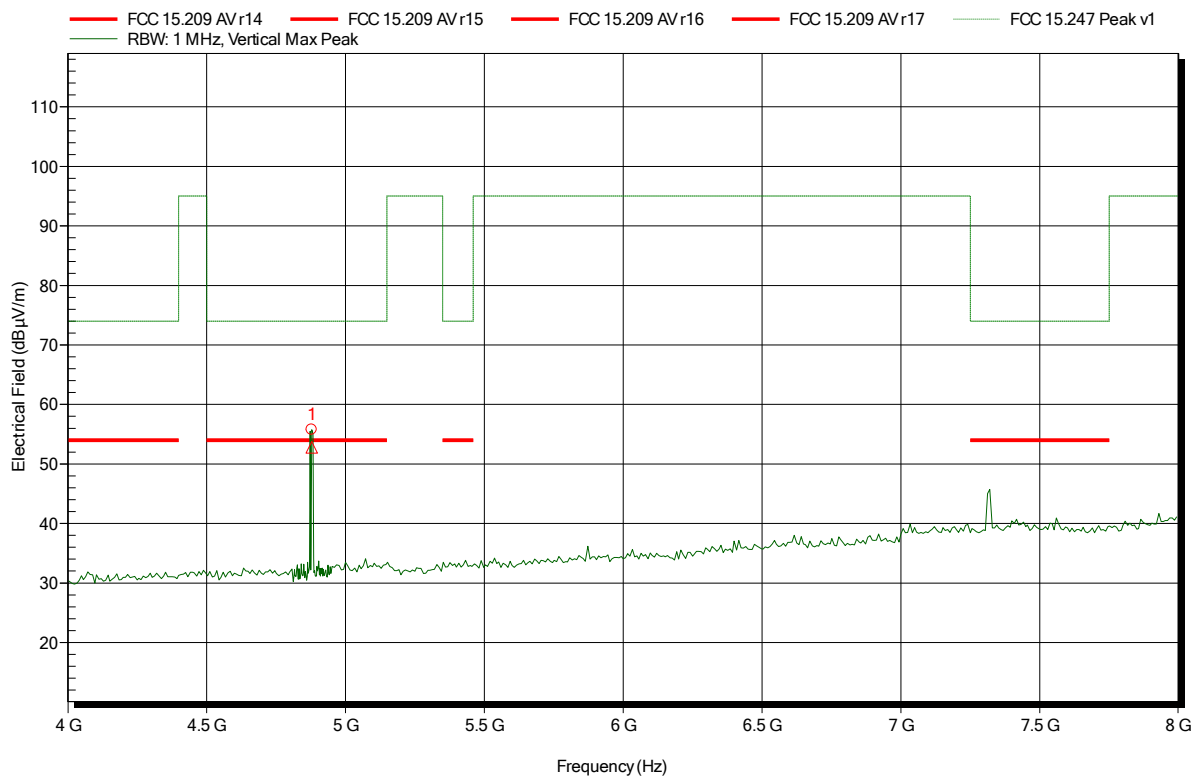
Frequency 4.881 GHz	Peak 54.04 dBµV/m	Peak Limit 74 dBµV/m	Peak Difference -19.96 dB	Peak Status Pass
Frequency 4.881 GHz	RMS 50.86 dBµV/m	RMS Limit 54 dBµV/m	RMS Difference -3.14 dB	RMS Status Pass

Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2440 MHz
Test Date: 2018-03-05
Note:

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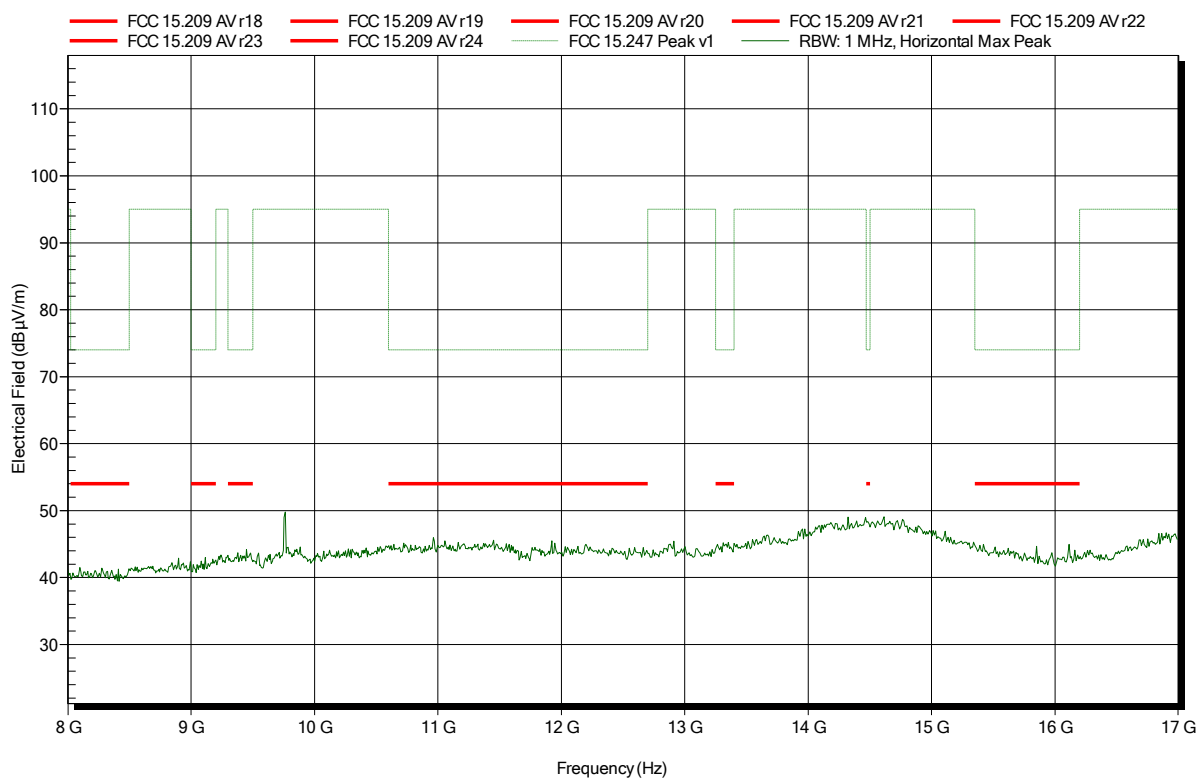
Frequency	Peak	Peak Limit	Peak Difference	Peak Status
4.879 GHz	55.79 dBµV/m	74 dBµV/m	-18.26 dB	Pass
Frequency	RMS	RMS Limit	RMS Difference	RMS Status
4.879 GHz	52.79 dBµV/m	54 dBµV/m	-1.21 dB	Pass

Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2440 MHz
Test Date: 2018-03-05
Note:

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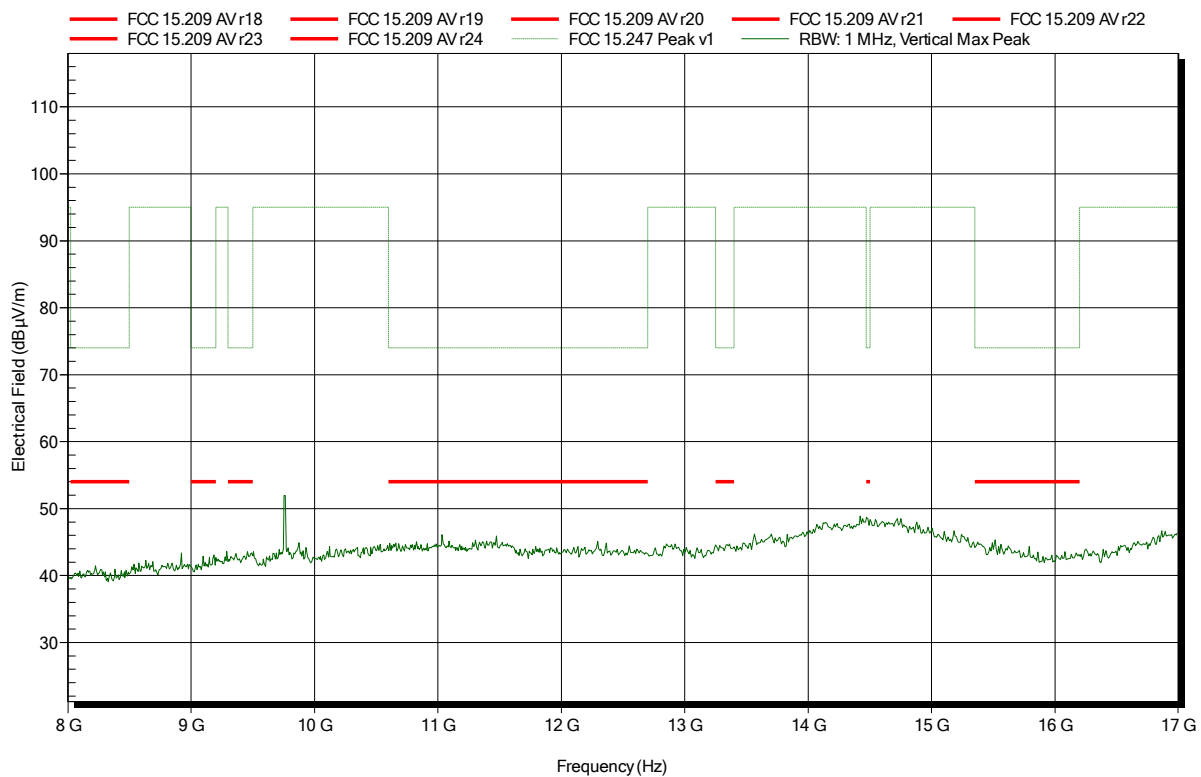


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2440 MHz
Test Date: 2018-03-05
Note:

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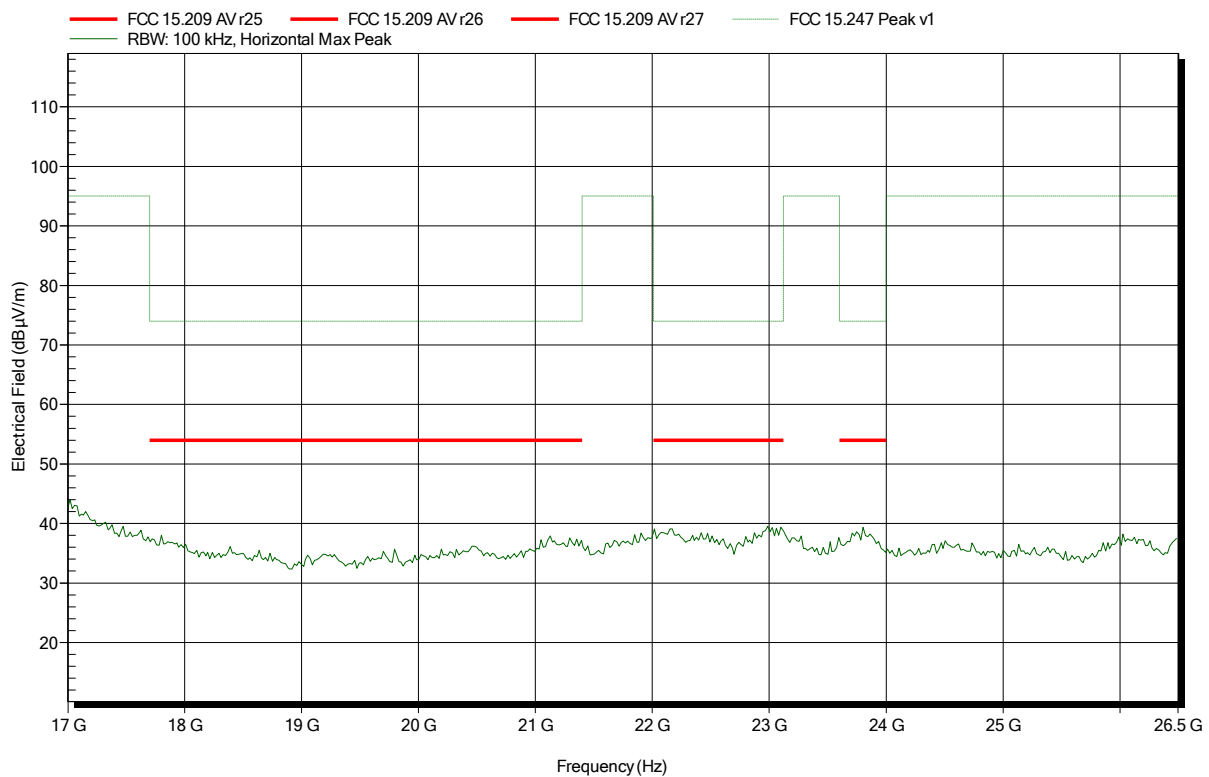


