

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-1902-8046-TFC247BL-V01
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 ISED Testing Laboratory site: 3470A-2
Applicant	Panasonic Industrial Devices Europe GmbH
Address	Zeppelinstr. 19 21337 Lüneburg GERMANY
Test Specification	According to FCC/ISED rules
Standard	47 CFR Part 15C RSS-247, Issue 2, 2017-02 RSS-Gen, Issue 5, 2018-04
Non-Standard Test Method	None
Equipment under Test (EUT):	
Product Description	Bluetooth Low Energy Module
Model(s)	ENW89823A5KF
Additional Model(s)	None
Brand Name(s)	PAN1326C2
Hardware Version(s)	01
Software Version(s)	04
FCC-ID	T7V1326C2
IC	216Q-1326C2
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	2019-02-22	
Report:		
Compiled by	Wilfried Treffke	
Tested by (+ signature) (Responsible for Test)	Wilfried Treffke	
Approved by (+ signature) (Head of Lab)	Christian Weber	
Date of Issue	2019-08-27	
Total number of pages	92	
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	2019-08-27	Initial Release	

ABBREVIATIONS AND ACRONYMS

Acronyms	
Acronym	Description
EUT	Equipment Under Test
FCC	Federal Communications Commission
ISED	Innovation, Science and Economic Development Canada
RBW	Resolution bandwidth
RMS	Root mean square
VBW	Video bandwidth
V _{NOM}	Nominal supply voltage

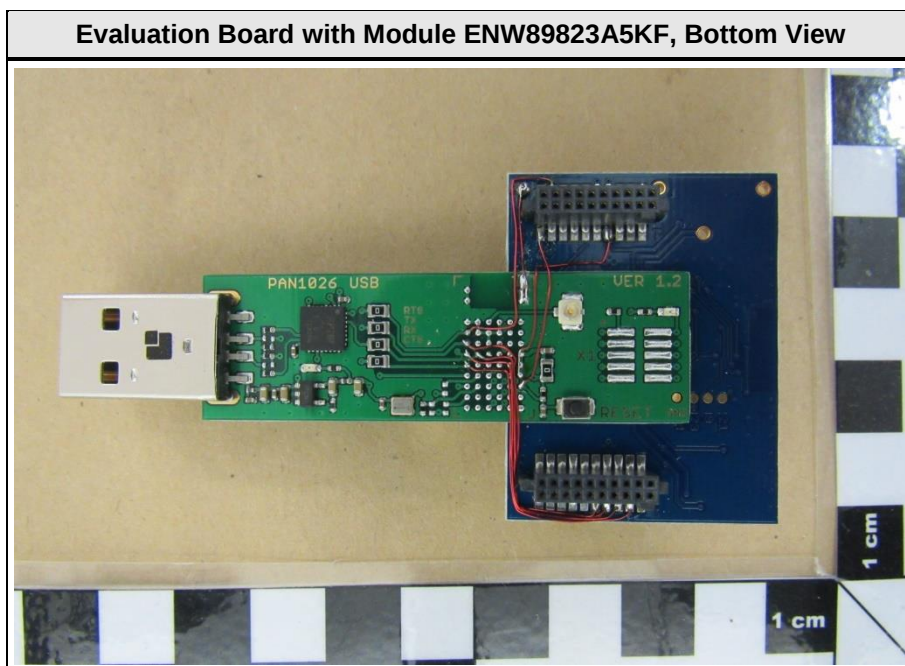
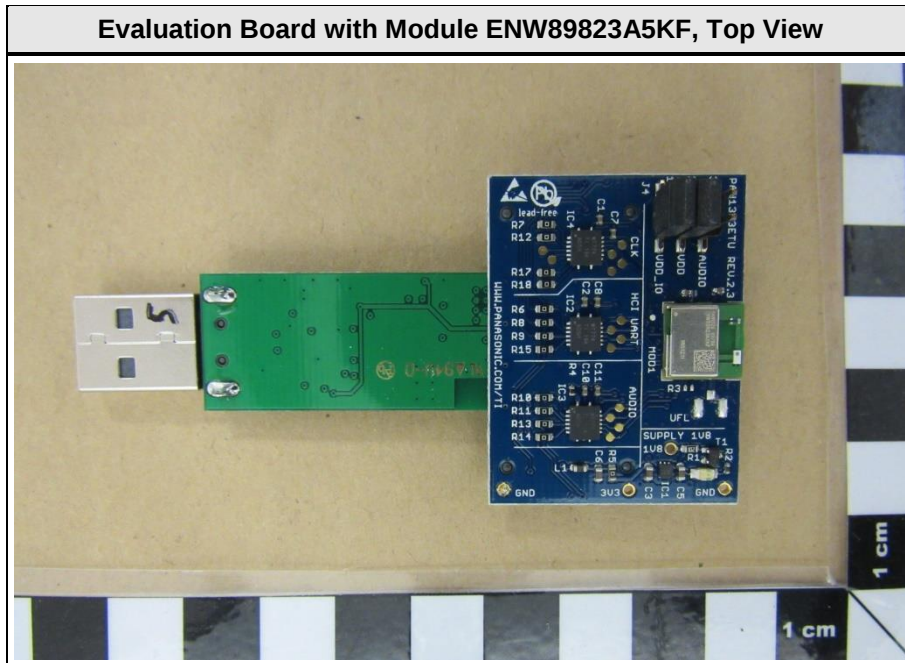
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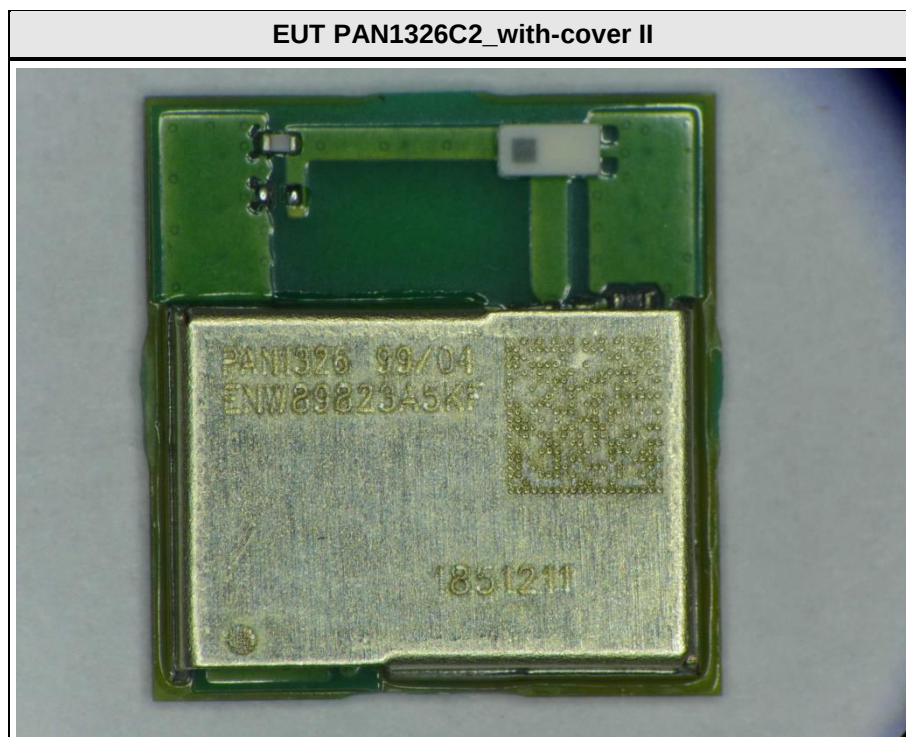
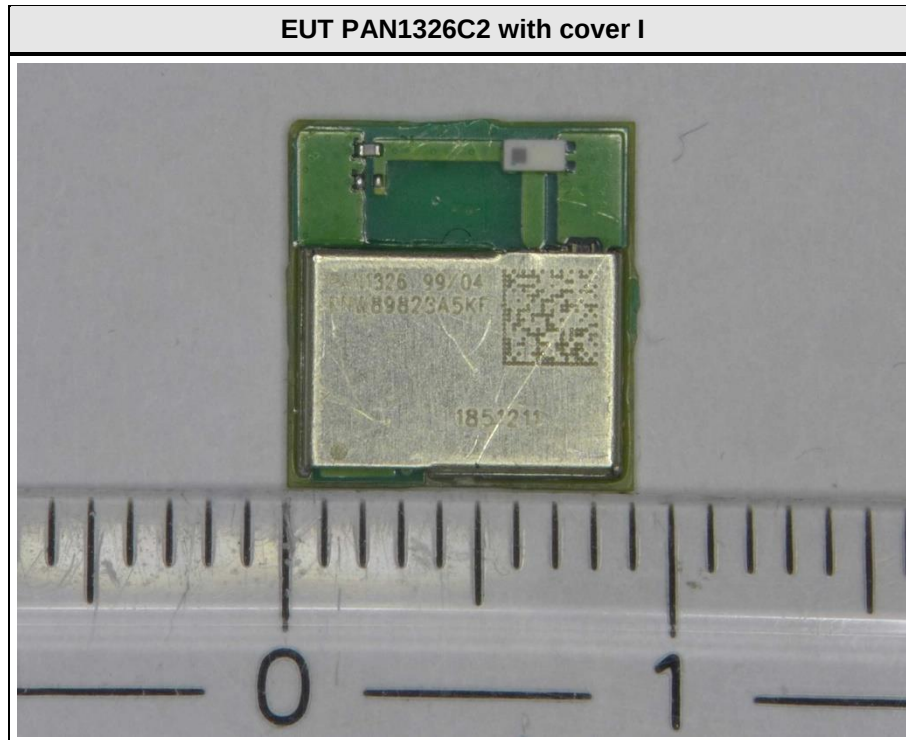
1 Equipment (Test Item) Under Test

Description	Bluetooth Low Energy Module	
Model	ENW89823A5KF	
Additional Model(s)	None	
Brand Name(s)	PAN1326C2	
Serial Number(s)	None	
Hardware Version(s)	01	
Software Version(s)	04	
PMN	PAN1362C2	
HVIN	ENW89823A5KF	
FVIN	N/A	
HMN	N/A	
FCC-ID	T7V1326C2	
IC	216Q-1326C2	
Equipment type	Radio Module	
Radio type	Transceiver	
Assigned frequency bands	2400 - 2483.5 MHz	
Radio technology	Bluetooth LE	
Modulation	GFSK	
Number of antenna ports	1	
Antenna	Type	Integrated
	Model	ANT016008LCS2442MA1
	Manufacturer	TDK
	Gain	1.6 dBi (customer declaration)
Supply Voltage	V _{NOM}	3.3 VDC
Operating Temperature	T _{NOM}	25 °C
AC/DC-Adaptor	Model	None
	Vendor	None
	Input	None
	Output	None
Manufacturer	Panasonic Industrial Devices Europe GmbH Zeppelinstr. 19 21337 Lüneburg GERMANY	

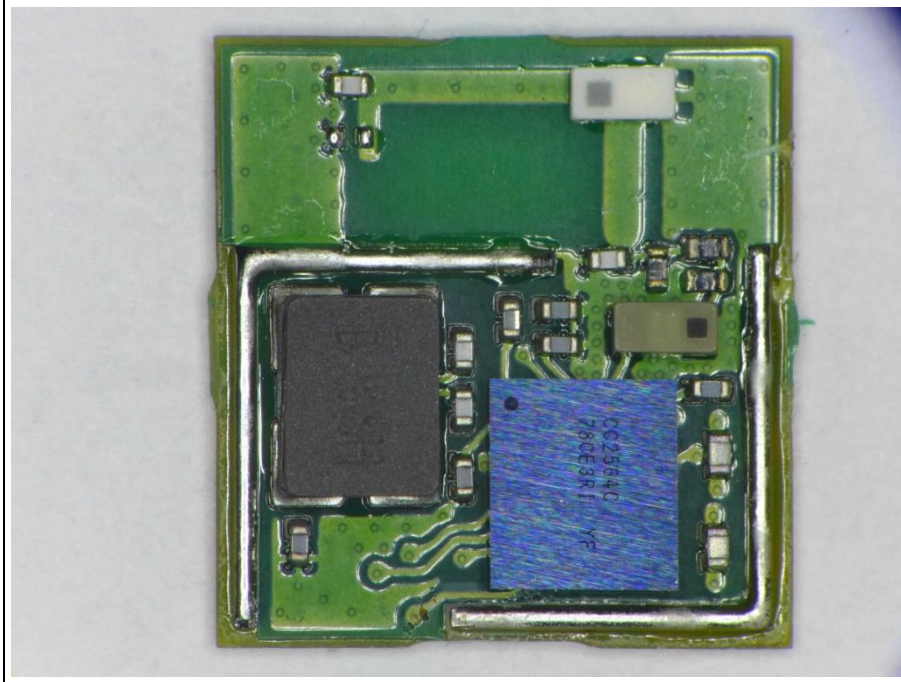
1.1 Photos – Equipment External



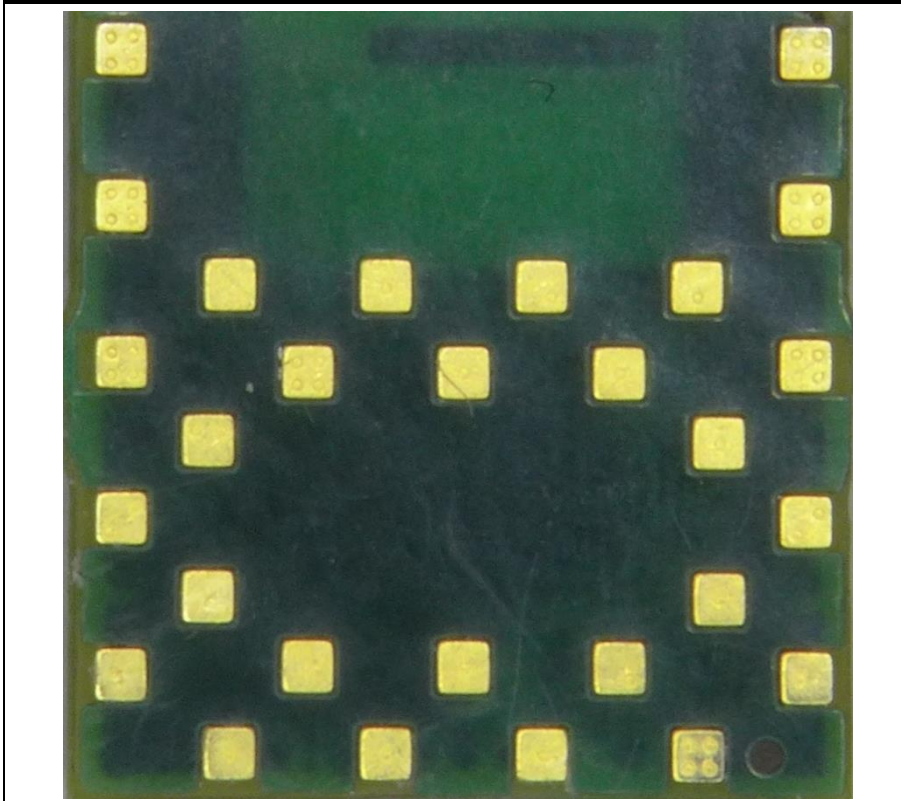
1.2 Photos – Equipment Internal



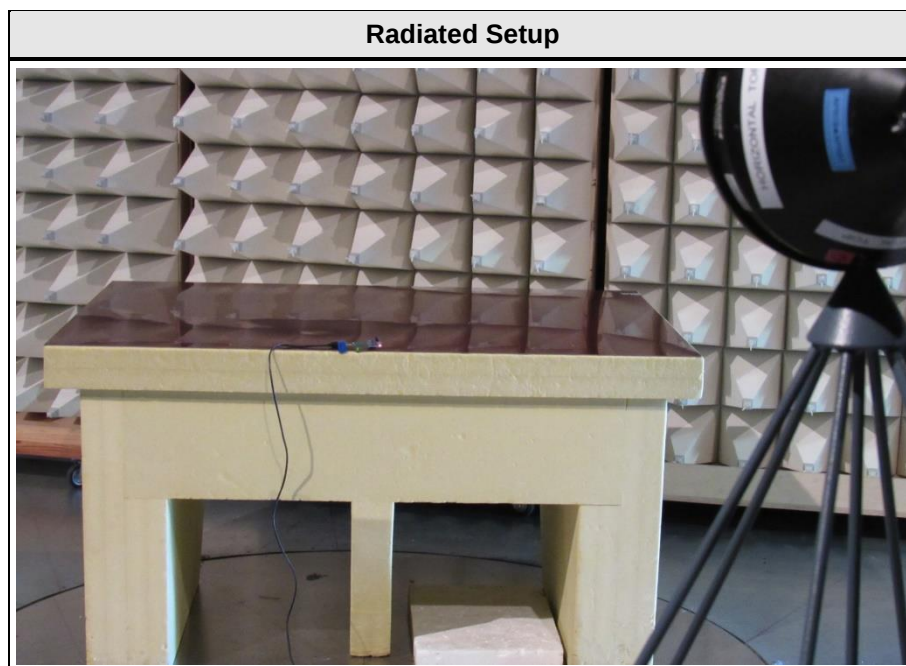
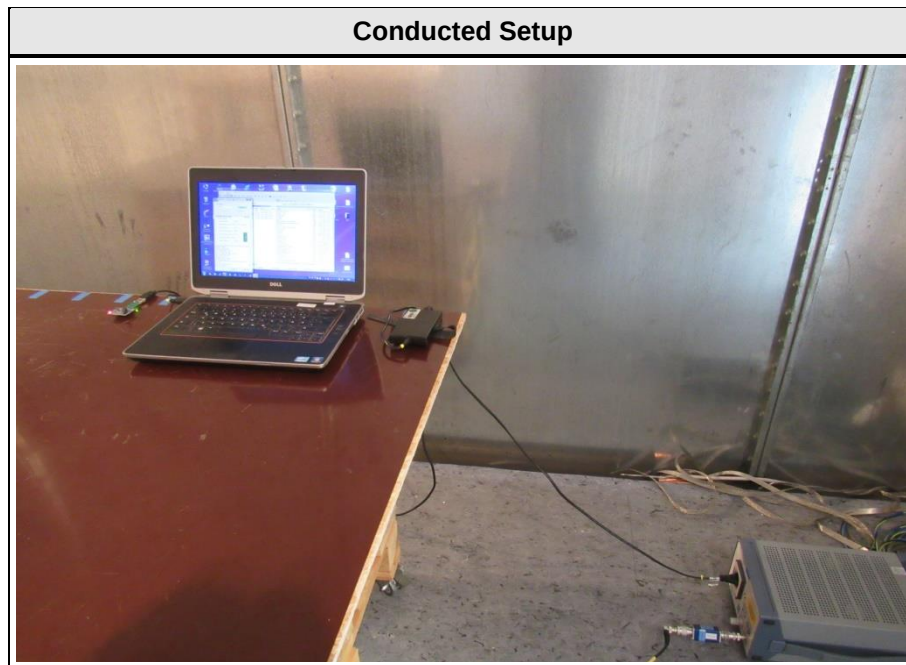
EUT PAN1326C2 without cover