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Amplifier Research AT 4560, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2440 MHz
Test Date: 2018-03-05
Note:

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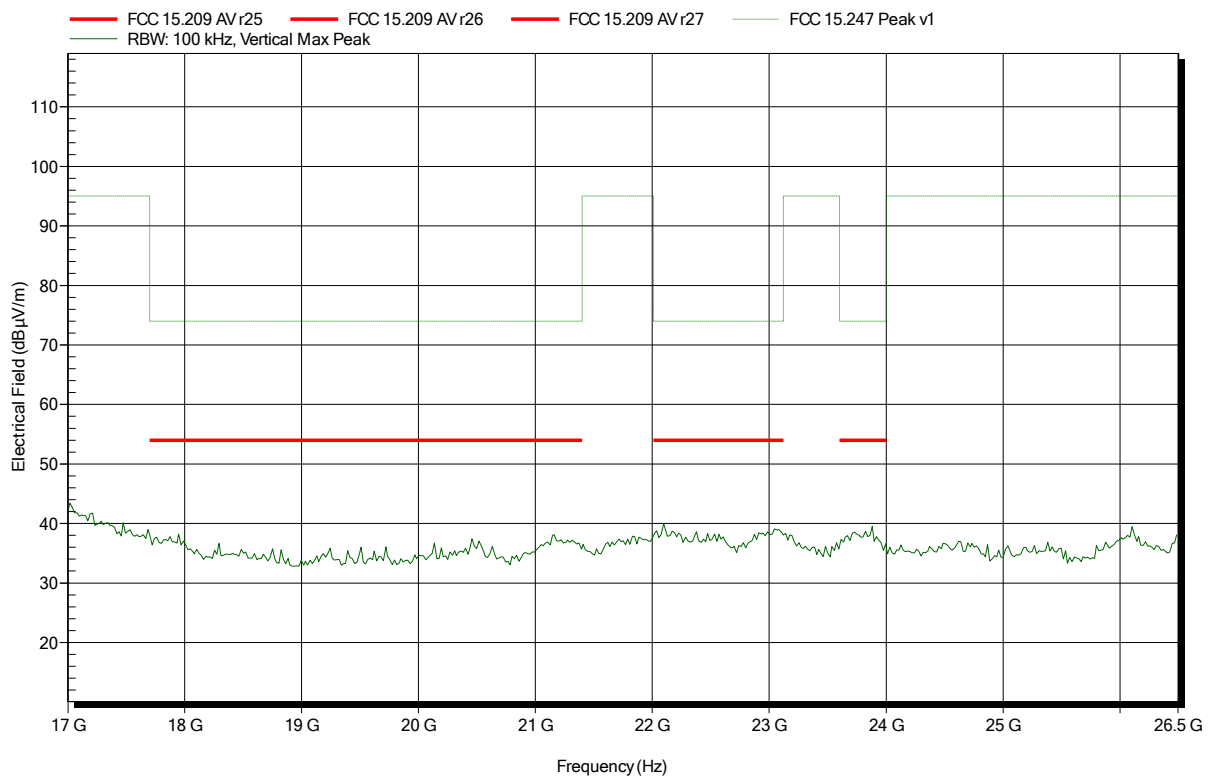


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Amplifier Research AT 4560, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2440 MHz
Test Date: 2018-03-05
Note:

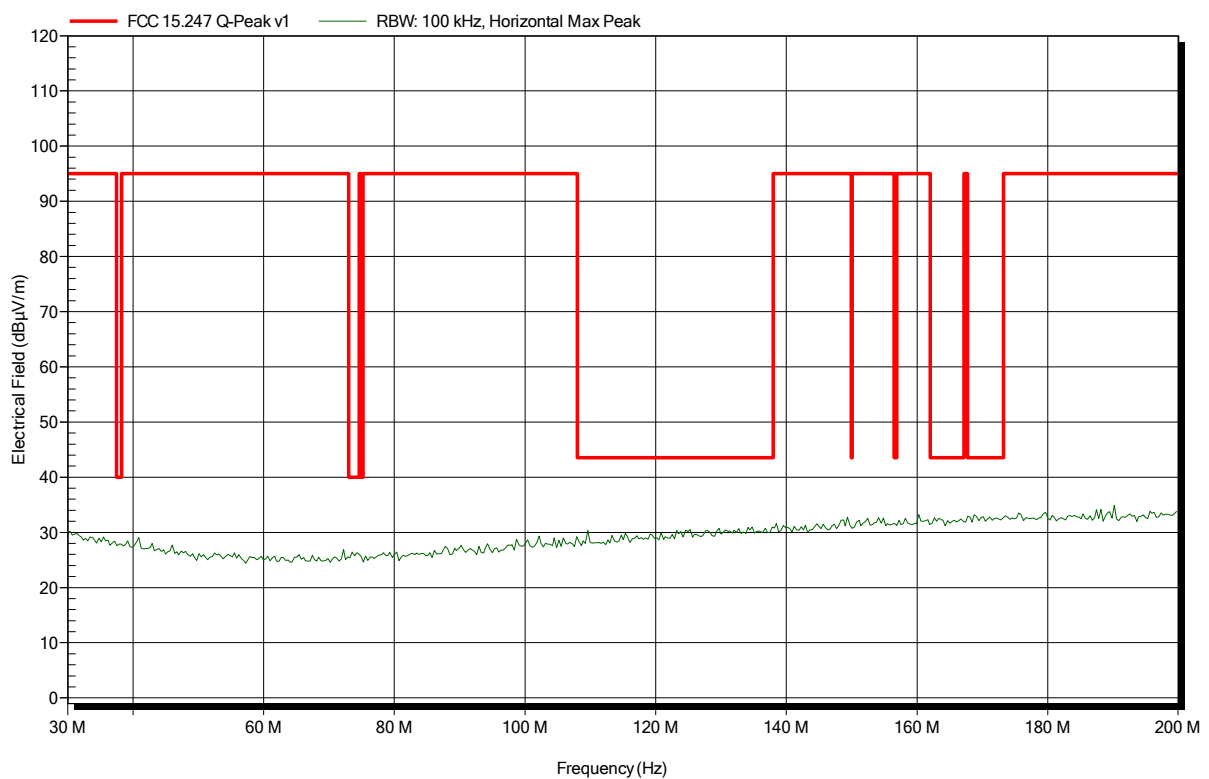
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Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163
 Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Rohde & Schwarz HK 116, Horizontal
 Measurement distance: 3 m
 Mode: TX; IEEE 802.15.4, 2480 MHz
 Test Date: 2018-03-05
 Note:

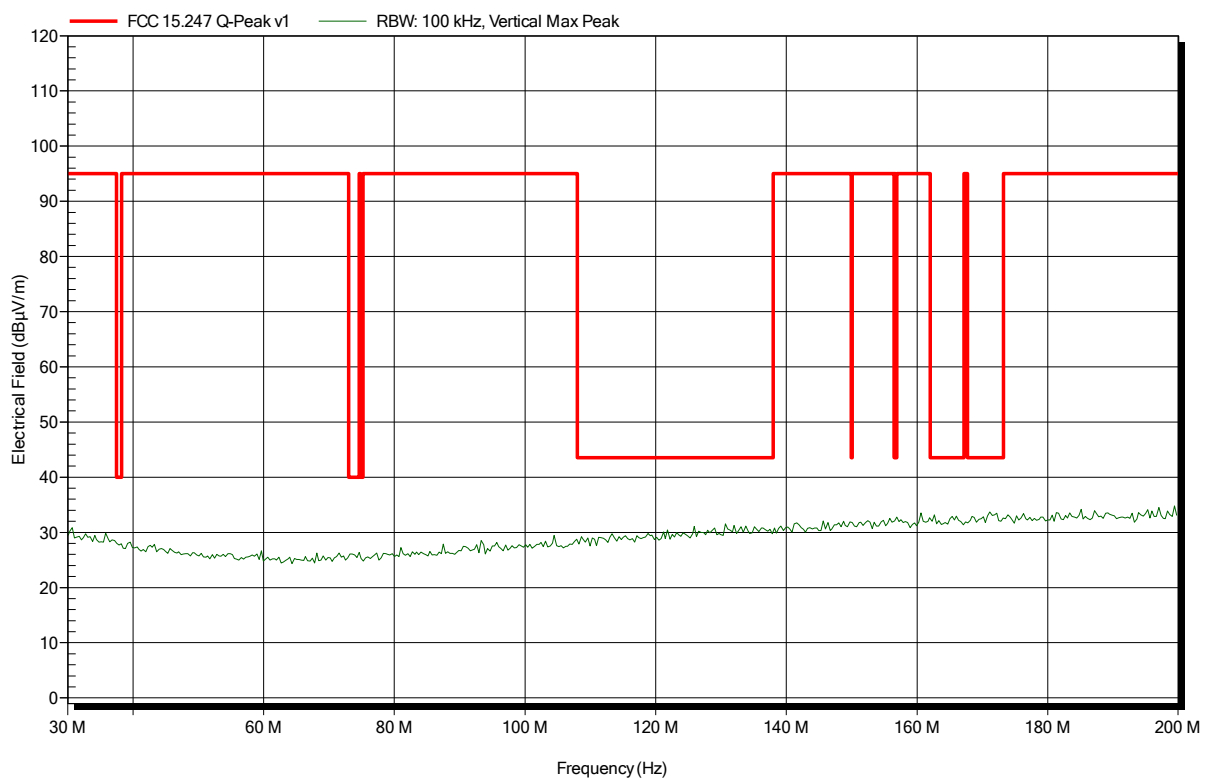
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Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163
 Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Rohde & Schwarz HK 116, Vertical
 Measurement distance: 3 m
 Mode: TX; IEEE 802.15.4, 2480 MHz
 Test Date: 2018-03-05
 Note:

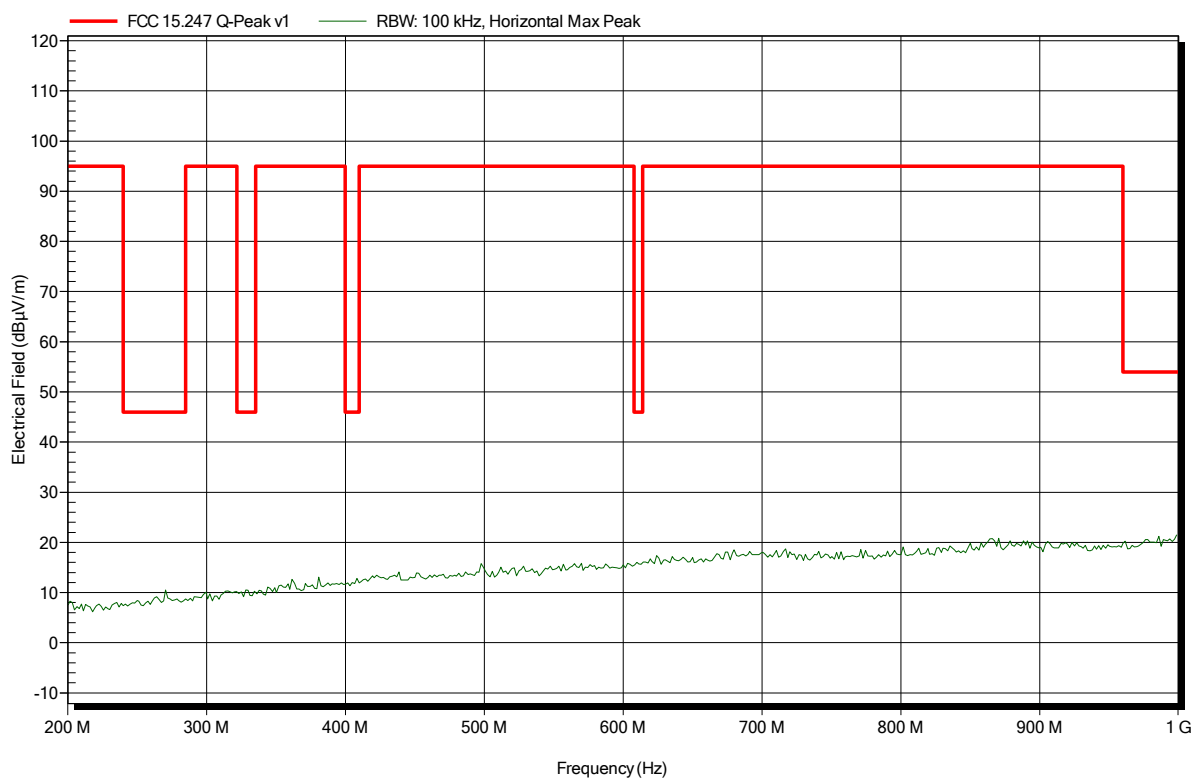
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Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163
 Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Rohde & Schwarz HL 223, Horizontal
 Measurement distance: 3 m
 Mode: TX; IEEE 802.15.4, 2480 MHz
 Test Date: 2018-03-05
 Note:

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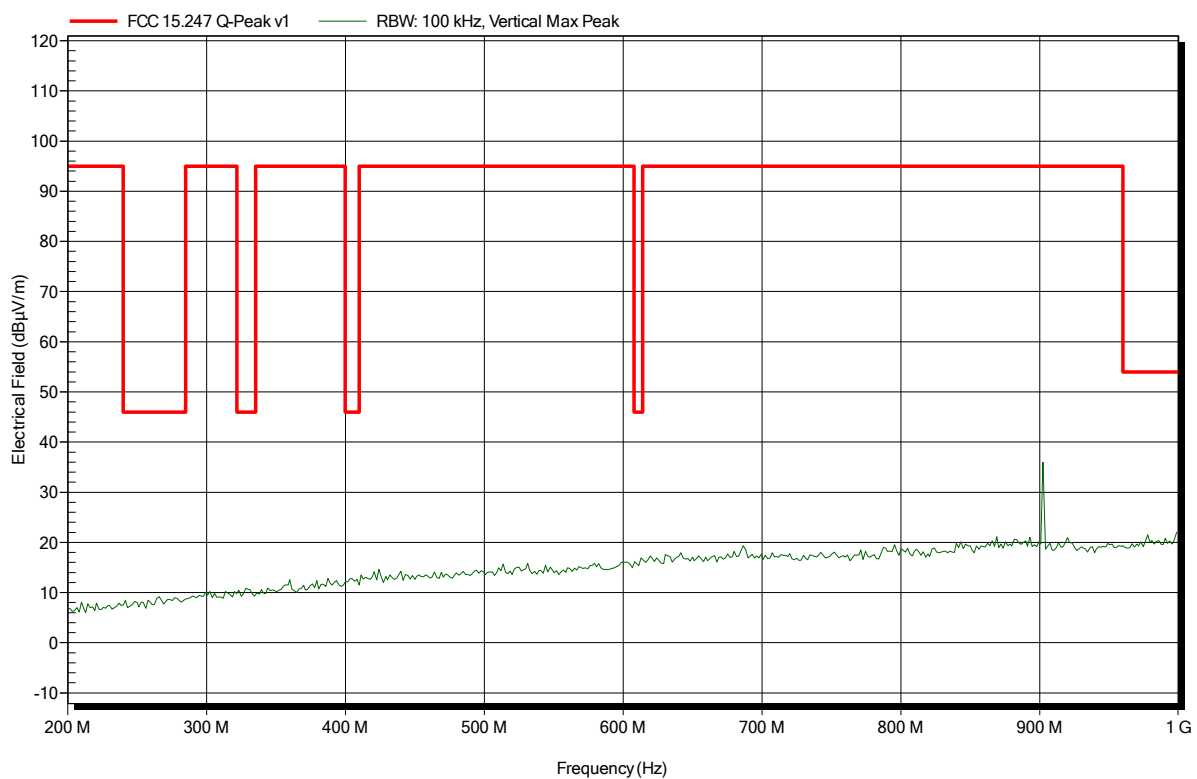


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Rohde & Schwarz HL 223, Vertical
Measurement distance: 3 m
Mode: TX; IEEE 802.15.4, 2480 MHz
Test Date: 2018-03-05
Note:

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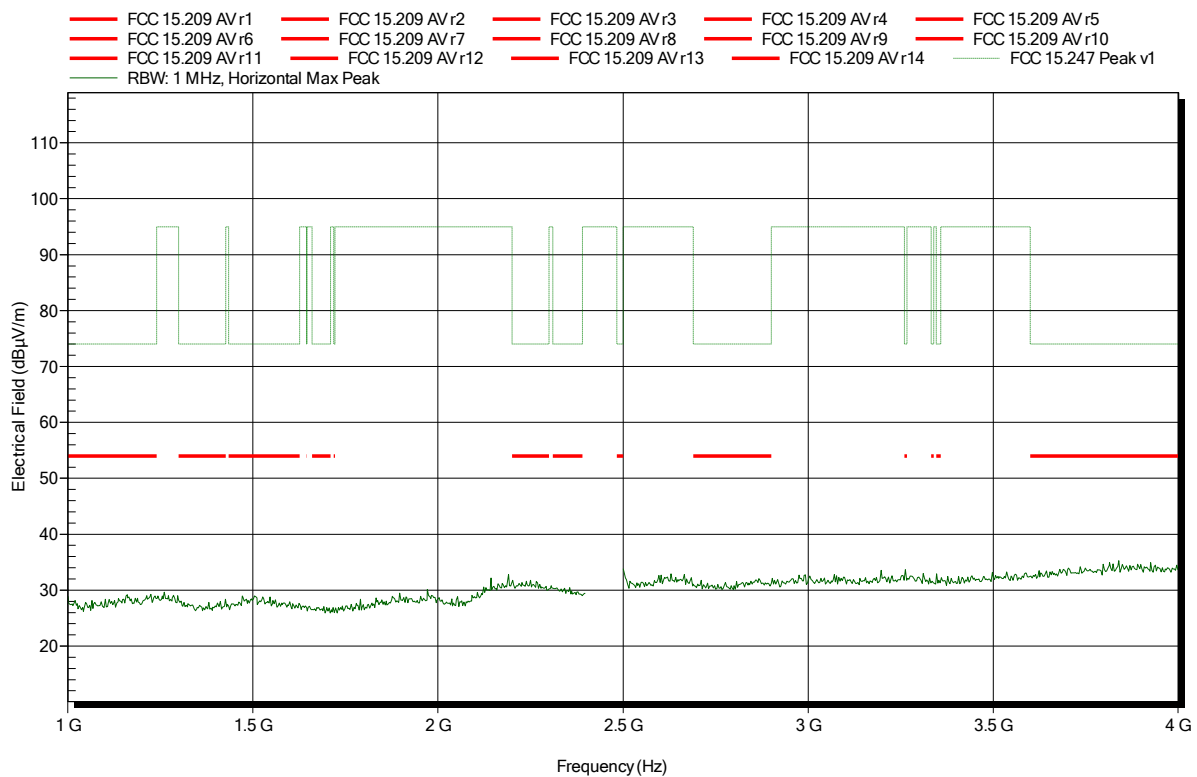


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2480 MHz
Test Date: 2018-03-02
Note:

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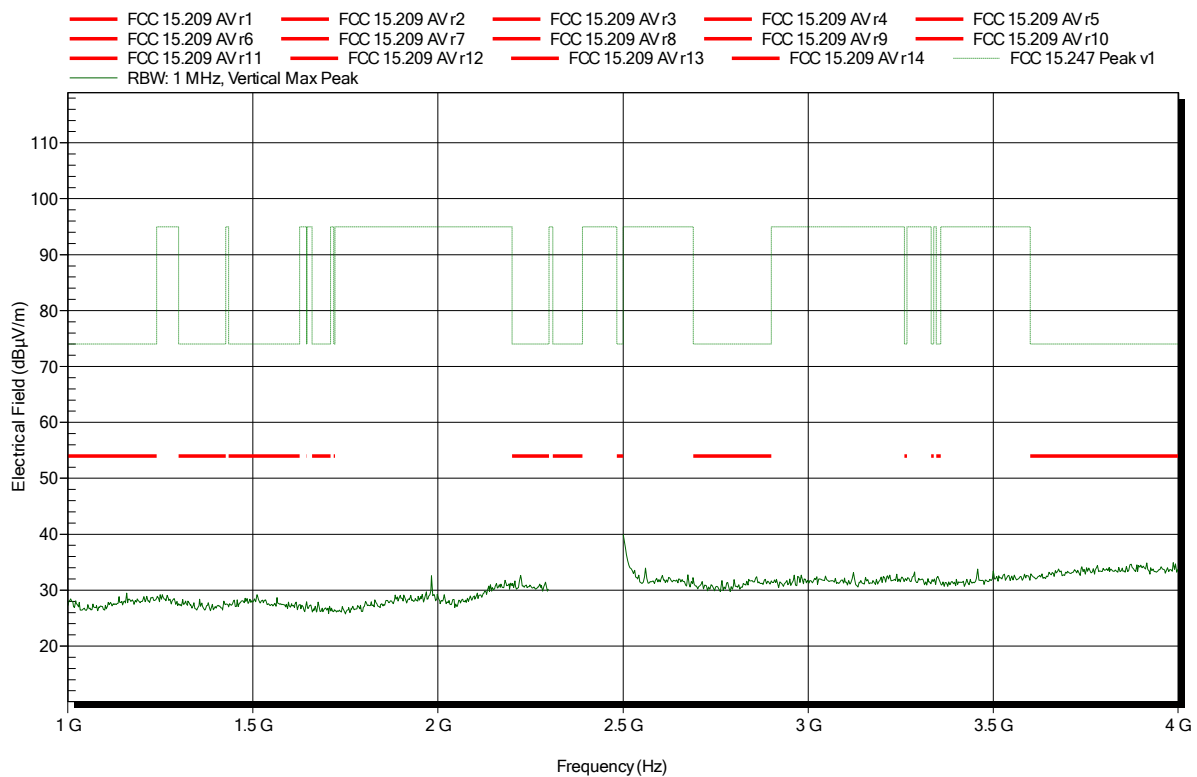


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2480 MHz
Test Date: 2018-03-02
Note:

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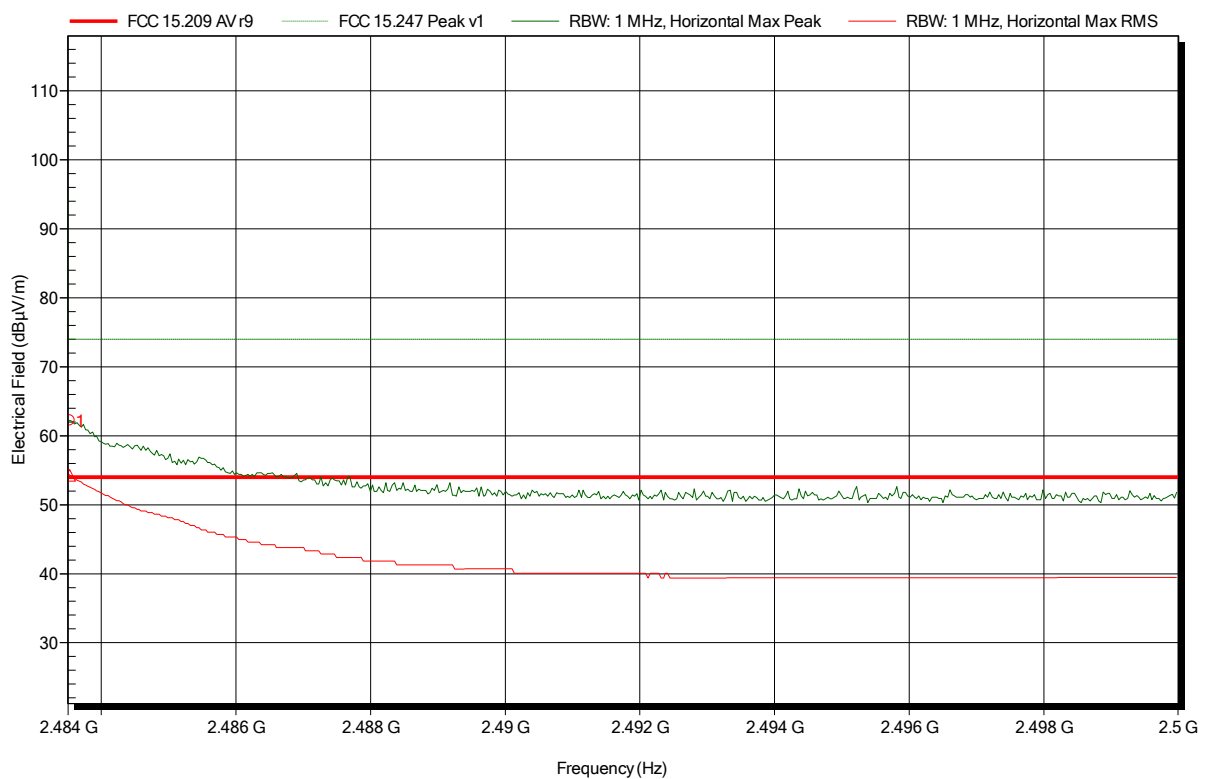