EUT PAN1326C2 back side



1.3 Photos – Test Setup



1.4 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
AE	Laptop	Dell	Latitude E6420	S/N HPJ4R1
AE	Power Supply	Dell	FA65NE0-00	S/N RX929
Description:				
AE	Auxiliary Equipment			
SIM	Simulator			
CBL	Connecting Cable			
Comment:				

1.5 Test Modes

Mode	Description
GFSK	Mode = Transmit Modulation = GFSK Spreading = None Duty cycle = 64%
Receive	Mode = Receive
Comment:	

1.6 Test Frequencies

Designator	Mode	Channel	Frequency [MHz]
F1	Tx / Rx	0	2402
F2	Tx / Rx	19	2440
F3	Tx / Rx	39	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:

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

Net:

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

Limit:

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

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

Margin:

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

Example only:

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

2 Result Summary

FCC 47 CFR Part 15C, ISED RSS-247				
Product Standard Reference	Requirement	Reference Method	Result	Remarks
ISED RSS-Gen, Issue 5 (section 6.6)	Occupied Bandwidth	ANSI C63.10-2013	N/R	Informational only
FCC § 15.247(a)(2) ISED RSS-247, Issue 2 (section 5.2)	6 dB Bandwidth	ANSI C63.10-2013	PASS	
FCC § 15.247(b)(1) ISED RSS-247, Issue 2 (section 5.4)	Maximum peak conducted power	ANSI C63.10-2013	PASS	
FCC § 15.247(e) ISED RSS-247, Issue 2 (section 5.2)	Power spectral density	ANSI C63.10-2013	PASS	
FCC § 15.207 ISED RSS-247, Issue 2 (section 3.1)	AC power line conducted emissions	ANSI C63.10-2013	PASS	
FCC § 15.247(d) ISED RSS-247, Issue 2 (section 5.5)	Band edge compliance	ANSI C63.10-2013	PASS	
FCC § 15.247(d) ISED RSS-247, Issue 2 (section 5.5)	Conducted spurious emissions	ANSI C63.10-2013	PASS	
FCC § 15.247(d) FCC § 15.209 ISED RSS-Gen, Issue 5 (section 6.13)	Transmitter radiated spurious emissions	ANSI C63.10-2013	PASS	
ISED RSS-247, Issue 2 (section 3.1)	Receiver radiated spurious emissions	ANSI C63.10-2013	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

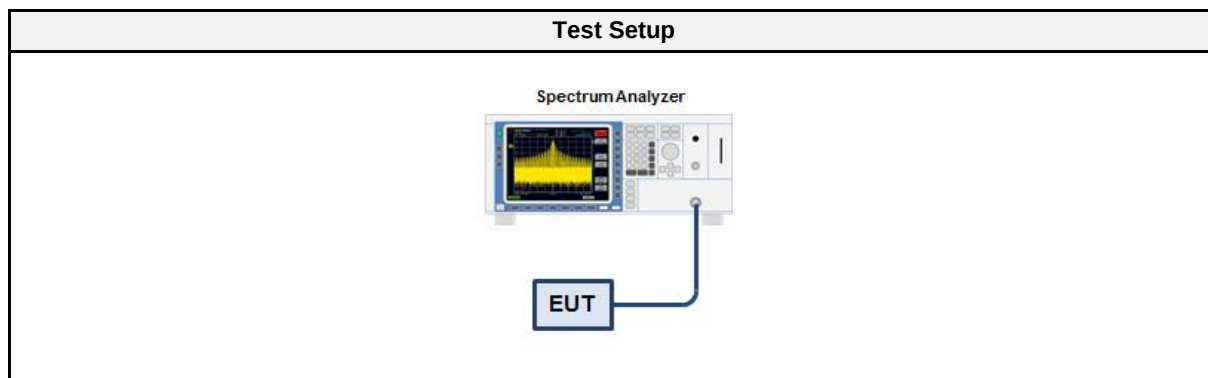
3.1.1 Information

Test Information	
Reference	ISED RSS-Gen, Issue 5 (section 6.6)
Measurement Method	ANSI C63.10 6.9.3
Operator	Wilfried Treffke
Date	2019-03-26

3.1.2 Limits

Limits
None (Informational only)

3.1.3 Setup



3.1.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSU 26	EF01407	2019-07	2020-07

3.1.5 Procedure

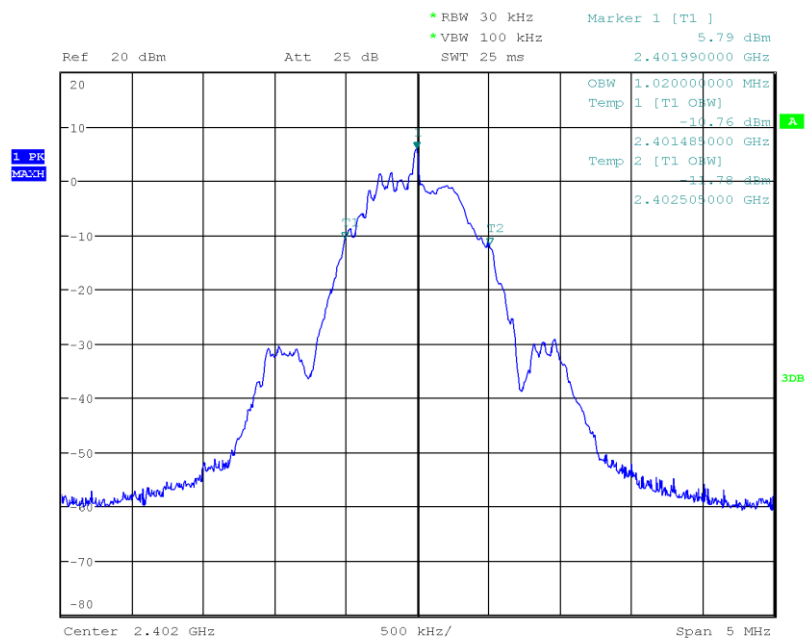
Test Procedure
1. EUT transmitter is activated in test mode under normal conditions 2. The spectrum analyzer is set to peak detection and maximum hold with a span twice the emission spectrum 3. The resolution bandwidth is set to the range of 1 % to 5 % of the occupied bandwidth 4. The occupied bandwidth is measured with the build-in analyzer function

3.1.6 Results

Test Results		
Mode	Frequency [MHz]	Bandwidth [MHz]
GFSK	2402	1.020
GFSK	2440	1.015
GFSK	2480	1.020

Occupied Bandwidth

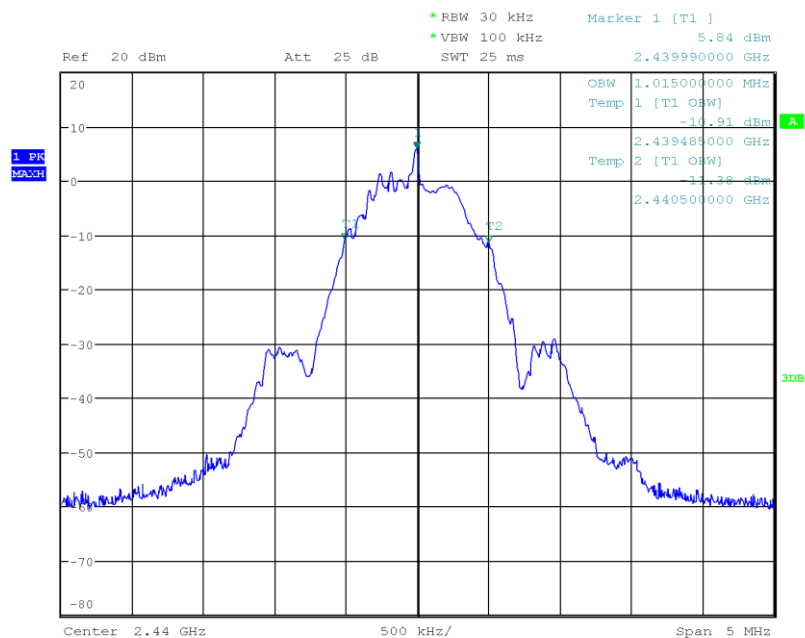
Project Number: G0M-1902-8046
 Applicant: Panasonic Industrial Devices Europe GmbH
 Model Description: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Sample ID: 23051
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 6.9.3
 Operational Mode: GFSK, Channel: 0, 2402 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Wilfried Treffke
 Test Site: Eurofins Product Service GmbH
 Test Date: 2019-03-26
 Occupied Bandwidth [MHz]: 1.020



Date: 26.MAR.2019 04:43:48

Occupied Bandwidth

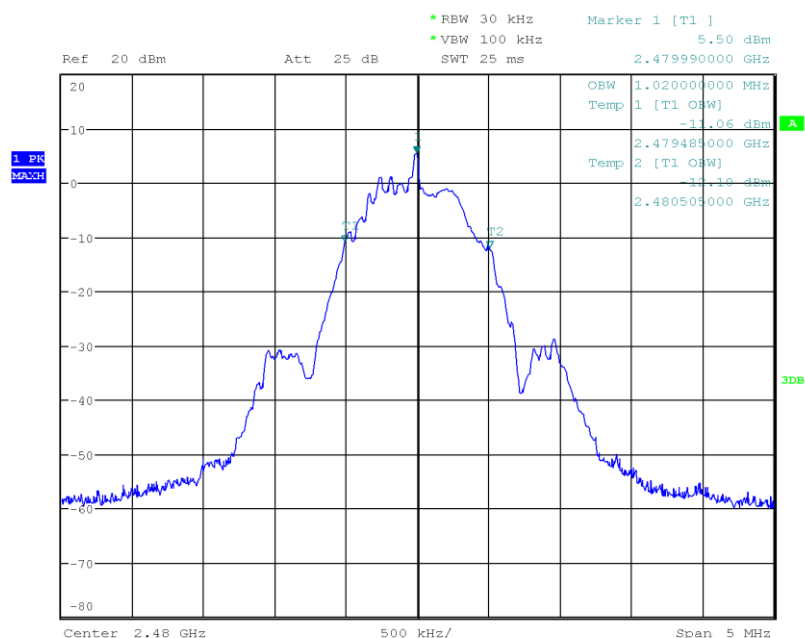
Project Number: G0M-1902-8046
 Applicant: Panasonic Industrial Devices Europe GmbH
 Model Description: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Sample ID: 23051
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 6.9.3
 Operational Mode: GFSK, Channel: 19, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Wilfried Treffke
 Test Site: Eurofins Product Service GmbH
 Test Date: 2019-03-26
 Occupied Bandwidth [MHz]: 1.015



Date: 26.MAR.2019 04:38:31

Occupied Bandwidth

Project Number:	G0M-1902-8046
Applicant:	Panasonic Industrial Devices Europe GmbH
Model Description:	Bluetooth Low Energy Module
Model:	ENW89823A5KF
Test Sample ID:	23051
Reference Standards:	FCC 15.247, RSS-247
Reference Method:	ANSI C63.10:2013, Section 6.9.3
Operational Mode:	GFSK, Channel: 39, 2480 MHz
Operating Conditions:	Tnom/Vnom
Operator:	Wilfried Treffke
Test Site:	Eurofins Product Service GmbH
Test Date:	2019-03-26
Occupied Bandwidth [MHz]:	1.020



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3.2 Test Conditions and Results - 6 dB bandwidth

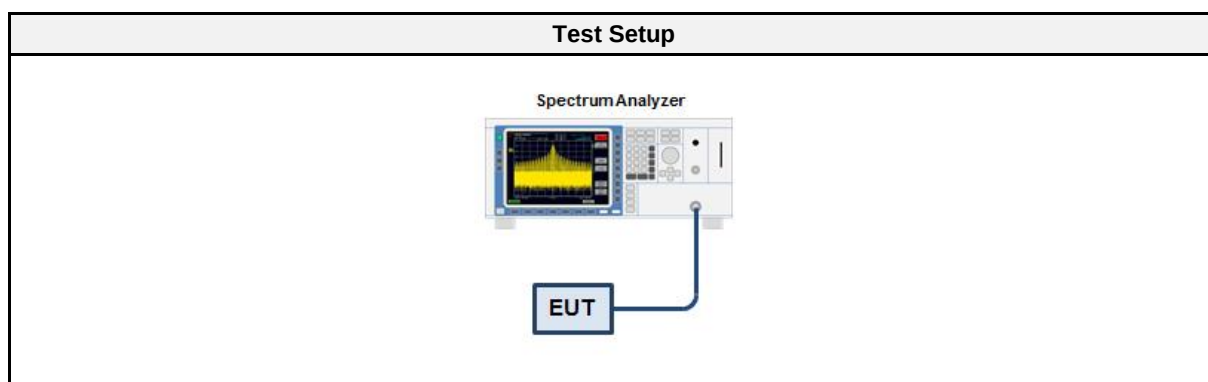
3.2.1 Information

Test Information	
Reference	FCC § 15.247(a)(2); ISED RSS-247, Issue 2 (section 5.2)
Measurement Method	ANSI C63.10 11.8
Operator	Wilfried Treffke
Date	2019-03-26

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	EF01407	2019-07	2020-07

3.2.5 Procedure

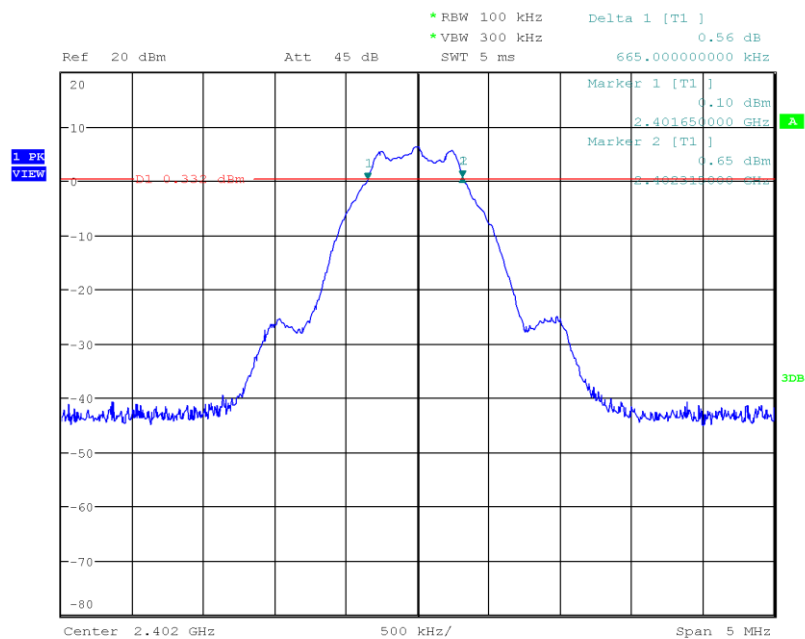
Test Procedure
1. EUT set to test mode 2. Span set to at least twice the emission spectrum 3. Detector set to peak and max hold and RBW is set to 100 kHz 4. Envelope peak value of emission spectrum is selected 5. Marker on envelope of spectrum is set to level of -6 dB to the left of the peak 6. Marker 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
GFSK	2402	665	500	PASS
GFSK	2440	670	500	PASS
GFSK	2480	665	500	PASS

DTS (6 dB) Bandwidth

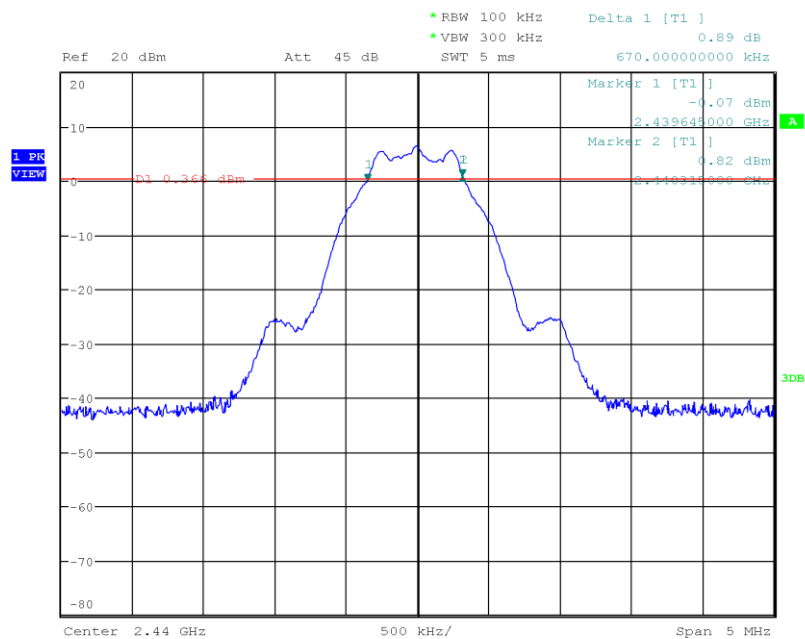
Project Number: G0M-1902-8046
 Applicant: Panasonic Industrial Devices Europe GmbH
 Model Description: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Sample ID: 23051
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: GFSK, Channel: 0, 2402 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Wilfried Treffke
 Test Site: Eurofins Product Service GmbH
 Test Date: 2019-03-26
 Lower Frequency [MHz]: 2401.650
 Upper Frequency [MHz]: 2402.315
 6 dB Bandwidth [kHz]: 665



Date: 26.MAR.2019 04:50:29

DTS (6 dB) Bandwidth

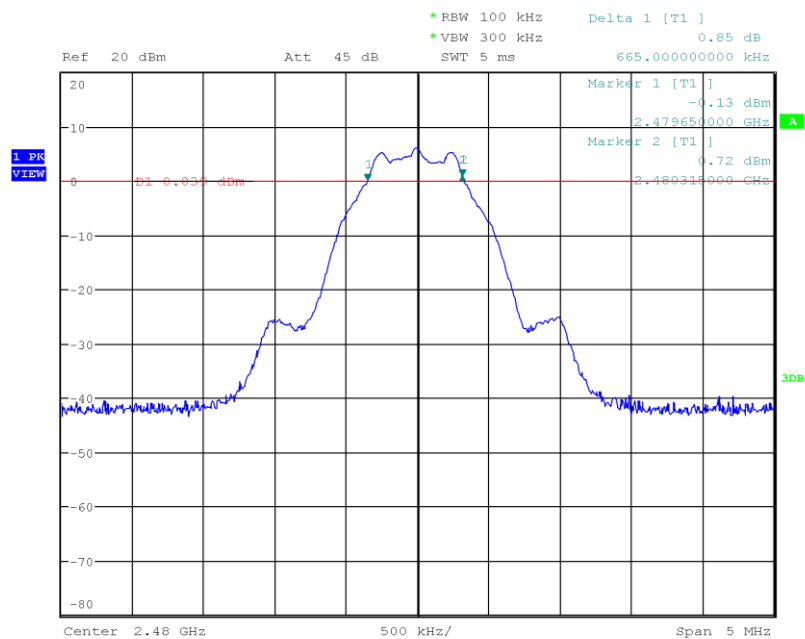
Project Number: G0M-1902-8046
 Applicant: Panasonic Industrial Devices Europe GmbH
 Model Description: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Sample ID: 23051
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: GFSK, Channel: 19, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Wilfried Treffke
 Test Site: Eurofins Product Service GmbH
 Test Date: 2019-03-26
 Lower Frequency [MHz]: 2439.645
 Upper Frequency [MHz]: 2440.315
 6 dB Bandwidth [kHz]: 670



Date: 26.MAR.2019 04:54:57

DTS (6 dB) Bandwidth

Project Number: G0M-1902-8046
 Applicant: Panasonic Industrial Devices Europe GmbH
 Model Description: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Sample ID: 23051
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: GFSK, Channel: 39, 2480 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Wilfried Treffke
 Test Site: Eurofins Product Service GmbH
 Test Date: 2019-03-26
 Lower Frequency [MHz]: 2479.650
 Upper Frequency [MHz]: 2480.315
 6 dB Bandwidth [kHz]: 665



Date: 26.MAR.2019 04:57:10

3.3 Test Conditions and Results - Maximum peak conducted output power

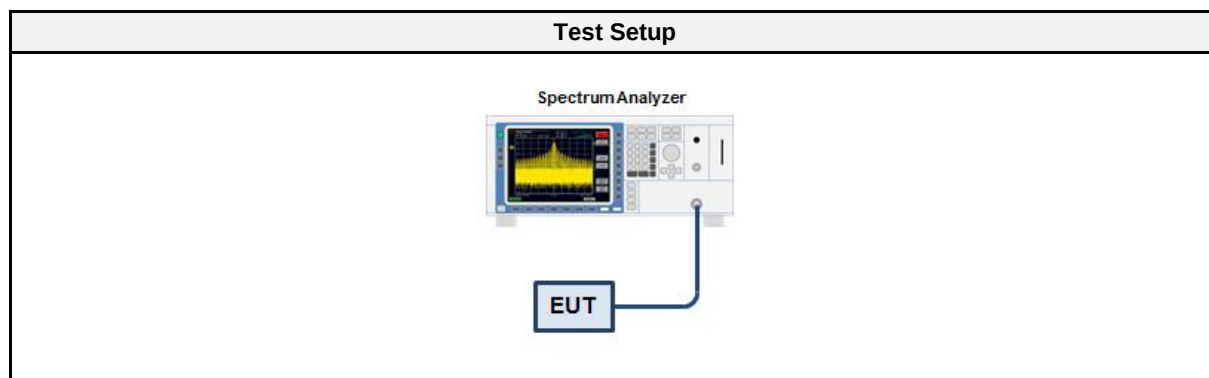
3.3.1 Information

Test Information	
Reference	FCC § 15.247(b)(1); ISED RSS-247, Issue 2 (section 5.4)
Measurement Method	ANSI C63.10 11.9.1
Operator	Wilfried Treffke
Date	2019-03-26

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	EF01407	2019-07	2020-07

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
2402	8.374	0.0069	1.0	PASS
2440	8.474	0.0070	1.0	PASS
2480	8.080	0.0064	1.0	PASS

3.4 Test Conditions and Results - Power spectral density

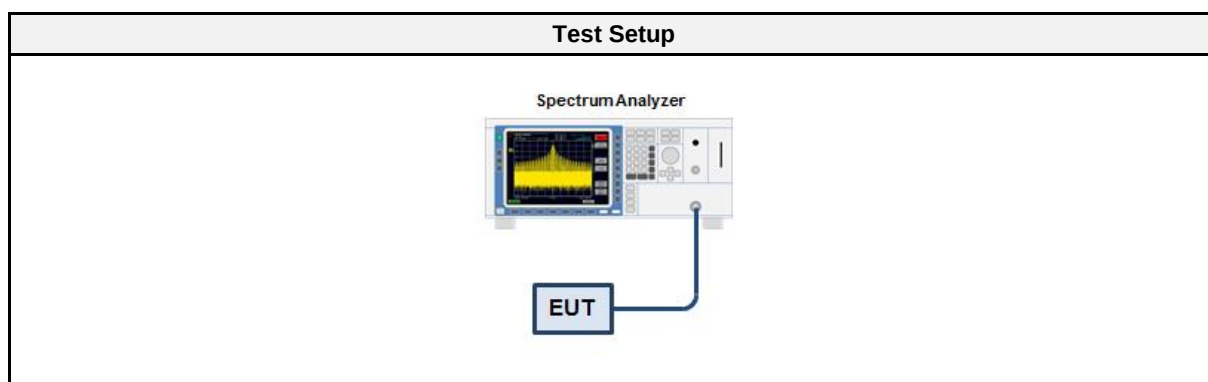
3.4.1 Information

Test Information	
Reference	FCC § 15.247(e); ISSED RSS-247, Issue 2 (section 5.2)
Measurement Method	ANSI C63.10 11.10.2, 14.3.2
Operator	Wilfried Treffke
Date	2019-03-26

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	EF01407	2018-12	2019-12

3.4.5 Procedure

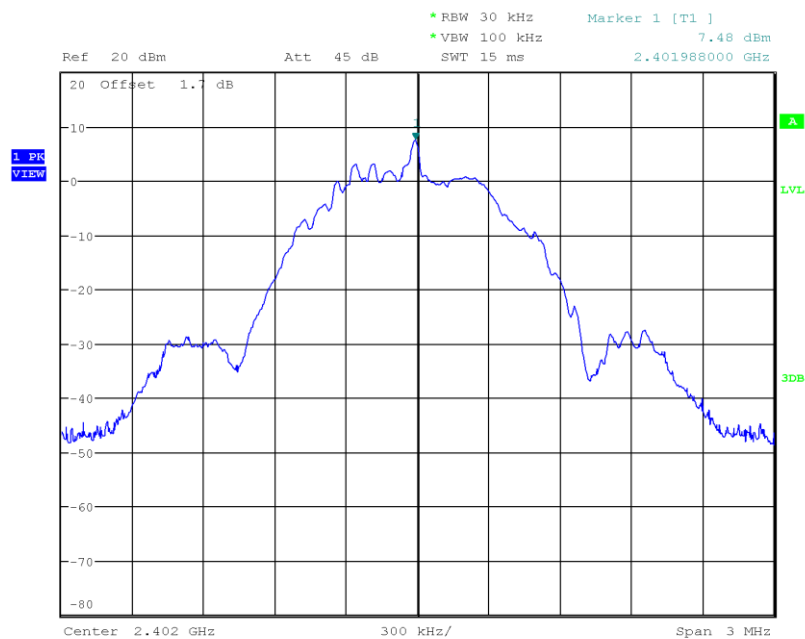
Test Procedure
1. EUT set to test mode 2. The analyzer is set to DTS channel center frequency with a span of 1.5 times the DTS bandwidth 3. The RBW is set to 100 kHz with VBW $\geq$ RBW and the detector is set to peak with max hold 4. After the trace has stabilized a marker is set to the envelope maximum 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]	RBW [kHz]	Limit [dBm/3kHz]	Verdict
2402	7.482	30	8.0	PASS
2440	7.516	30	8.0	PASS
2480	7.752	100	8.0	PASS

Peak Power Spectral Density

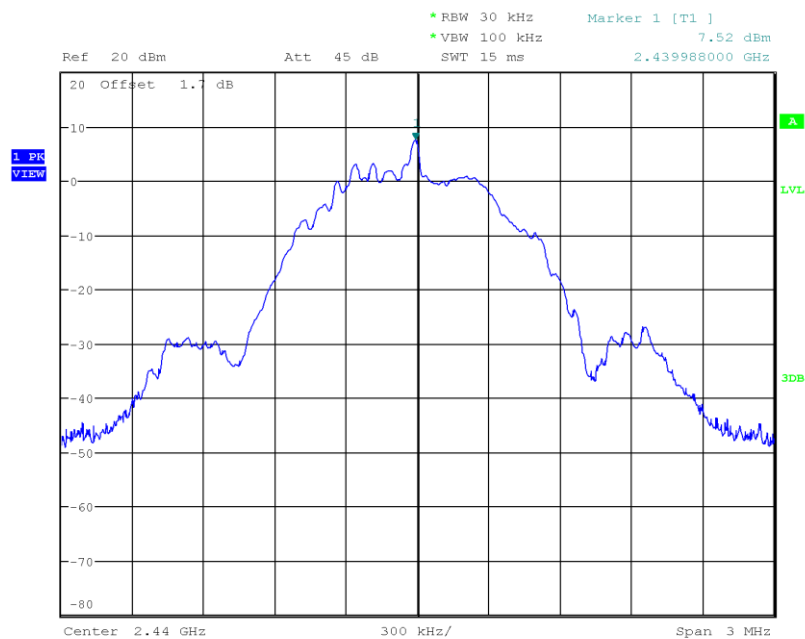
Project Number:	G0M-1902-8046
Applicant:	Panasonic Industrial Devices Europe GmbH
Model Description:	Bluetooth Low Energy Module
Model:	ENW89823A5KF
Test Sample ID:	23051
Reference Standards:	FCC 15.247, RSS-247
Reference Method:	ANSI C63.10:2013, Section 11.10.2
Operational Mode:	GFSK, Channel: 0, 2402 MHz
Operating Conditions:	Tnom/Vnom
Operator:	Wilfried Treffke
Test Site:	Eurofins Product Service GmbH
Test Date:	2019-03-26
Peak Frequency [MHz]:	2401.988
Spectral Density [dBm/RBW]:	7.482
Resolution Bandwidth [kHz]:	30 kHz



Date: 26.MAR.2019 05:17:42

Peak Power Spectral Density

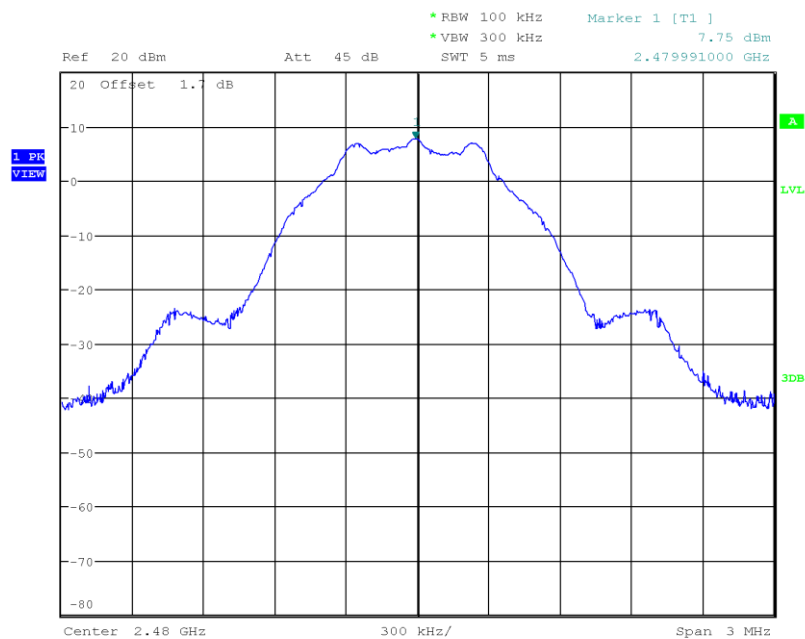
Project Number: G0M-1902-8046
 Applicant: Panasonic Industrial Devices Europe GmbH
 Model Description: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Sample ID: 23051
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.10.2
 Operational Mode: GFSK, Channel: 19, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Wilfried Treffke
 Test Site: Eurofins Product Service GmbH
 Test Date: 2019-03-26
 Peak Frequency [MHz]: 2439.988
 Spectral Density [dBm/RBW]: 7.516
 Resolution Bandwidth [kHz]: 30 kHz



Date: 26.MAR.2019 05:19:32

Peak Power Spectral Density

Project Number: G0M-1902-8046
 Applicant: Panasonic Industrial Devices Europe GmbH
 Model Description: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Sample ID: 23051
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.10.2
 Operational Mode: GFSK, Channel: 39, 2480 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Wilfried Treffke
 Test Site: Eurofins Product Service GmbH
 Test Date: 2019-03-26
 Peak Frequency [MHz]: 2479.991
 Spectral Density [dBm/RBW]: 7.752
 Resolution Bandwidth [kHz]: 100 kHz