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2480 MHz
Test Date: 2018-03-02
Note: upper bandedge; 81.62 - 35.89 = 45.73 PASS

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Frequency	Peak	Peak Limit	Peak Difference	Peak Status
2.4835 GHz	62.23 dBµV/m	74 dBµV/m	-11.77 dB	Pass
Frequency	RMS	RMS Limit	RMS Difference	RMS Status
2.4835 GHz	45.73 dBµV/m	54 dBµV/m	-8.27 dB	Pass; corrected

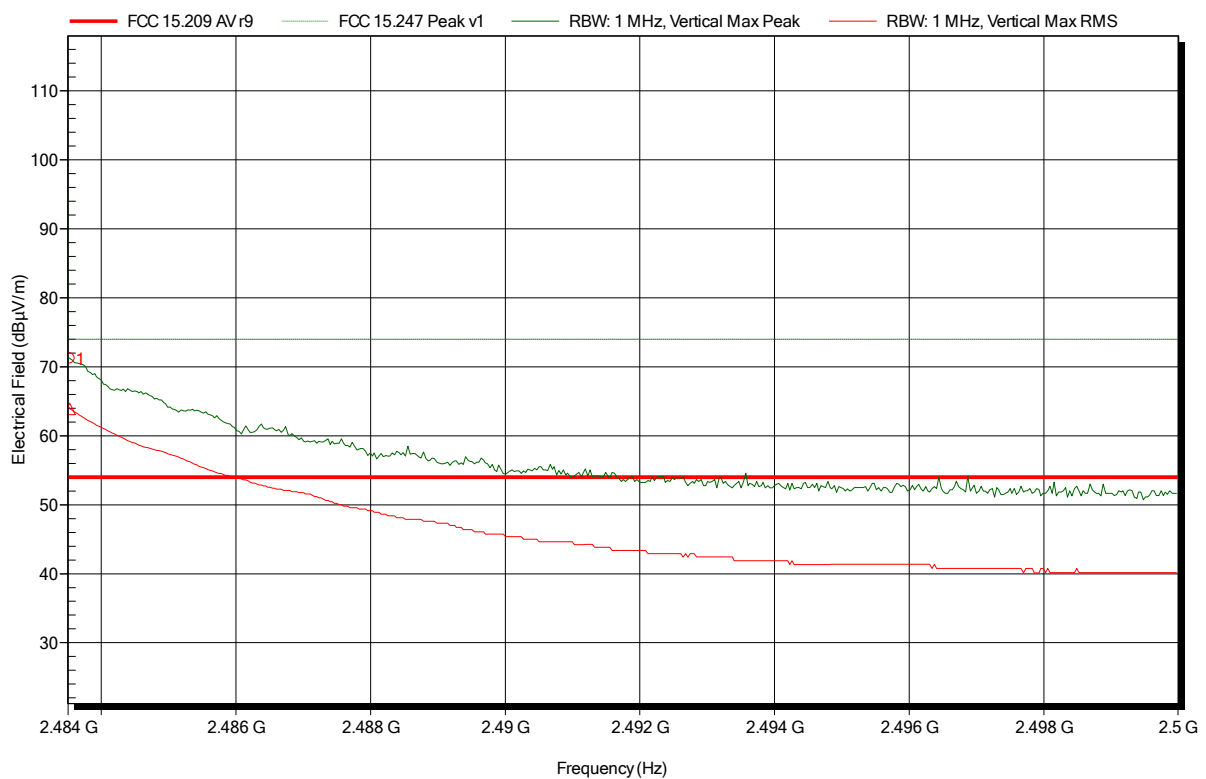
Value corrected according to ANSI 63.10; 6.10.6.2

Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2480 MHz
Test Date: 2018-03-02
Note: upper bandedge; 89.08 - 35.89 = 53.19 PASS

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Frequency	Peak	Peak Limit	Peak Difference	Peak Status
2.4835 GHz	71.22 dBµV/m	74 dBµV/m	-2.78 dB	Pass
Frequency	RMS	RMS Limit	RMS Difference	RMS Status
2.4835 GHz	53.19 dBµV/m	54 dBµV/m	-0.71 dB	Pass; corrected

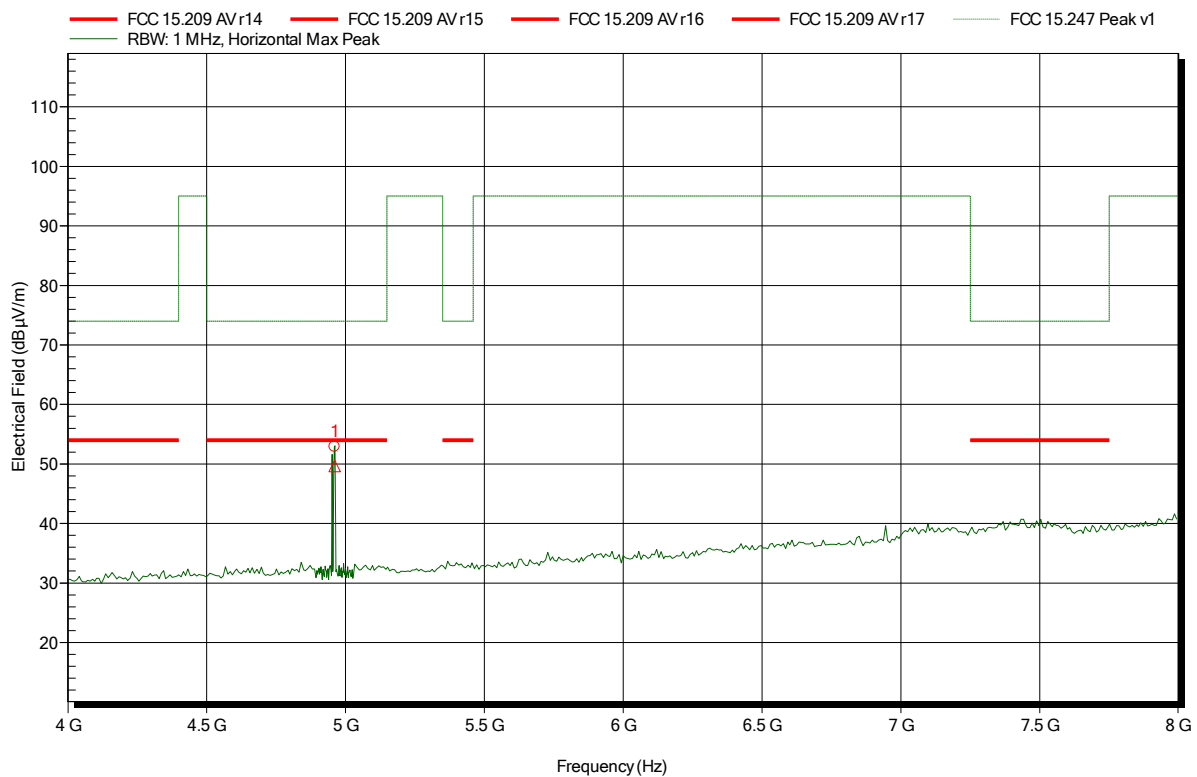
Value corrected according to ANSI 63.10; 6.10.6.2

Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; IEEE 802.15.4, 2480 MHz
 Test Date: 2018-03-02
 Note:

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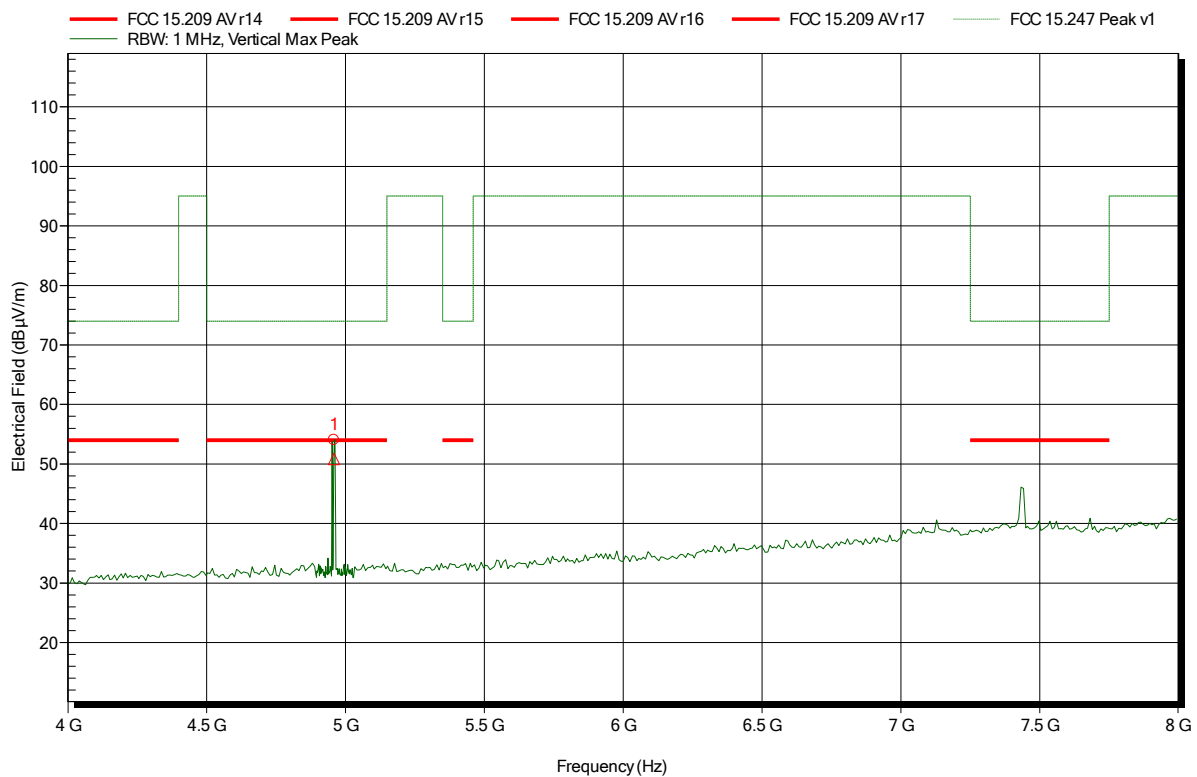
Frequency	Peak	Peak Limit	Peak Difference	Peak Status
4.961 GHz	52.92 dBµV/m	74 dBµV/m	-21.08 dB	Pass
Frequency	RMS	RMS Limit	RMS Difference	RMS Status
4.961 GHz	49.66 dBµV/m	54 dBµV/m	-4.34 dB	Pass

Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 1 m converted to 3m
 Mode: TX; IEEE 802.15.4, 2480 MHz
 Test Date: 2018-03-02
 Note:

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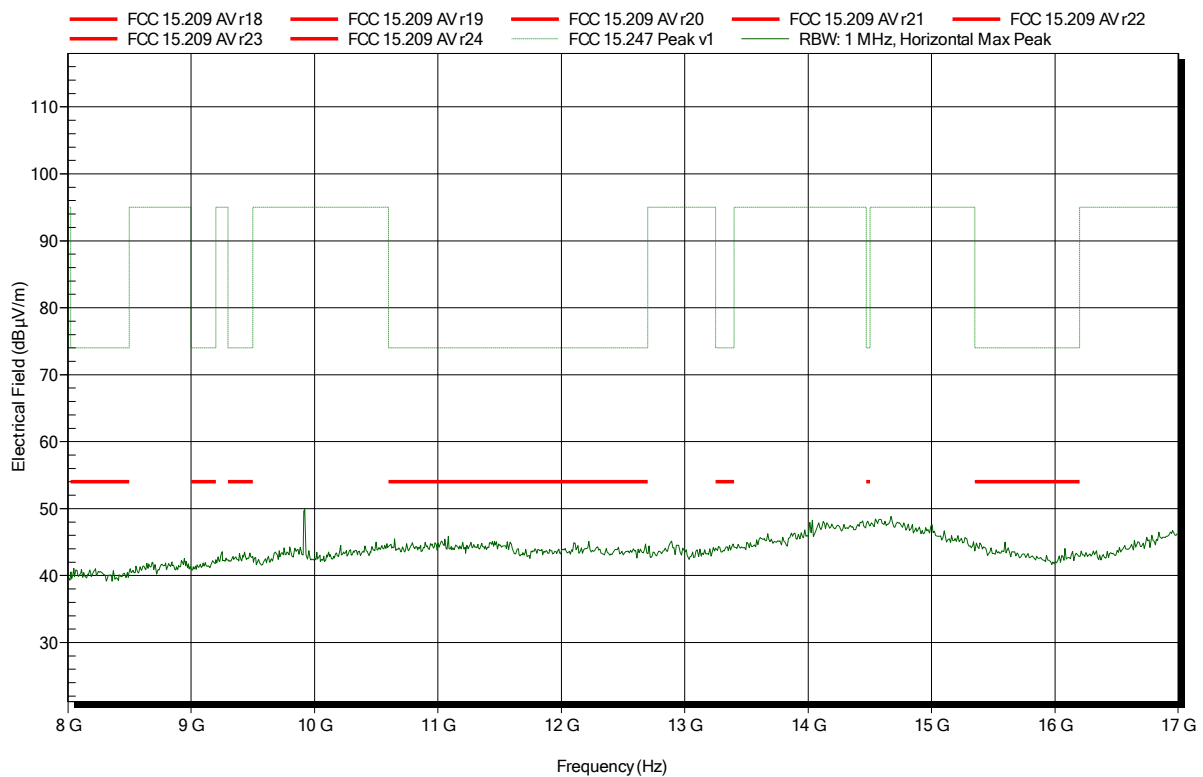
Frequency 4.959 GHz	Peak 54.01 dBµV/m	Peak Limit 74 dBµV/m	Peak Difference -19.99 dB	Peak Status Pass
Frequency 4.959 GHz	RMS 50.86 dBµV/m	RMS Limit 54 dBµV/m	RMS Difference -3.14 dB	RMS Status Pass

Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2480 MHz
Test Date: 2018-03-02
Note:

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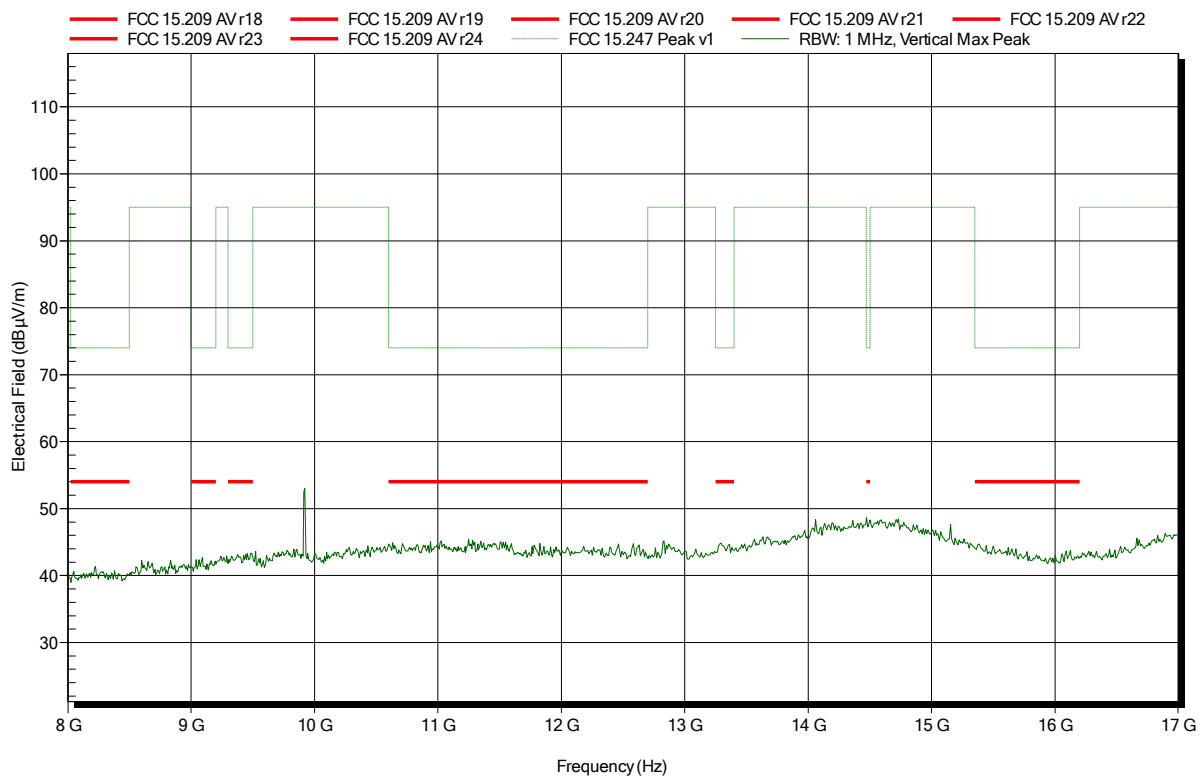


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2480 MHz
Test Date: 2018-03-02
Note:

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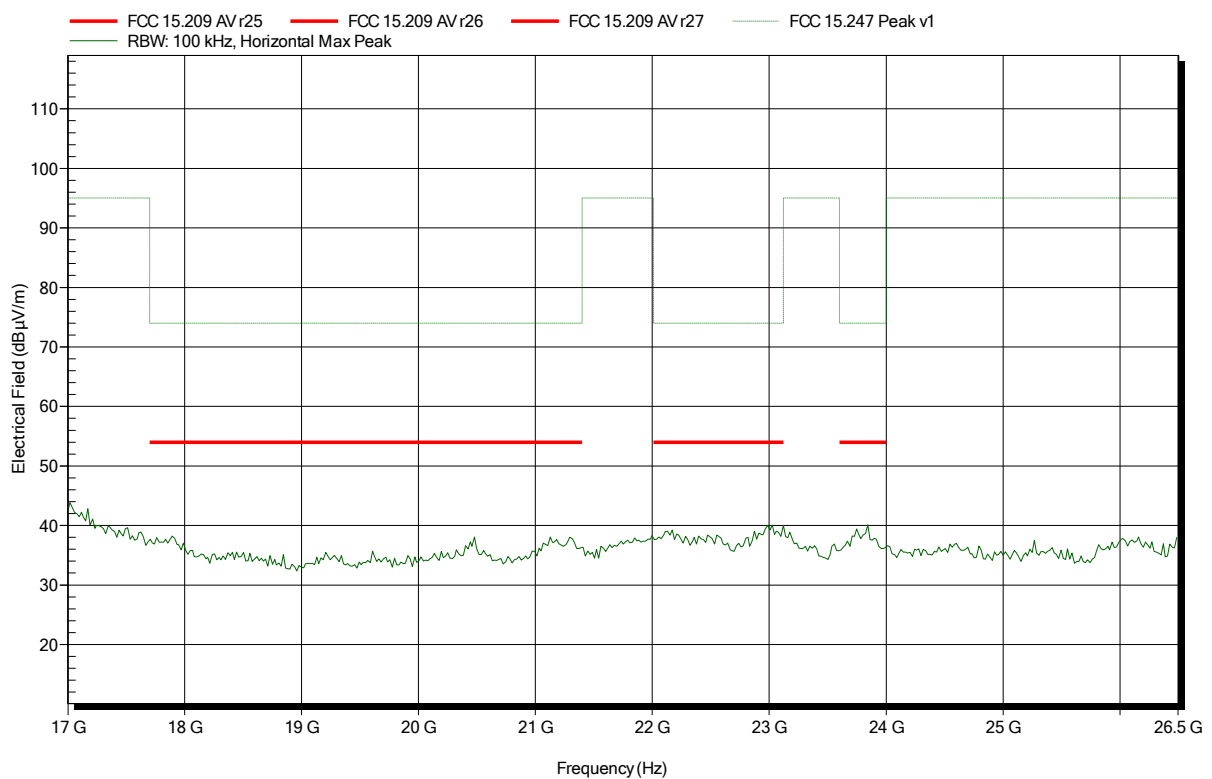


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Amplifier Research AT 4560, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2480 MHz
Test Date: 2018-03-05
Note:

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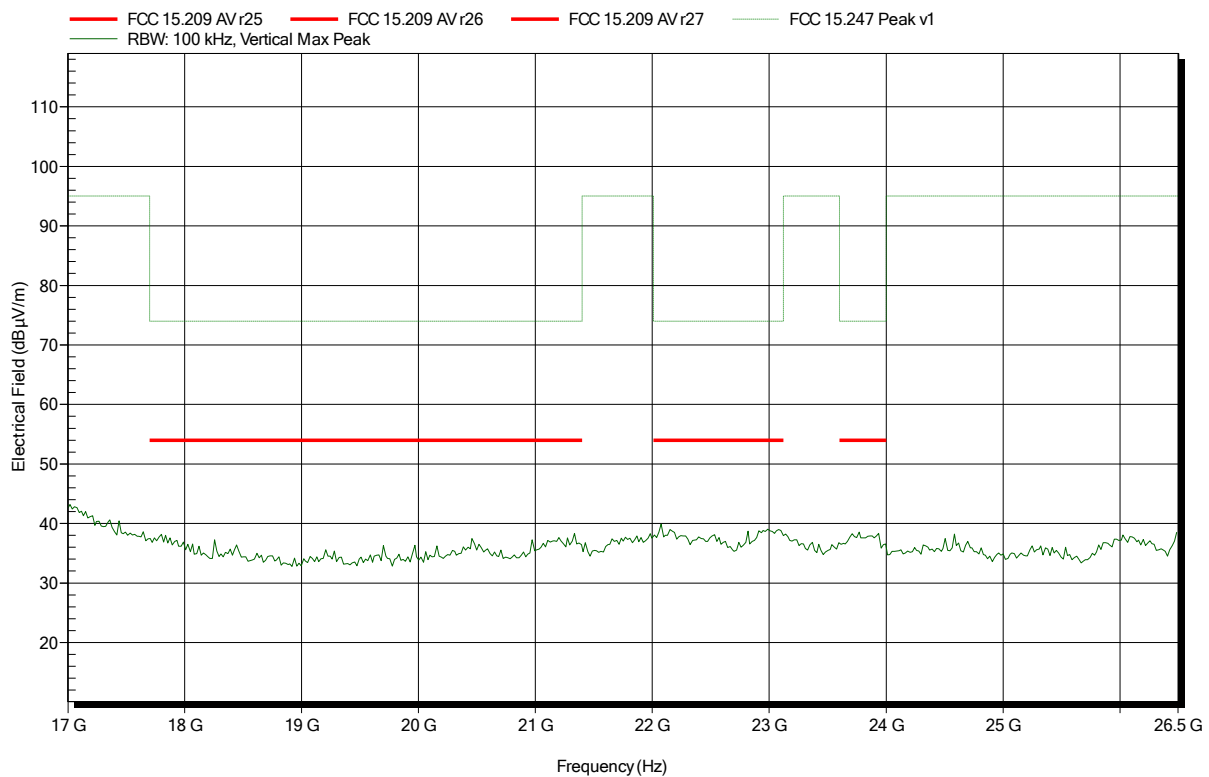