Date: 26.MAR.2019 05:34:26

3.5 Test Conditions and Results - AC powerline conducted emissions

3.5.1 Information

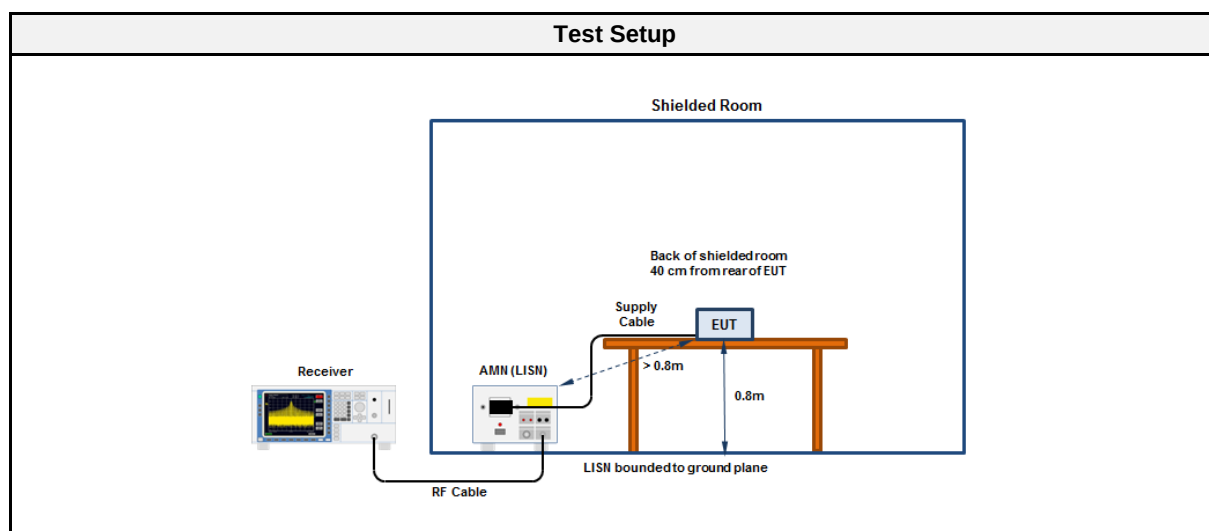
Test Information	
Reference	FCC § 15.207; ISED RSS-247, Issue 2 (section 3.1)
Measurement Method	ANSI C63.10 6.2
Operator	Wilfried Treffke
Date	2019-04-26

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 Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	RadiMation	2016.1.10

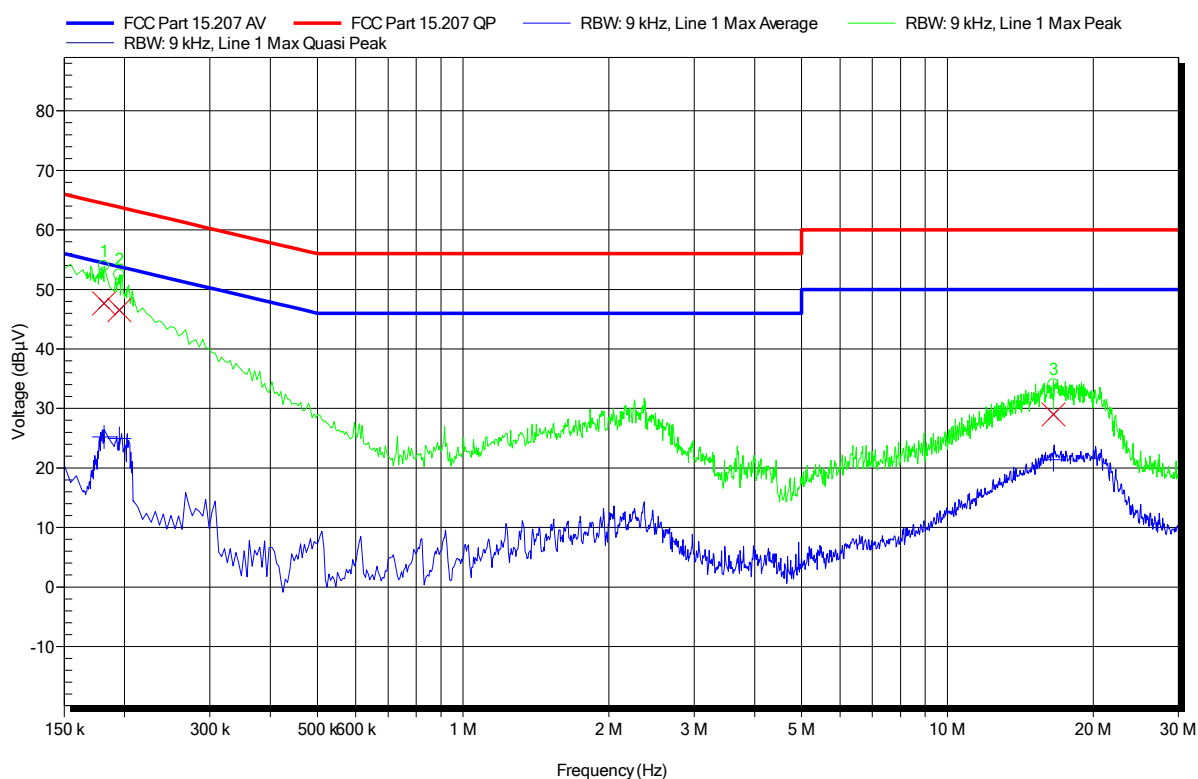
Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
EMI Receiver	R&S	ESU 26	EF00241	2017-07	2019-07
LISN	R&S	ESH3-Z5	EF00036	2017-01	2019-07

EMI voltage test in the ac-mains according to FCC part 15 C

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Unom: 120 VAC
 LISN: ESH3-Z5 (L)
 Mode: BLE; 2440 MHz
 Test Date: 2019-04-26
 Note:

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Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status
1	181.5 kHz	47.63 dBμV	64.42 dBμV	-16.78 dB	Pass
2	195 kHz	46.53 dBμV	63.82 dBμV	-17.29 dB	Pass
3	16.546 MHz	29 dBμV	60 dBμV	-31 dB	Pass

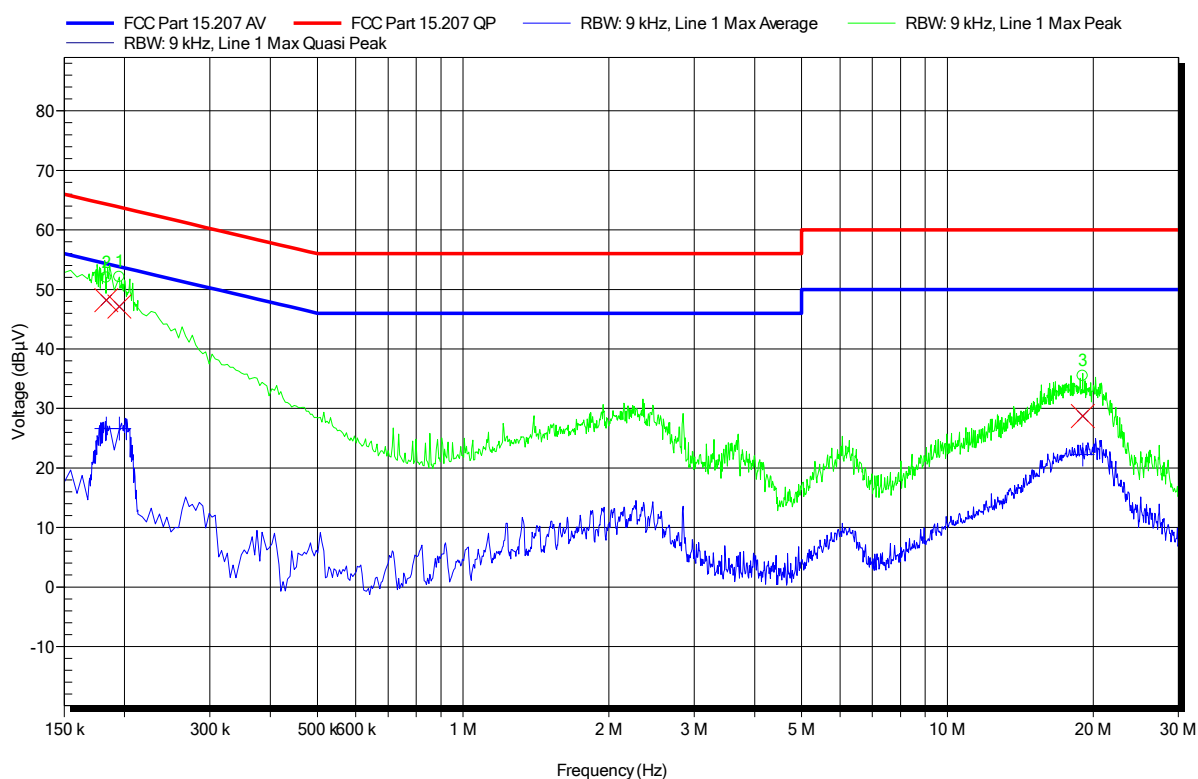
Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status
1	181.5 kHz	25.24 dBμV	54.42 dBμV	-29.18 dB	Pass
2	195 kHz	24.94 dBμV	53.82 dBμV	-28.88 dB	Pass
3	16.546 MHz	21.4 dBμV	50 dBμV	-28.6 dB	Pass

EMI voltage test in the ac-mains according to FCC part 15 C

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Unom: 120 VAC
 LISN: ESH3-Z5 (N)
 Mode: BLE; 2440 MHz
 Test Date: 2019-04-26
 Note:

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Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status
1	195 kHz	47.11 dBμV	63.82 dBμV	-16.71 dB	Pass
2	183.3 kHz	48.21 dBμV	64.33 dBμV	-16.12 dB	Pass
3	19.019 MHz	28.71 dBμV	60 dBμV	-31.29 dB	Pass

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status
1	195 kHz	26.64 dBμV	53.82 dBμV	-27.18 dB	Pass
2	183.3 kHz	26.63 dBμV	54.33 dBμV	-27.71 dB	Pass
3	19.019 MHz	22.25 dBμV	50 dBμV	-27.75 dB	Pass

3.6 Test Conditions and Results - Band-edge compliance

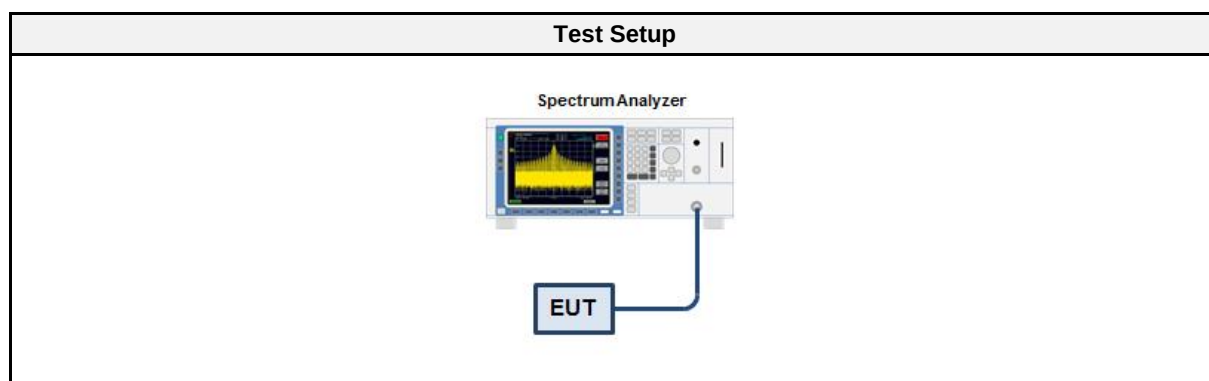
3.6.1 Information

Test Information	
Reference	FCC § 15.247(d); ISSED RSS-247, Issue 2 (section 5.5)
Measurement Method	ANSI C63.10 11.13
Operator	Wilfried Treffke
Date	2019-03-26

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	EF01407	2019-07	2020-07

3.6.5 Procedure

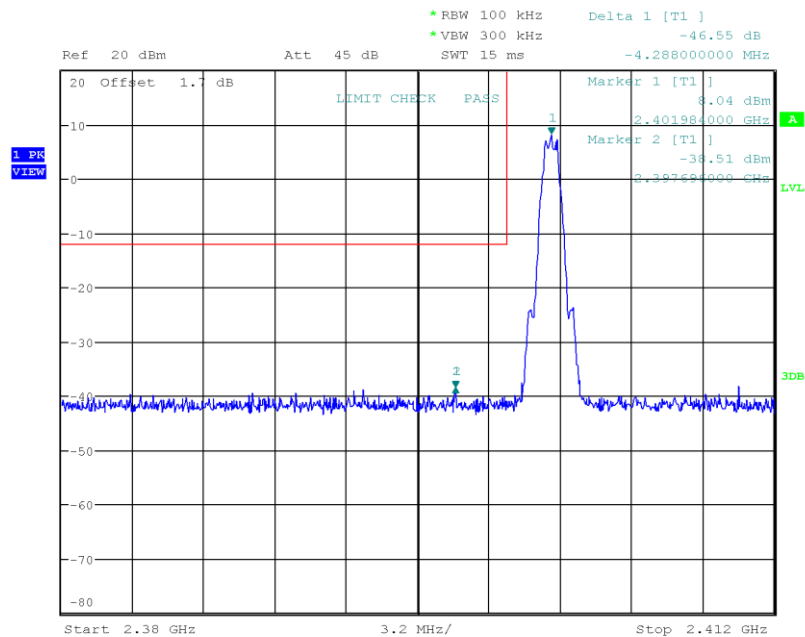
Test Procedure
1. EUT set to test mode (Communication tester is used if needed) 2. Span set around lower band edge and detector is set to peak and max hold 3. Resolution bandwidth is set to 100 kHz 4. Markers are set to peak emission levels within frequency band and outside frequency band 5. Band edge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

3.6.6 Results

Test Results				
Mode	Channel [MHz]	Out-of-band Attenuation [dB]	Limit [dB]	Verdict
GFSK	2402	-46.55	-20	PASS
GFSK	2480	-45.56	-20	PASS

Band-edge Compliance

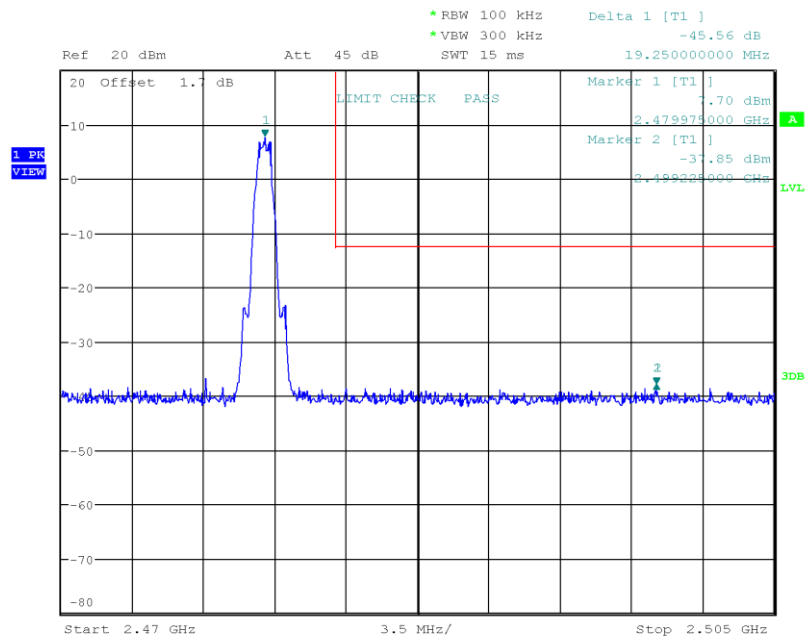
Project Number: G0M-1902-8046
 Applicant: Panasonic Industrial Devices Europe GmbH
 Model Description: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Sample ID: 23051
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 7.8.6, 6.10.4
 Operating Conditions: Tnom/Vnom
 Operator: Wilfried Treffke
 Test Site: Eurofins Product Service GmbH
 Test Date: 2019-03-26
 Band-edge: Lower
 In-band Frequency [MHz]: 2401.984
 Max. in-band Level [dBm/100 kHz]: 8.039
 Out-of-band Frequency [MHz]: 2397.696
 Max. out-of-band Level [dBm/100 kHz]: -38.513
 Attenuation [dB]: -46.55



Date: 26.MAR.2019 05:40:35

Band-edge Compliance

Project Number: GOM-1902-8046
 Applicant: Panasonic Industrial Devices Europe GmbH
 Model Description: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Sample ID: 23051
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 7.8.6, 6.10.4
 Operating Conditions: Tnom/Vnom
 Operator: Wilfried Treffke
 Test Site: Eurofins Product Service GmbH
 Test Date: 2019-03-26
 Band-edge: Upper
 In-band Frequency [MHz]: 2479.975
 Max. in-band Level [dBm/100 kHz]: 7.705
 Out-of-band Frequency [MHz]: 2499.225
 Max. out-of-band Level [dBm/100 kHz]: -37.851
 Attenuation [dB]: -45.56