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7163

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Amplifier Research AT 4560, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; IEEE 802.15.4, 2480 MHz
Test Date: 2018-03-05
Note:

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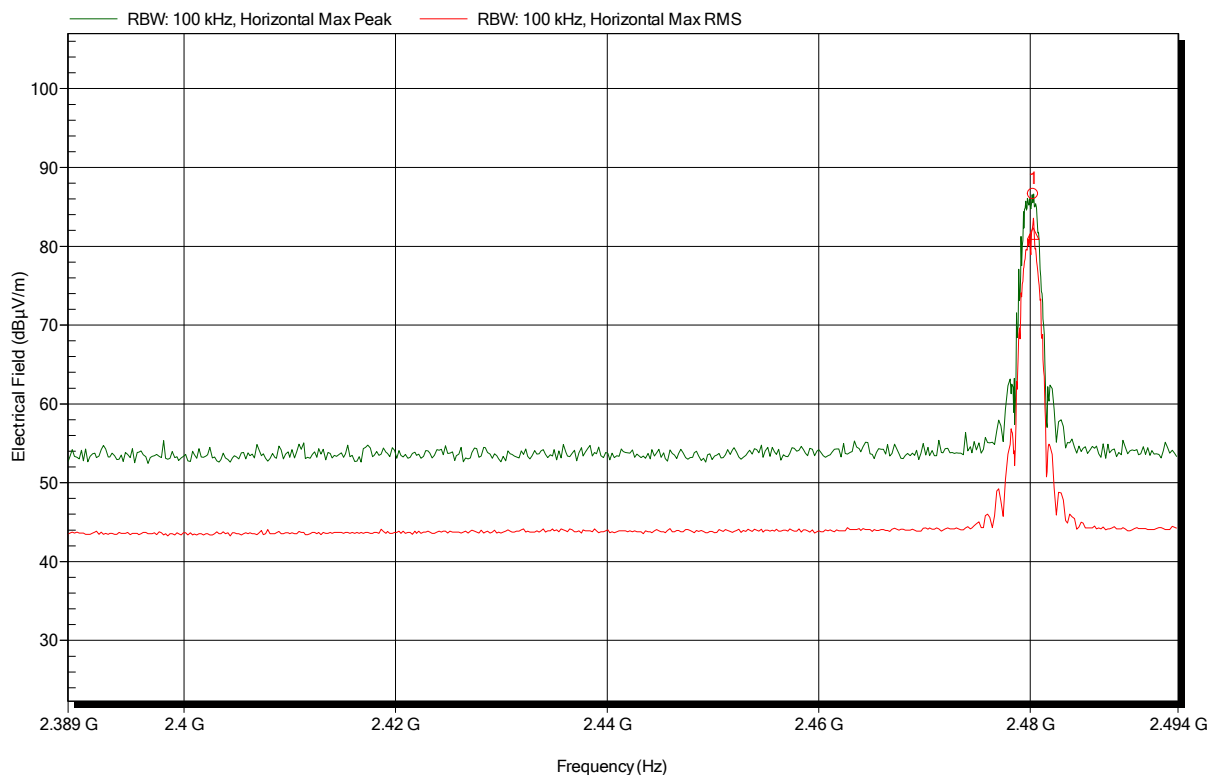


Radiated power according to FCC 15.247

Order number: G0M-1801-7162

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 3 m
Mode: Tx; IEEE 802.15.4, 2480 MHz
Test Date: 2018-03-02
Note:

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Frequency 2.48 GHz

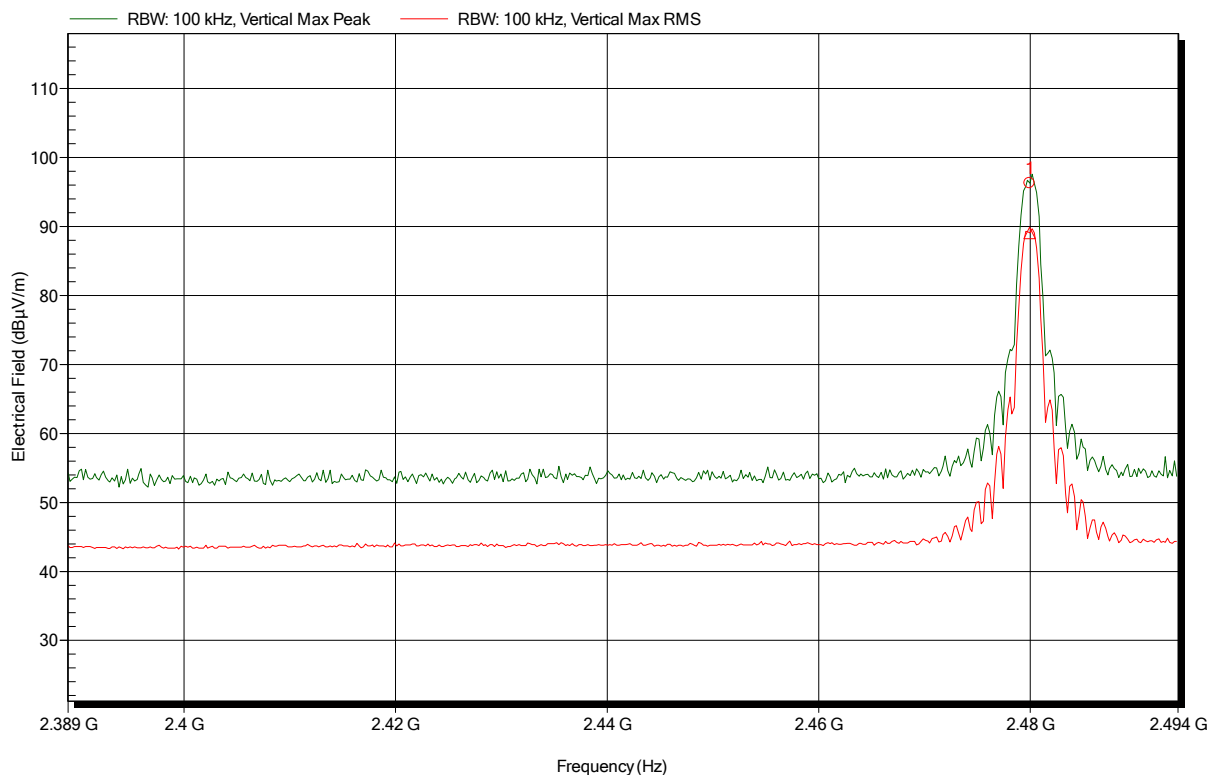
RMS 81.62 dBµV/m

Radiated power according to FCC 15.247

Order number: G0M-1801-7162

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 3 m
Mode: Tx; IEEE 802.15.4, 2480 MHz
Test Date: 2018-03-02
Note:

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Frequency
2.48 GHz

RMS
89.08 dBμV/m

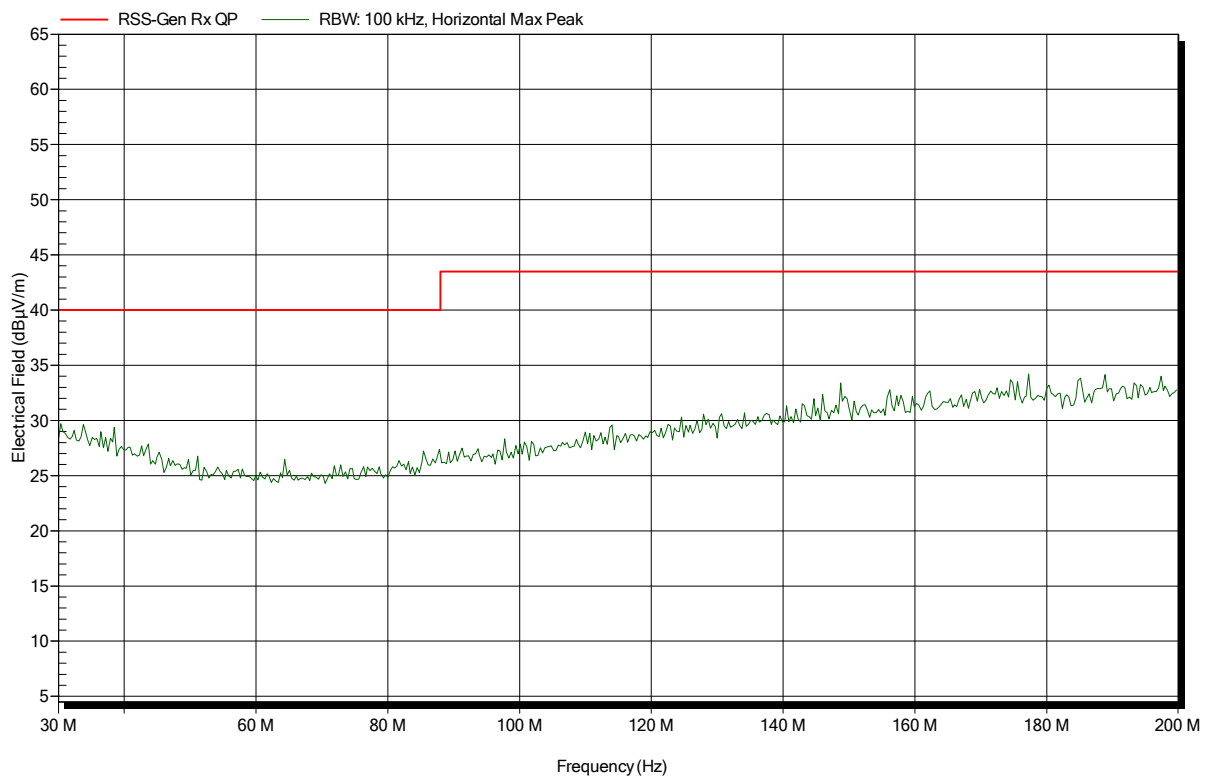
ANNEX B Receiver spurious emissions

Spurious emissions according to FCC 15.247

Project number: G0M-1801-7162

Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Rohde & Schwarz HK 116, Horizontal
 Measurement distance: 3 m
 Mode: RX; IEEE 802.15.4, 2440 MHz
 Test Date: 2018-03-05
 Note:

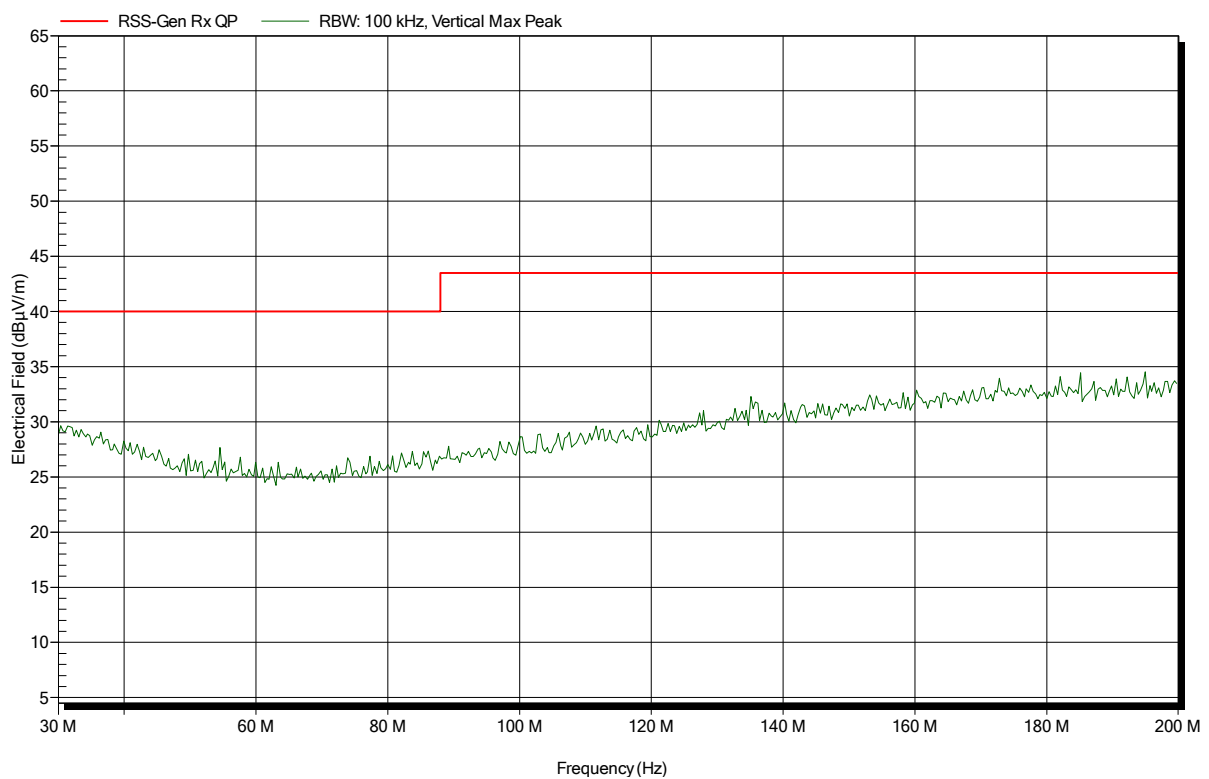
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Spurious emissions according to FCC 15.247