Date: 26.MAR.2019 05:38:54

3.7 Test Conditions and Results - Conducted spurious emissions

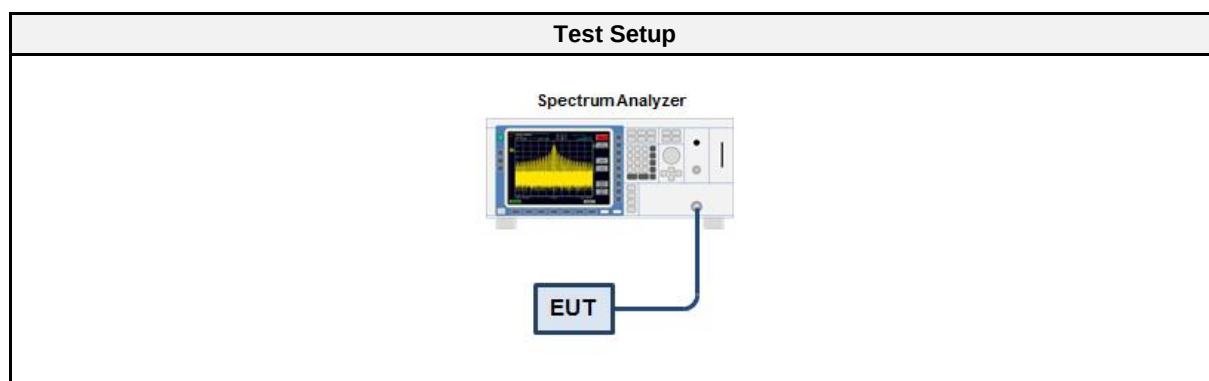
3.7.1 Information

Test Information	
Reference	FCC § 15.247(d); ISED RSS-247, Issue 2 (section 5.5)
Measurement Method	ANSI C63.10 11.11
Operator	Wilfried Treffke
Date	2019-03-26

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	EF01407	2019-07	2020-07

3.7.5 Procedure

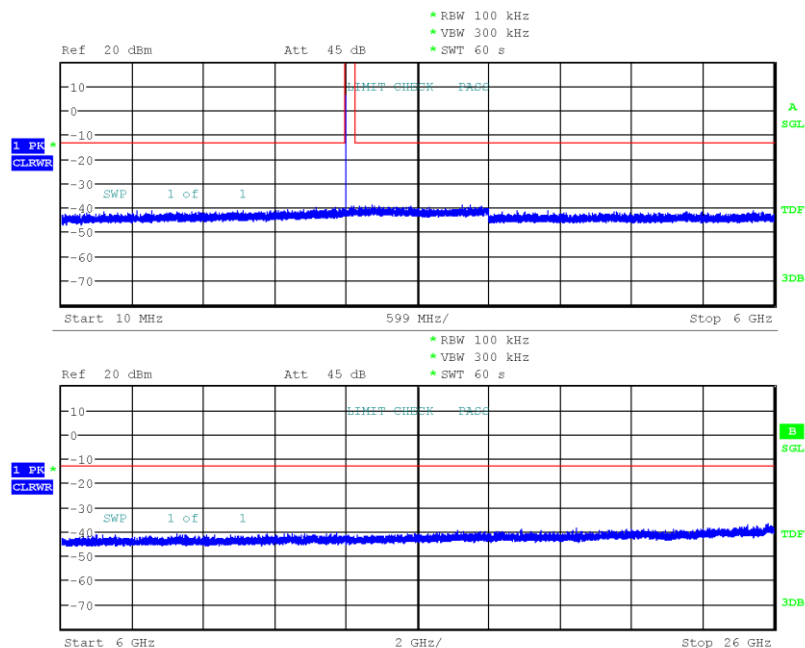
Test Procedure
1. EUT set to test mode (Communication tester is used if needed) 2. Span set around lower band edge and detector is set to peak and max hold 3. Resolution bandwidth is set to 100 kHz 4. Markers are set to peak emission levels within frequency band and outside frequency band 5. Band edge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

3.7.6 Results

Test Results		
Mode	Channel [MHz]	Verdict
GFSK	2402	PASS
GFSK	2440	PASS
GFSK	2480	PASS

Conducted Spurious Emissions

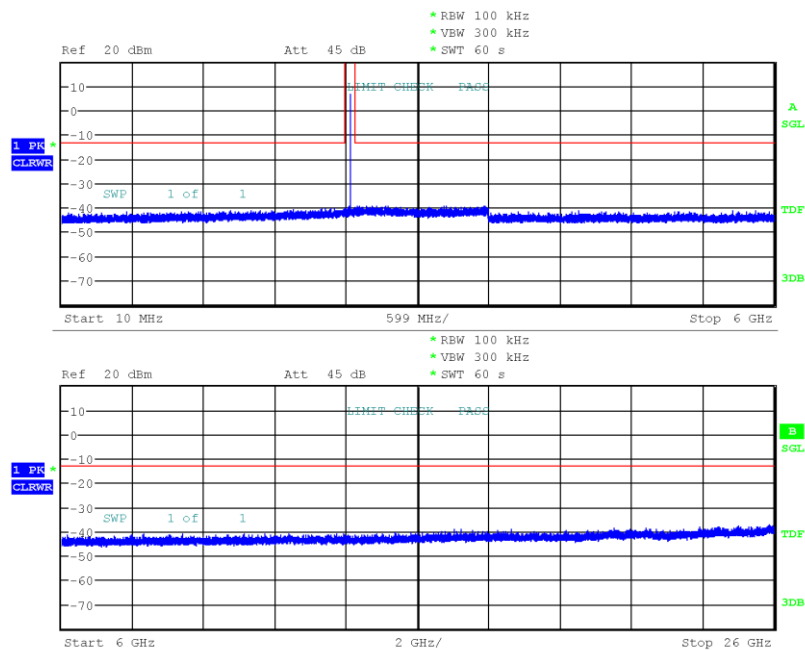
Project Number: G0M-1902-8046
 Applicant: Panasonic Industrial Devices Europe GmbH
 Model Description: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Sample ID: 23051
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: GFSK, Channel: 0, 2402 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Wilfried Treffke
 Test Site: Eurofins Product Service GmbH
 Test Date: 2019-03-26
 Max. in-band Frequency [MHz]: 2402.0
 Max. in-band Level [dBm/100 kHz]: 7.1
 Out-of-band Limit [dBm/100 kHz]: -12.9



Date: 26.MAR.2019 05:45:36

Conducted Spurious Emissions

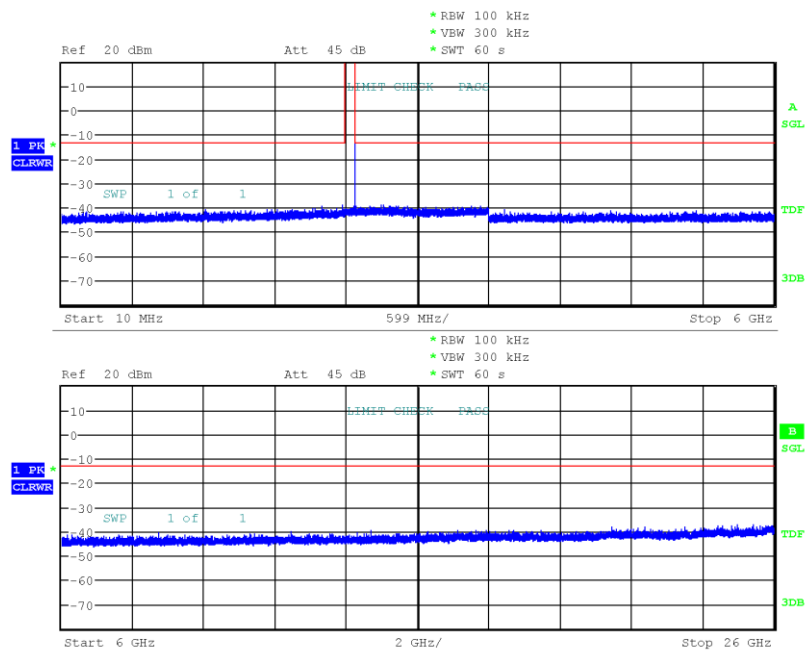
Project Number: G0M-1902-8046
 Applicant: Panasonic Industrial Devices Europe GmbH
 Model Description: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Sample ID: 23051
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: GFSK, Channel: 19, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Wilfried Treffke
 Test Site: Eurofins Product Service GmbH
 Test Date: 2019-03-26
 Max. in-band Frequency [MHz]: 2440.0
 Max. in-band Level [dBm/100 kHz]: 7.2
 Out-of-band Limit [dBm/100 kHz]: -12.8



Date: 26.MAR.2019 05:51:54

Conducted Spurious Emissions

Project Number: G0M-1902-8046
 Applicant: Panasonic Industrial Devices Europe GmbH
 Model Description: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Sample ID: 23051
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: GFSK, Channel: 39, 2480 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Wilfried Treffke
 Test Site: Eurofins Product Service GmbH
 Test Date: 2019-03-26
 Max. in-band Frequency [MHz]: 2480.0
 Max. in-band Level [dBm/100 kHz]: 6.9
 Out-of-band Limit [dBm/100 kHz]: -13.1



Date: 26.MAR.2019 05:56:00

3.8 Test Conditions and Results - Transmitter radiated emissions

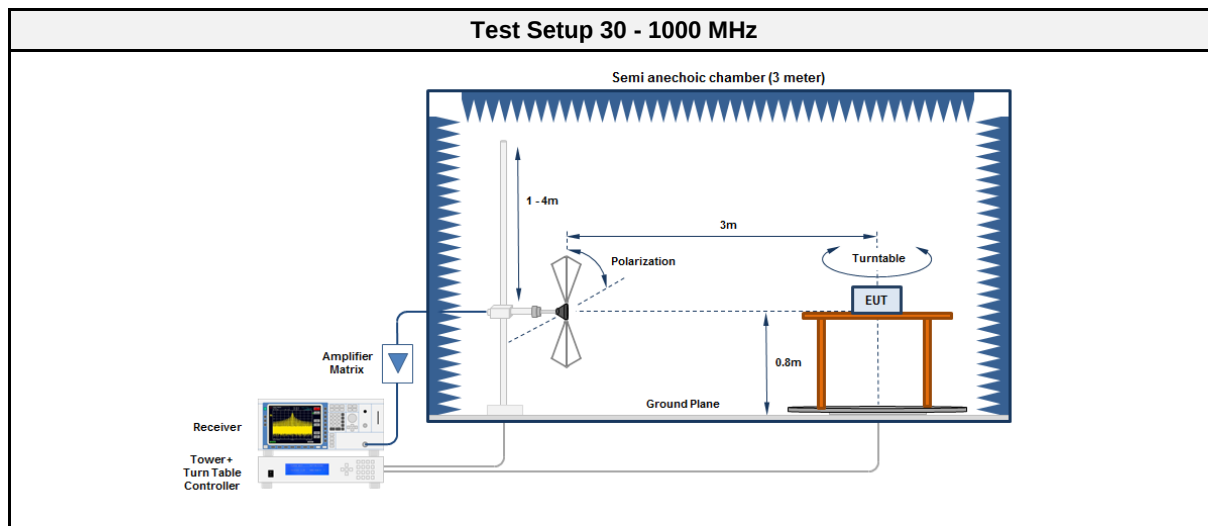
3.8.1 Information

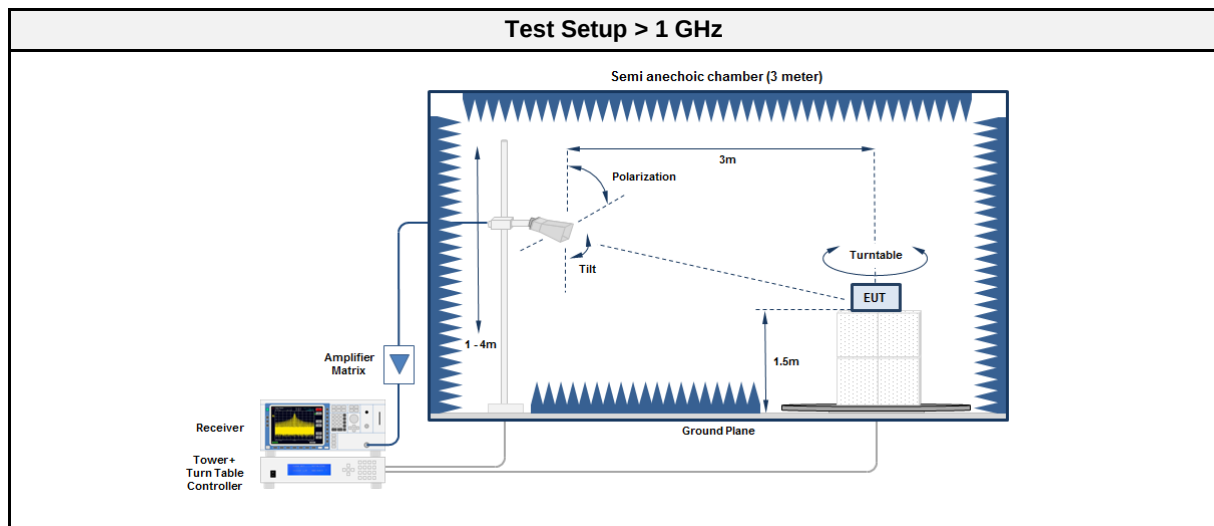
Test Information	
Reference	FCC § 15.247(d); FCC § 15.209; ISSED RSS-Gen, Issue 5 (section 6.13)
Measurement Method	ANSI C63.10 6.4, 6.5, 6.6, 11.12
Operator	Wilfried Treffke
Date	2019-04-24

3.8.2 Limits

Limits			
Frequency [MHz]	Detector	Field strength [$\mu\text{V/m}$]	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 Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	RadiMation	2015.2.4

Test Equipment 30 - 1000 MHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	2018-07	2021-07
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2018-08	2019-08
Antenna	R&S	HK 116	EF00030	2016-04	2019-04
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	2018-07	2021-07
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2018-08	2019-08
Antenna	Schwarzbeck	BBHA 9120D	EF01153	2018-09	2019-09
Antenna	Amplifier Research	AT4560	EF01152	2018-10	2019-10

3.8.5 Procedure

Test Procedure < 30 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 EUT is rotated through 360° 4. The emissions are measured with peak detector and max hold 5. All significant emissions are measured again using the corresponding final detector	

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]
2402	2376.9	56.55	pk	hor	74.00	-17.45
2402	2376.9	39.14	RMS	hor	54.00	-14.86
2440	2327.6	55.31	pk	hor	74.00	-18.69
2440	2327.6	40.44	RMS	hor	54.00	-13.56
2440	2379.8	43.10	pk	ver	74.00	-30.90
2440	7319	51.53	pk	hor	74.00	-22.47
2440	7319	49.08	RMS	hor	54.00	-04.92
2440	7321	54.92	pk	ver	74.00	-19.08
2440	7321	52.13	RMS	ver	54.00	-01.87
2480	2330	54.74	pk	hor	74.00	-19.26
2480	2330	39.86	RMS	hor	54.00	-14.14
2480	2483.6	53.21	pk	hor	74.00	-20.79
2480	2483.6	40.64	RMS	hor	54.00	-13.36
2480	4958	48.00	pk	hor	74.00	-26.00
2480	4962	45.73	pk	ver	74.00	-28.27
2480	7439	51.04	pk	ver	74.00	-22.96
2480	7439	48.40	RMS	ver	54.00	-05.60