Project number: G0M-1801-7162
 Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Rohde & Schwarz HK 116, Vertical
 Measurement distance: 3 m
 Mode: RX; IEEE 802.15.4, 2440 MHz
 Test Date: 2018-03-05
 Note:

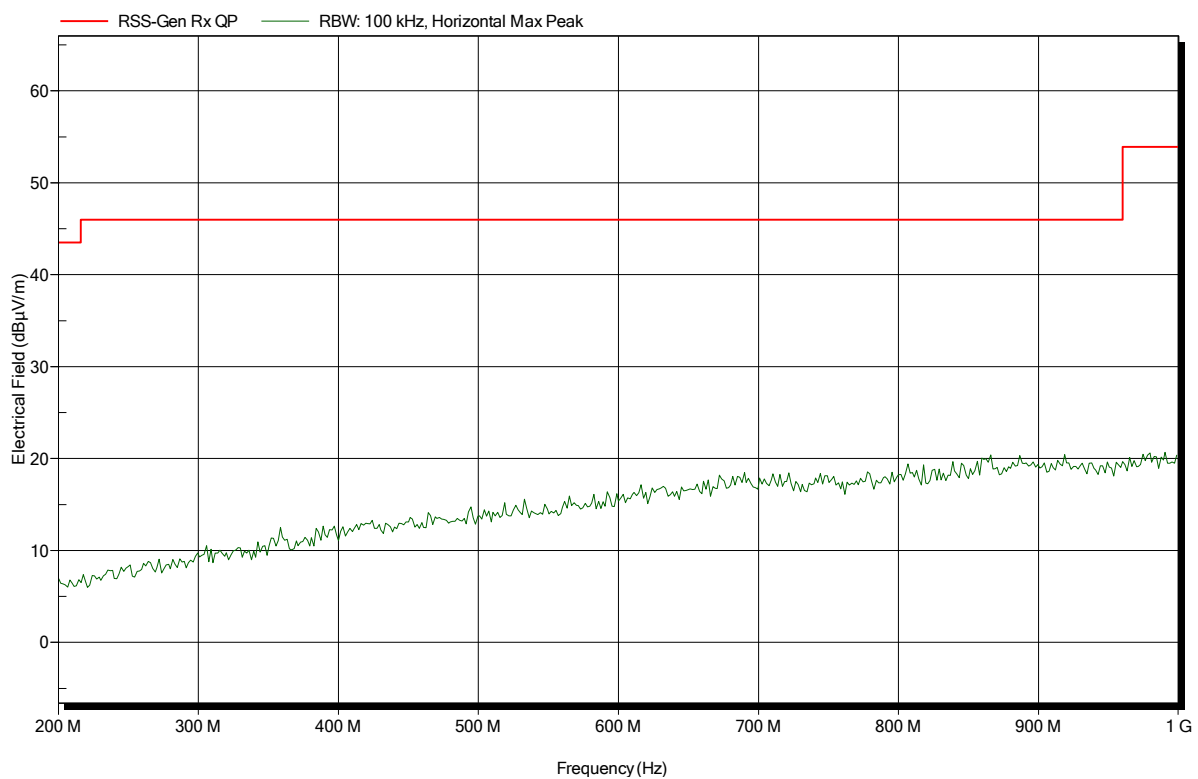
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Spurious emissions according to FCC 15.247

Project number: G0M-1801-7162
 Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Rohde & Schwarz HL 223, Horizontal
 Measurement distance: 3 m
 Mode: RX; IEEE 802.15.4, 2440 MHz
 Test Date: 2018-03-05
 Note:

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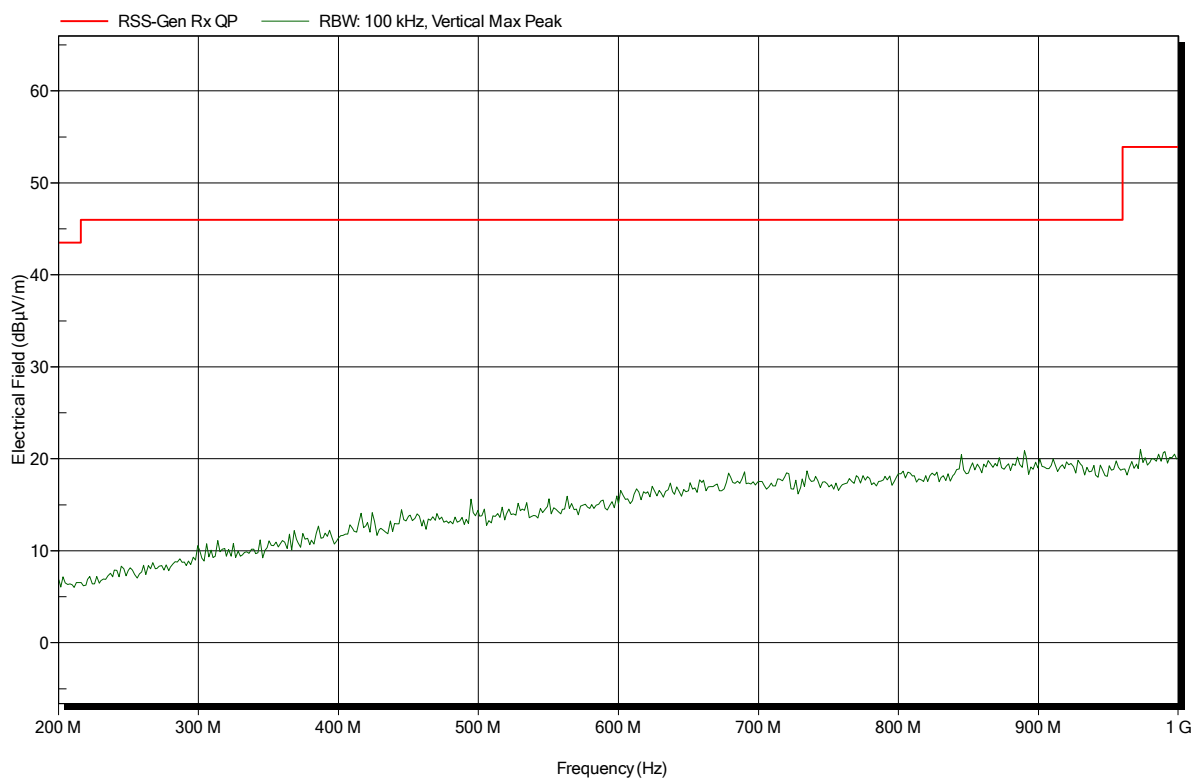


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7162

Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Rohde & Schwarz HL 223, Vertical
 Measurement distance: 3 m
 Mode: RX; IEEE 802.15.4, 2440 MHz
 Test Date: 2018-03-05
 Note:

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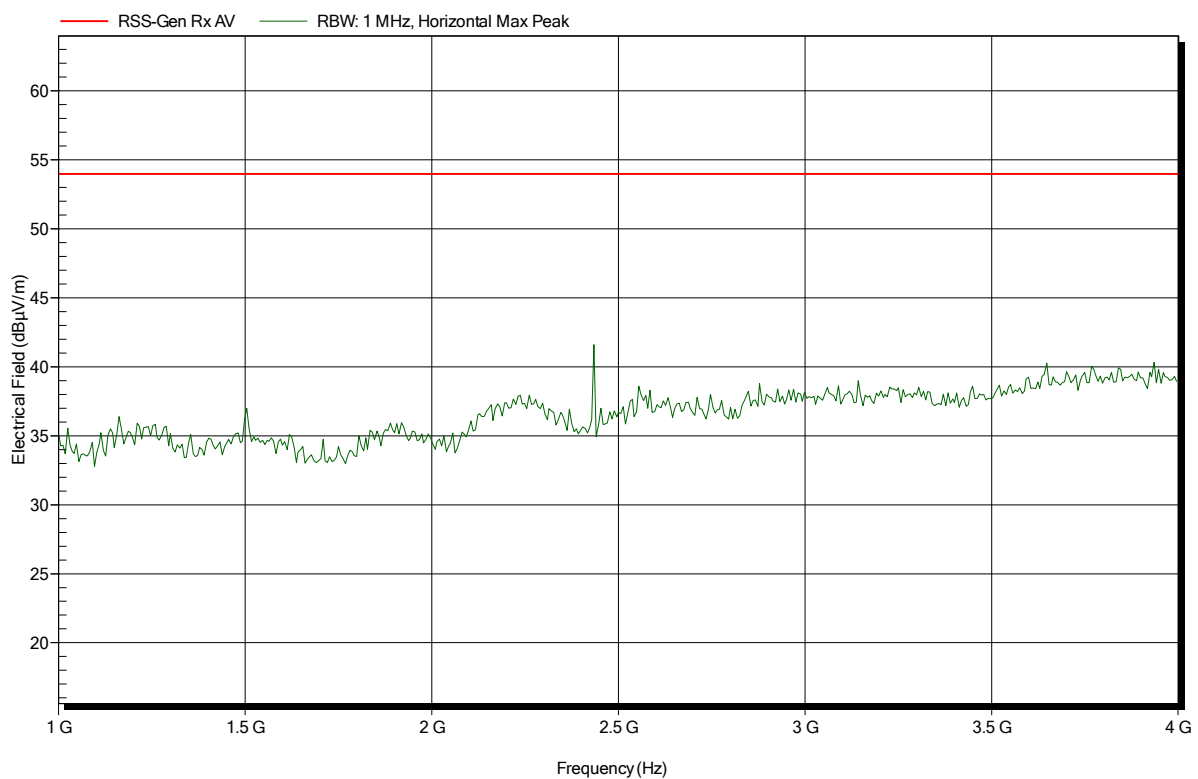


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7162

Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 3 m
 Mode: RX; IEEE 802.15.4, 2440 MHz
 Test Date: 2018-03-05
 Note:

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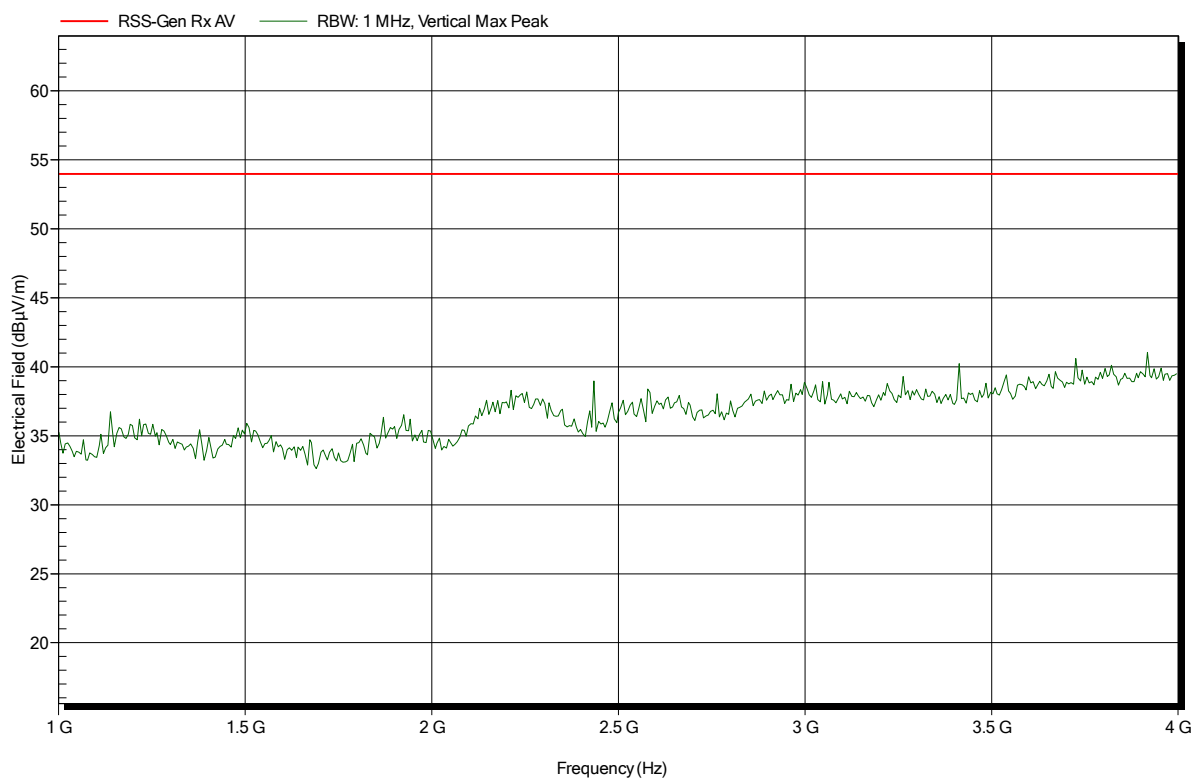


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7162

Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 3 m
 Mode: RX; IEEE 802.15.4, 2440 MHz
 Test Date: 2018-03-05
 Note:

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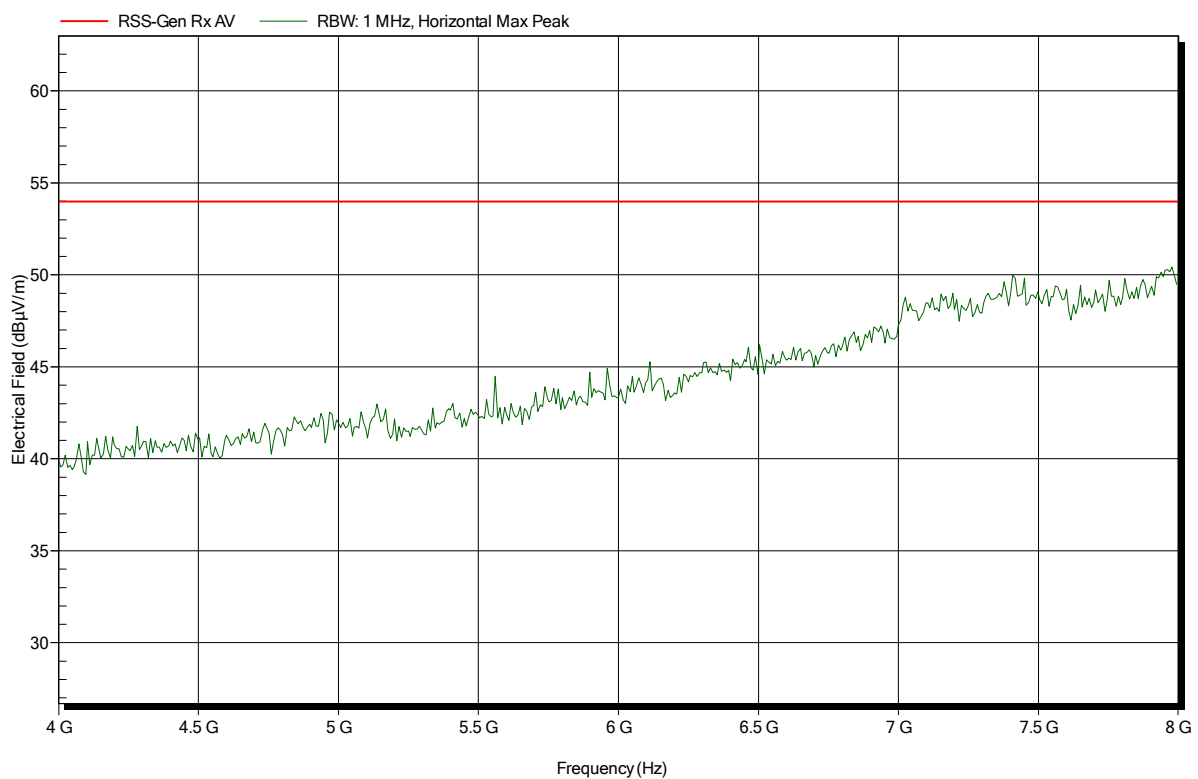


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7162

Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 3 m
 Mode: RX; IEEE 802.15.4, 2440 MHz
 Test Date: 2018-03-05
 Note:

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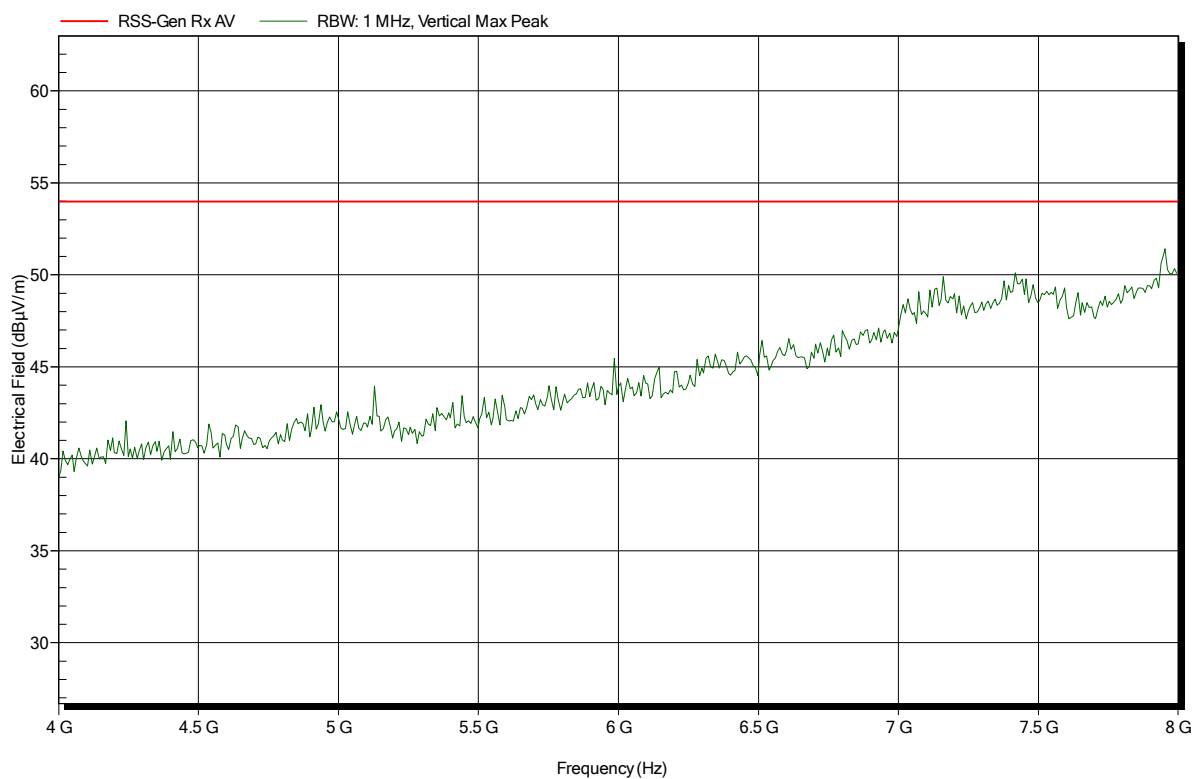


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7162

Applicant: Virtenio GmbH
 EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
 Model: Preon32
 Test Site: Eurofins Product Service GmbH
 Operator: Sebastian Suckow
 Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 3 m
 Mode: RX; IEEE 802.15.4, 2440 MHz
 Test Date: 2018-03-05
 Note:

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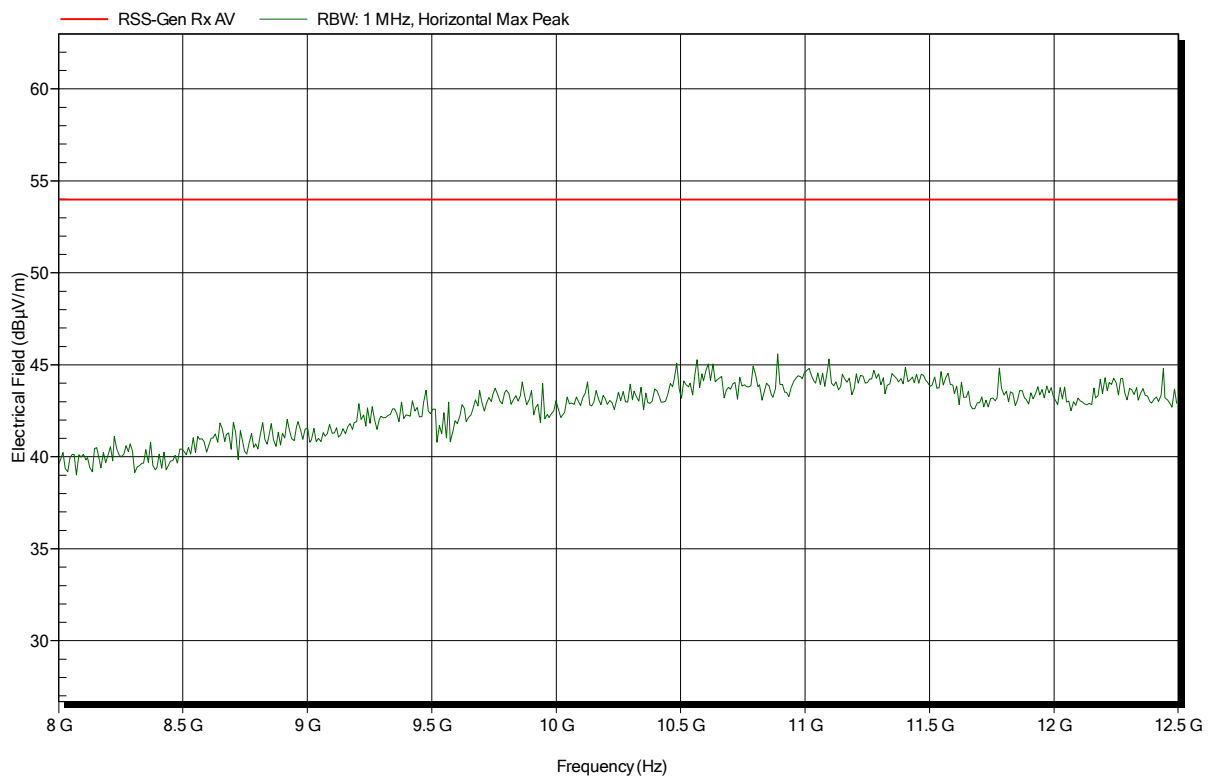


Spurious emissions according to FCC 15.247

Project number: G0M-1801-7162

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m converted to 3m
Mode: RX; IEEE 802.15.4, 2440 MHz
Test Date: 2018-03-05
Note:

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Spurious emissions according to FCC 15.247

Project number: G0M-1801-7162

Applicant: Virtenio GmbH
EUT Name: Wireless Module / 2.4 GHz / IEEE 802.15.4
Model: Preon32
Test Site: Eurofins Product Service GmbH
Operator: Sebastian Suckow
Test Conditions: Tnom: 23°C, Vnom: 3.3 VDC
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: RX; IEEE 802.15.4, 2440 MHz
Test Date: 2018-03-05
Note:

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