3.9 Test Conditions and Results - Receiver radiated emissions

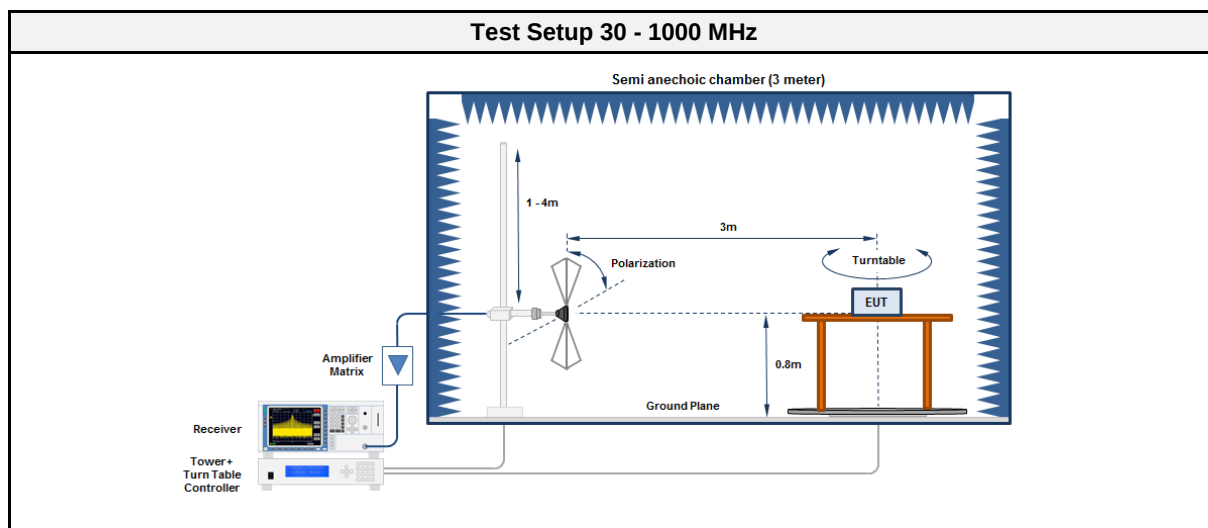
3.9.1 Information

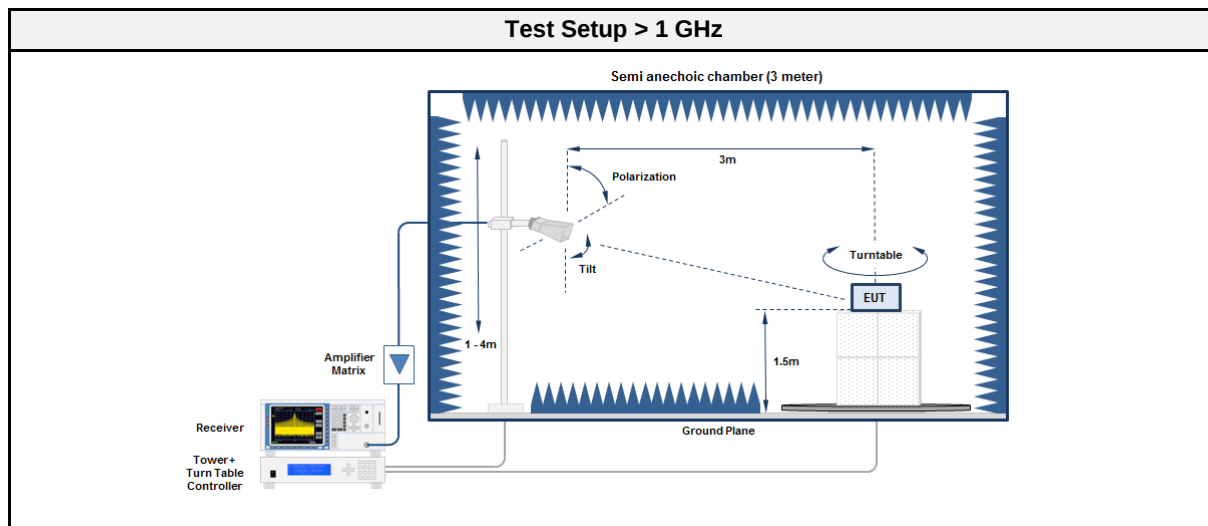
Test Information	
Reference	ISED RSS-247, Issue 2 (section 3.1)
Measurement Method	ANSI C63.10 6.5, 6.6, 11.12
Operator	Wilfried Treffke
Date	2019-04-25

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 Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	RadiMation	2015.2.4

Test Equipment 30 - 1000 MHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	2018-07	2021-07
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2018-08	2019-08
Antenna	R&S	HK 116	EF00030	2016-04	2019-04
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	2018-07	2021-07
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2018-08	2019-08
Antenna	Schwarzbeck	BBHA 9120D	EF01153	2018-09	2019-09
Antenna	Amplifier Research	AT4560	EF01152	2018-10	2019-10

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	30.742	31.83	qpk	ver	40.00	-08.17
2440	32.577	32.98	qpk	ver	40.00	-07.02
2440	4878	38.52	pk	hor	53.98	-15.46
2440	4878	37.94	pk	ver	53.98	-16.04
2440	9760	44.11	pk	hor	53.98	-09.87

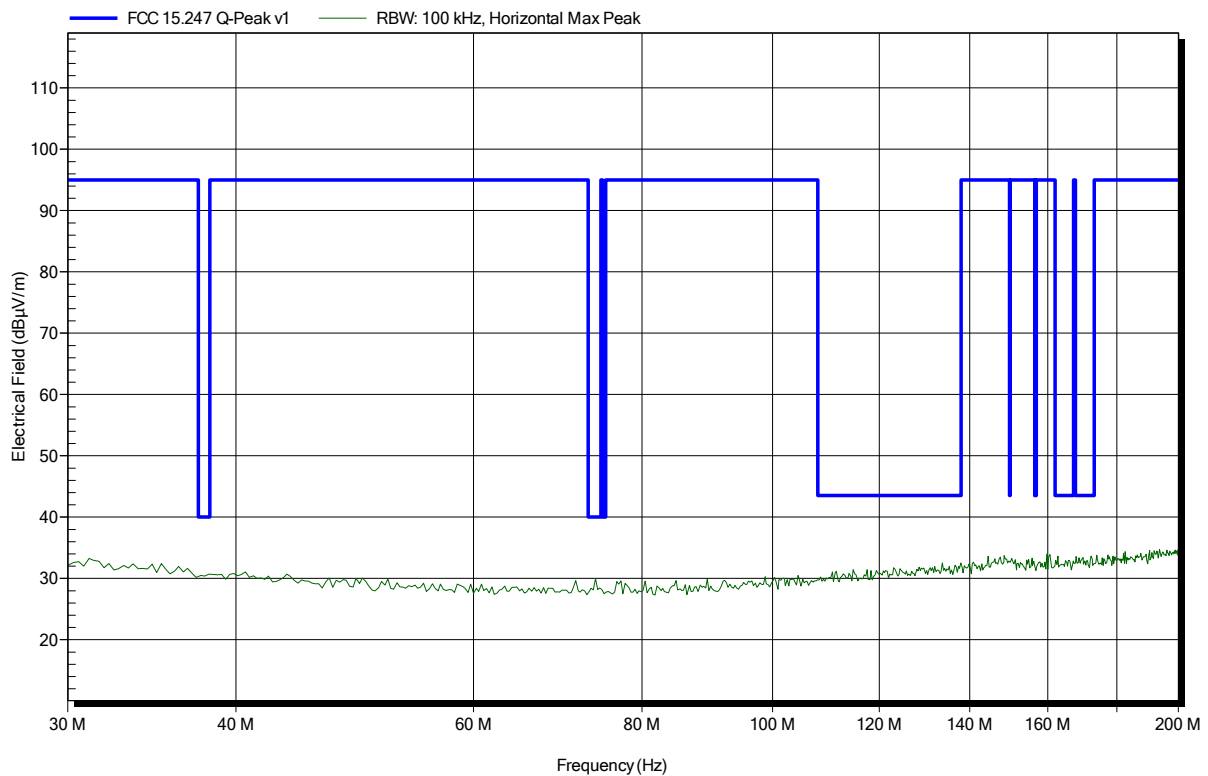
ANNEX A Transmitter spurious emissions

Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Rohde & Schwarz HK 116, Horizontal
 Measurement distance: 3 m
 Mode: TX; BLE; 2402 MHz
 Test Date: 2019-04-25
 Note:

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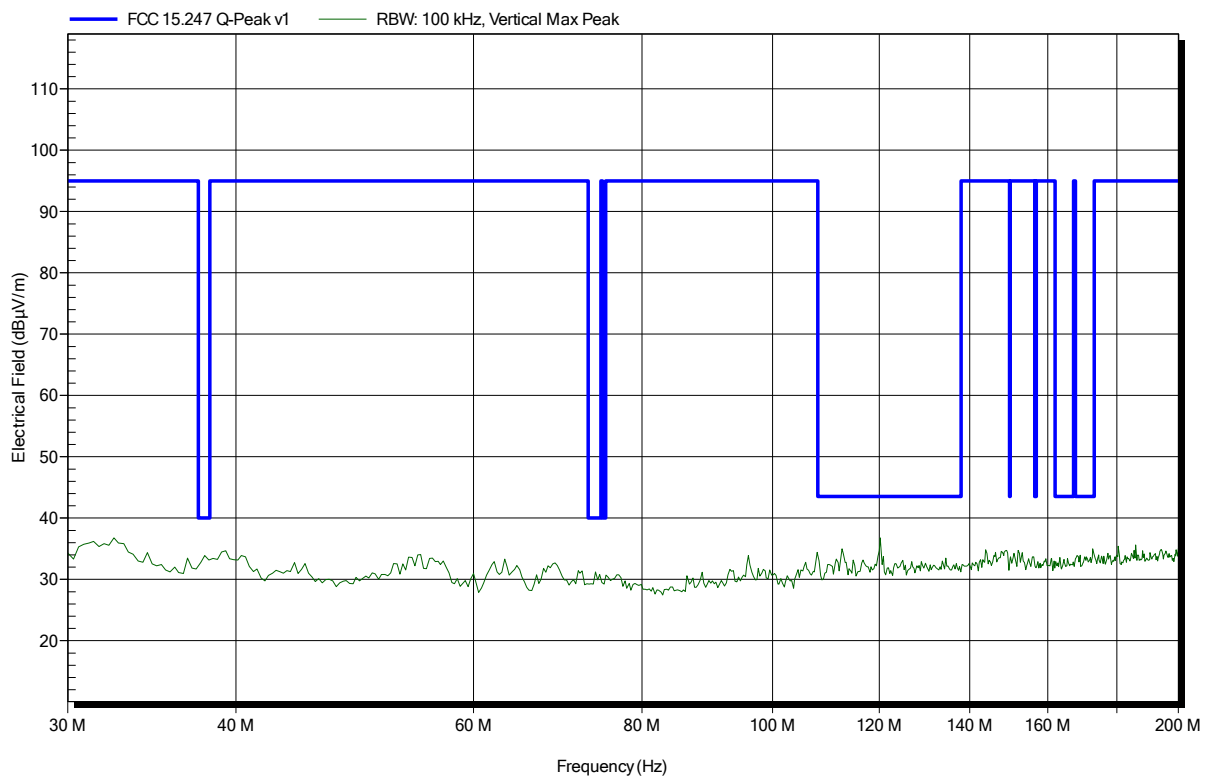


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Rohde & Schwarz HK 116, Vertical
Measurement distance: 3 m
Mode: TX; BLE; 2402 MHz
Test Date: 2019-04-25
Note:

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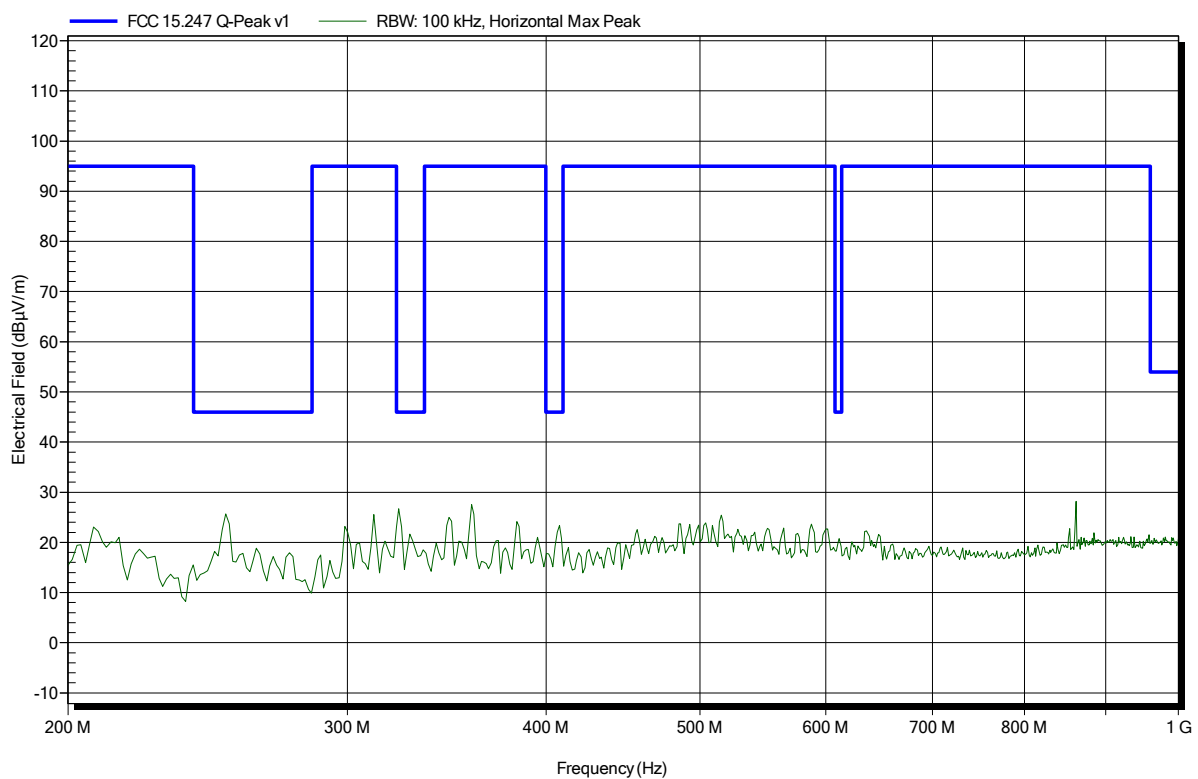


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Rohde & Schwarz HL 223, Horizontal
 Measurement distance: 3 m
 Mode: TX; BLE; 2402 MHz
 Test Date: 2019-04-25
 Note:

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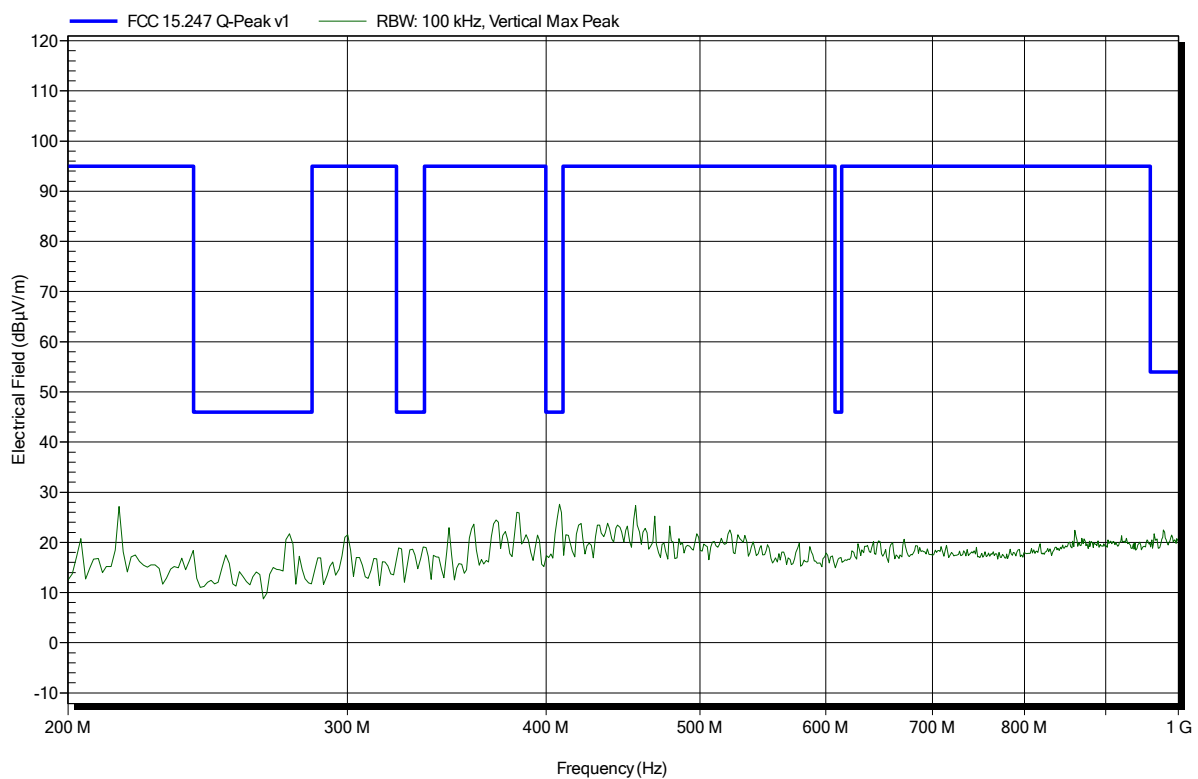


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Rohde & Schwarz HL 223, Vertical
 Measurement distance: 3 m
 Mode: TX; BLE; 2402 MHz
 Test Date: 2019-04-25
 Note:

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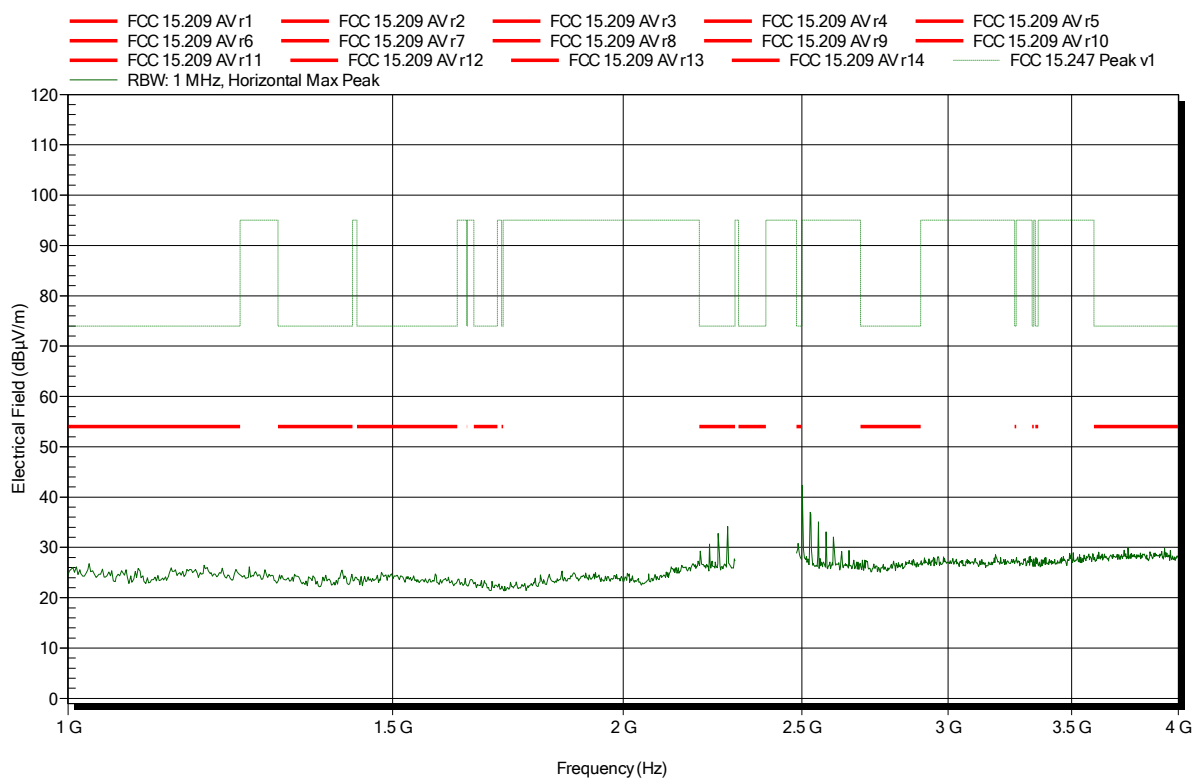


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2402 MHz
Test Date: 2019-04-24
Note:

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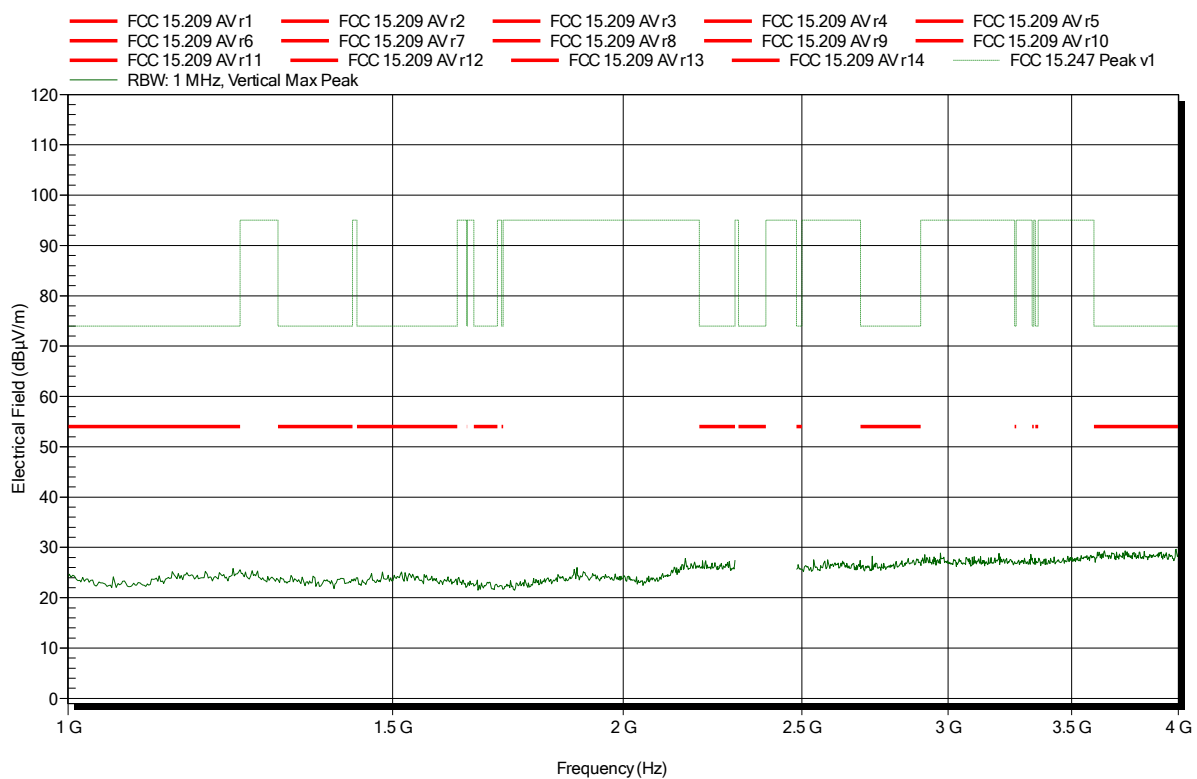


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2402 MHz
Test Date: 2019-04-24
Note:

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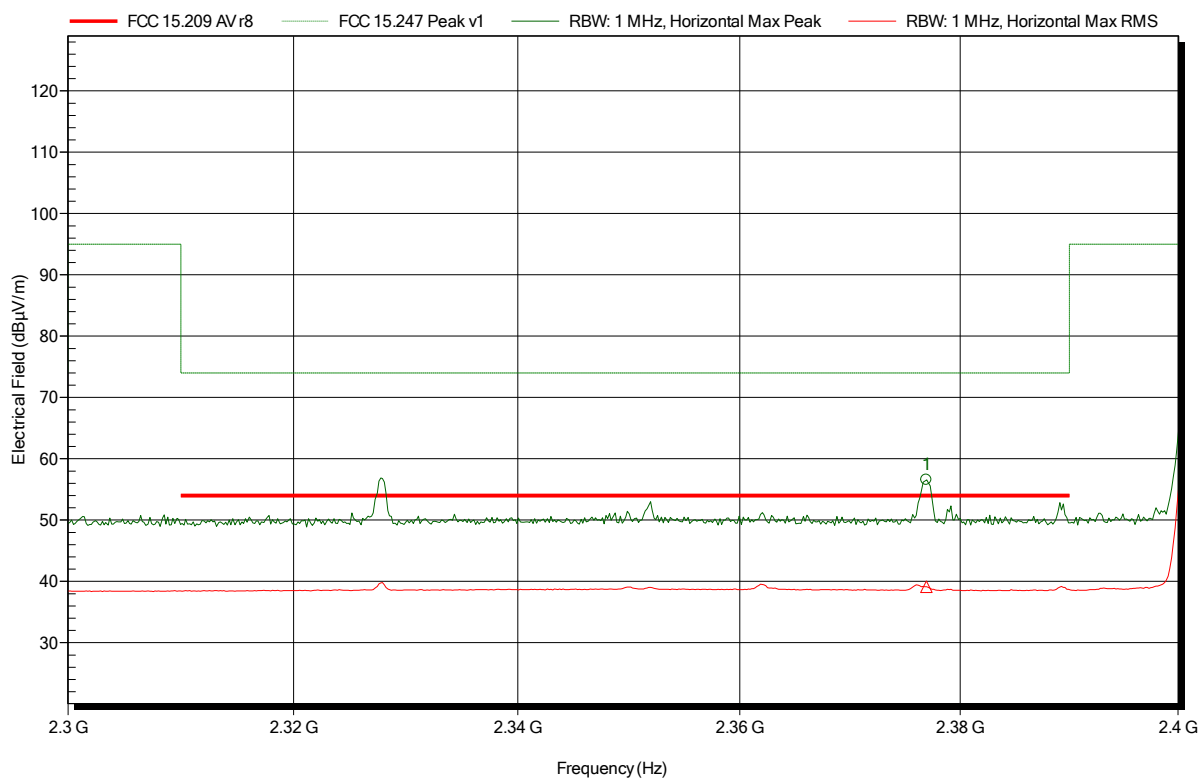


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2402 MHz
 Test Date: 2019-04-24
 Note: lower bandedge

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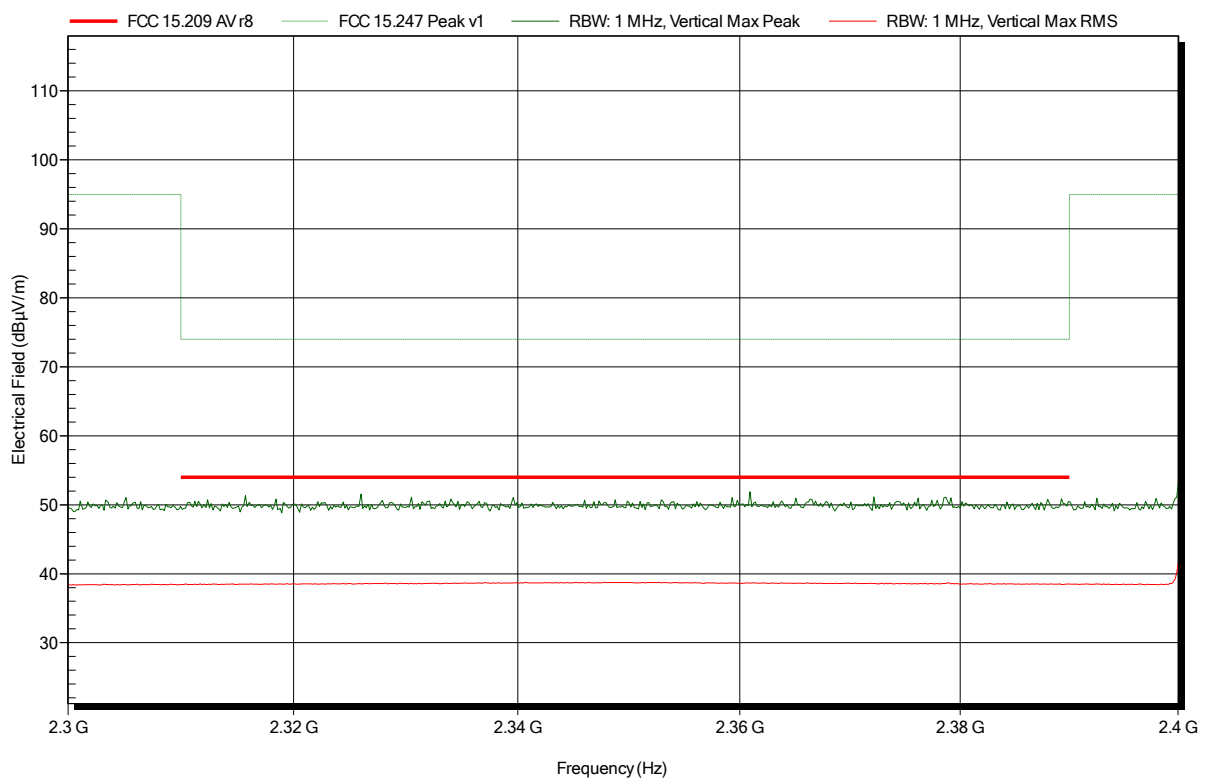
Frequency 2.3769 GHz	Peak 56.55 dBµV/m	Peak Limit 74 dBµV/m	Peak Difference -17.45 dB	Peak Status Pass
Frequency 2.3769 GHz	RMS 39.14 dBµV/m	RMS Limit 54 dBµV/m	RMS Difference -14.86 dB	RMS Status Pass

Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2402 MHz
Test Date: 2019-04-24
Note: lower bandedge

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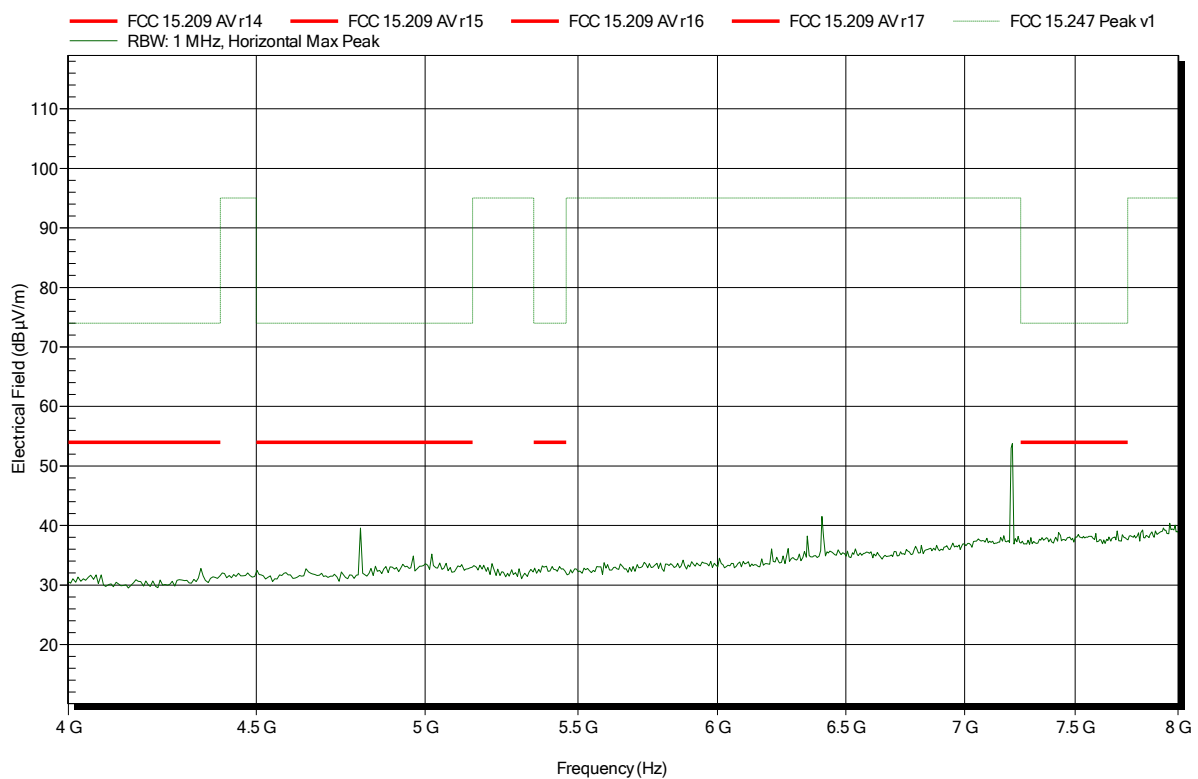


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2402 MHz
 Test Date: 2019-04-24
 Note:

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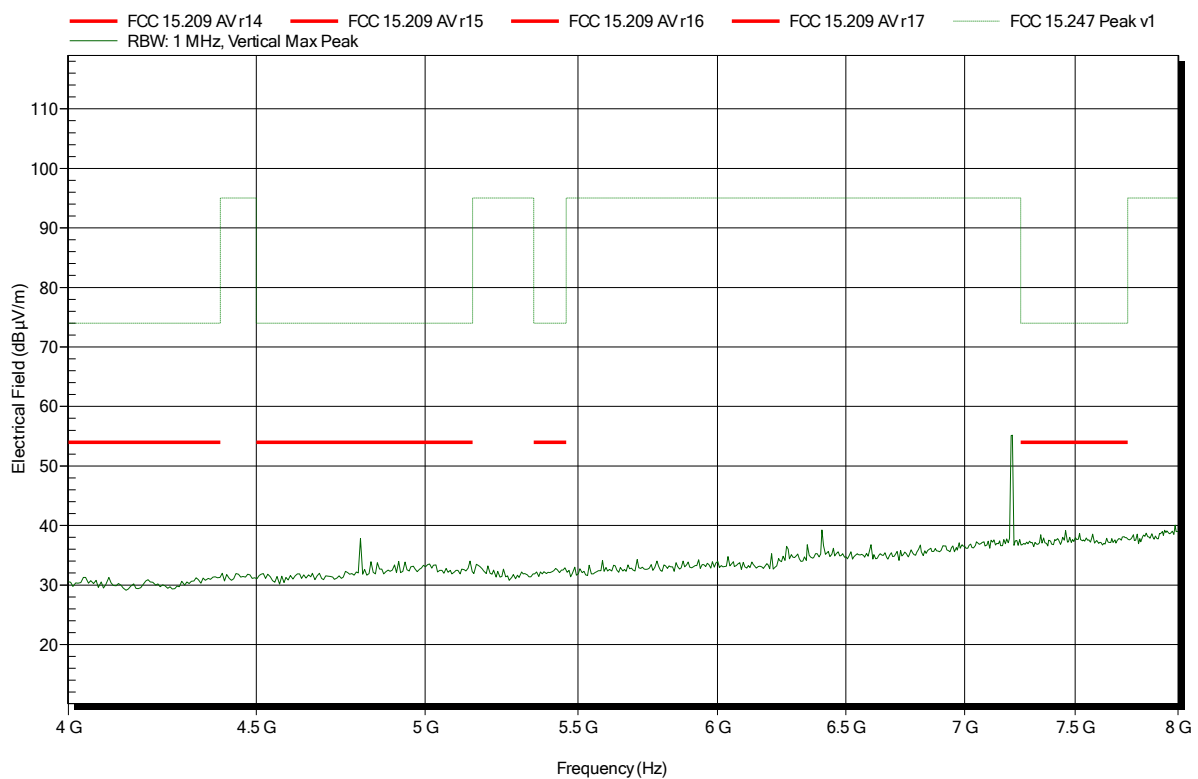


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2402 MHz
Test Date: 2019-04-24
Note:

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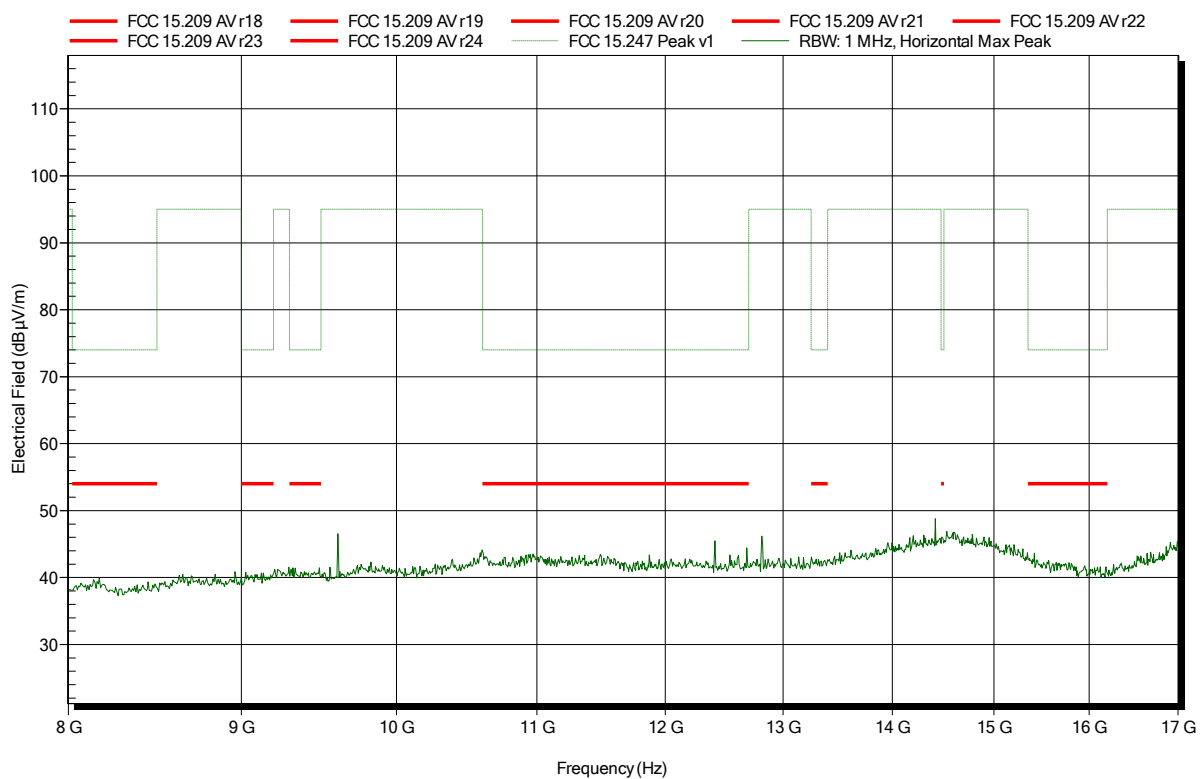


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2402 MHz
Test Date: 2019-04-24
Note:

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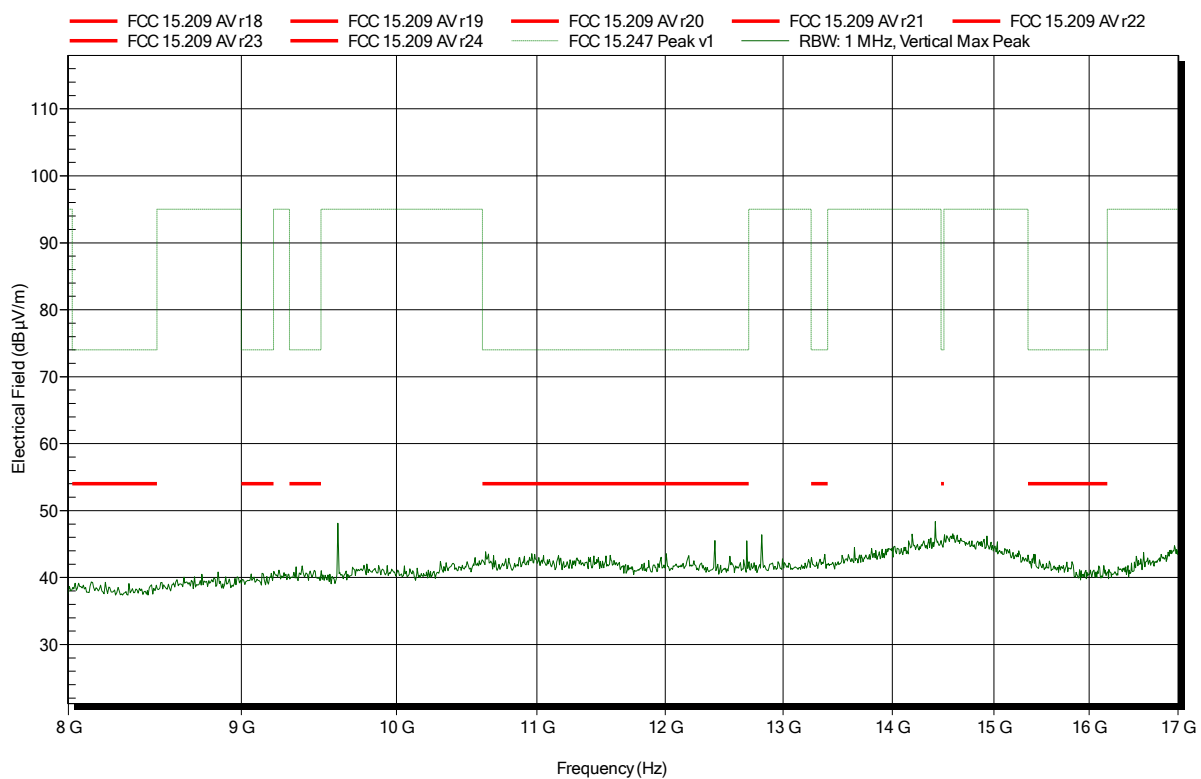


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2402 MHz
Test Date: 2019-04-24
Note:

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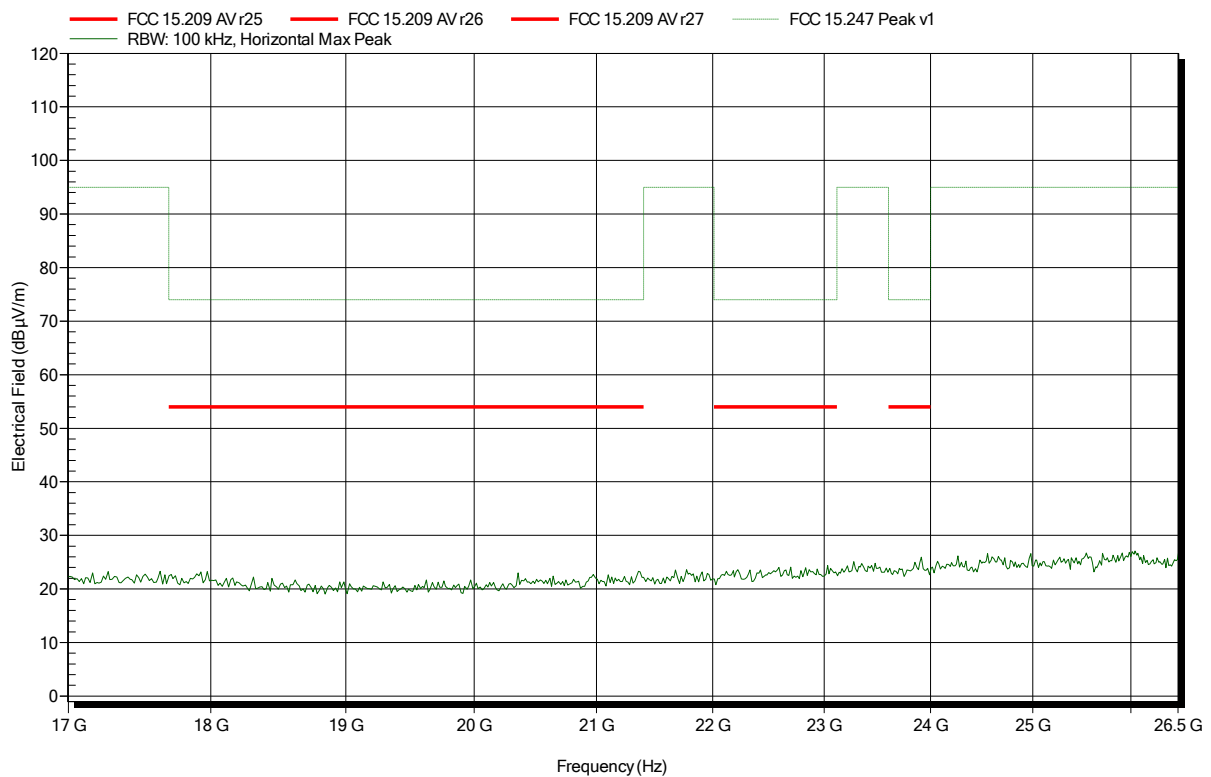


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Amplifier Research AT4560, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2402 MHz
 Test Date: 2019-04-24
 Note:

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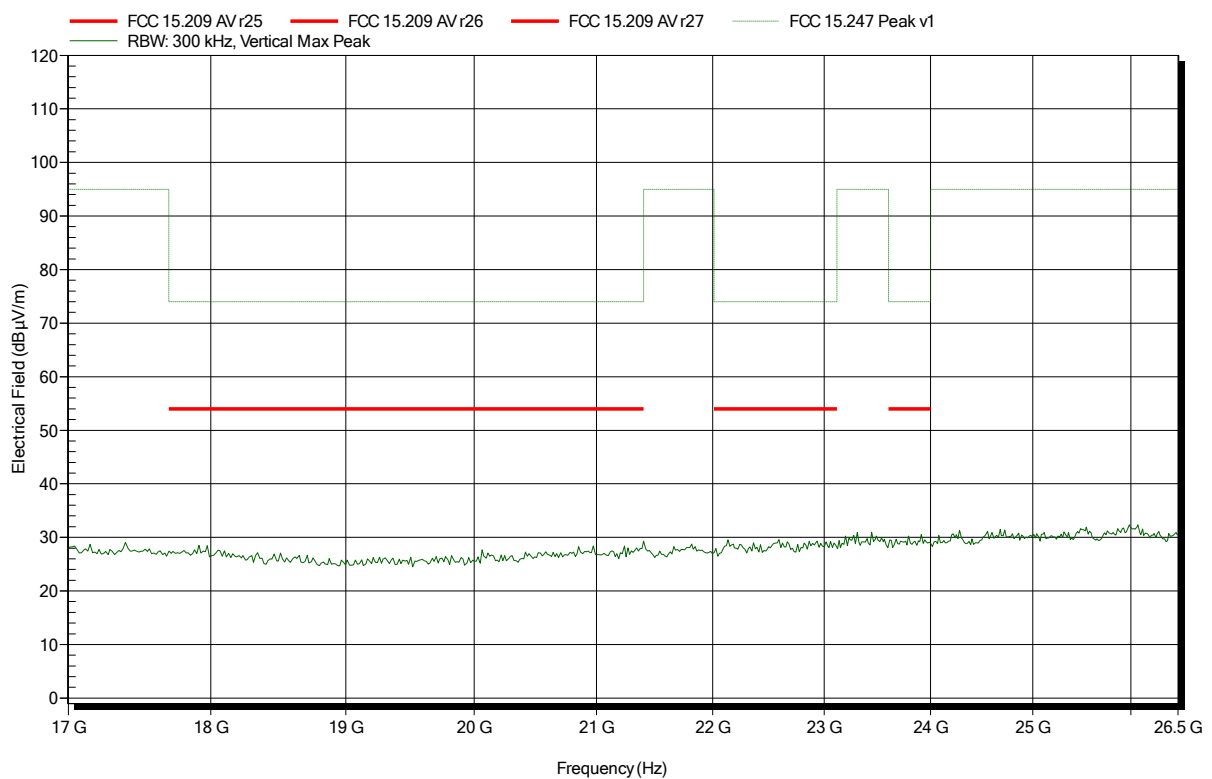


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Amplifier Research AT4560, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2402 MHz
Test Date: 2019-04-24
Note:

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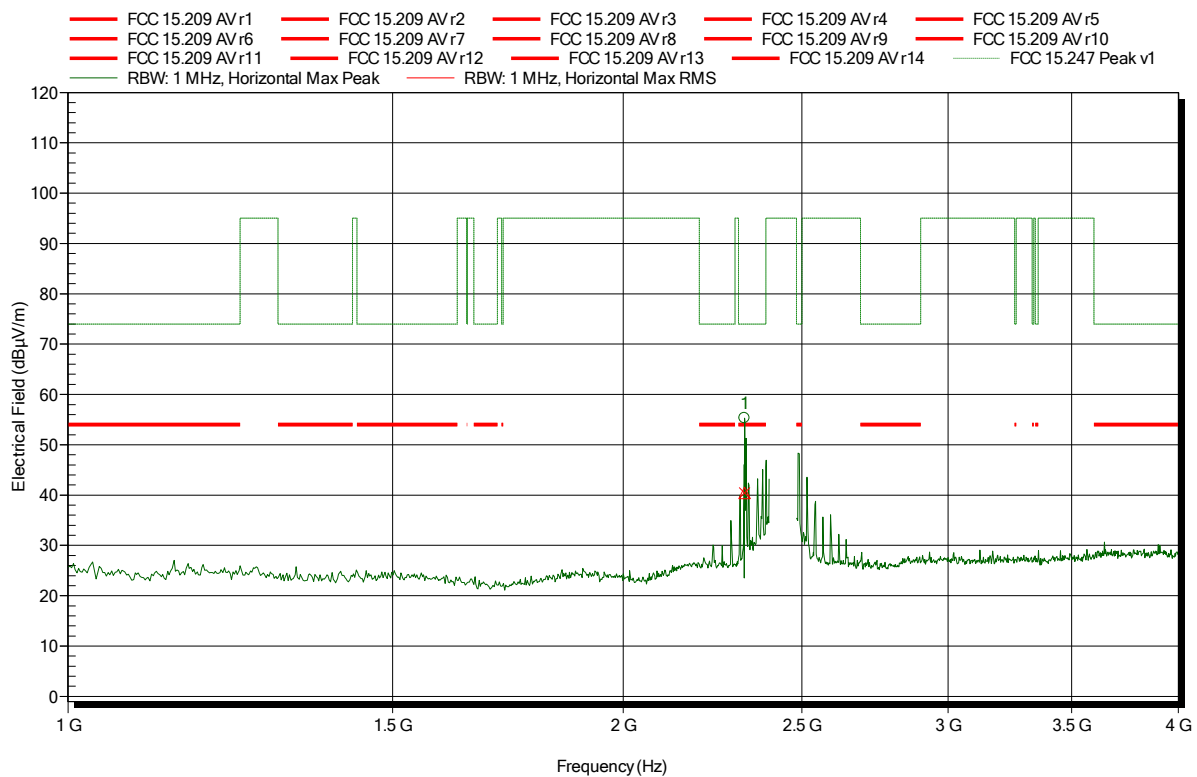


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2440 MHz
 Test Date: 2019-04-24
 Note:

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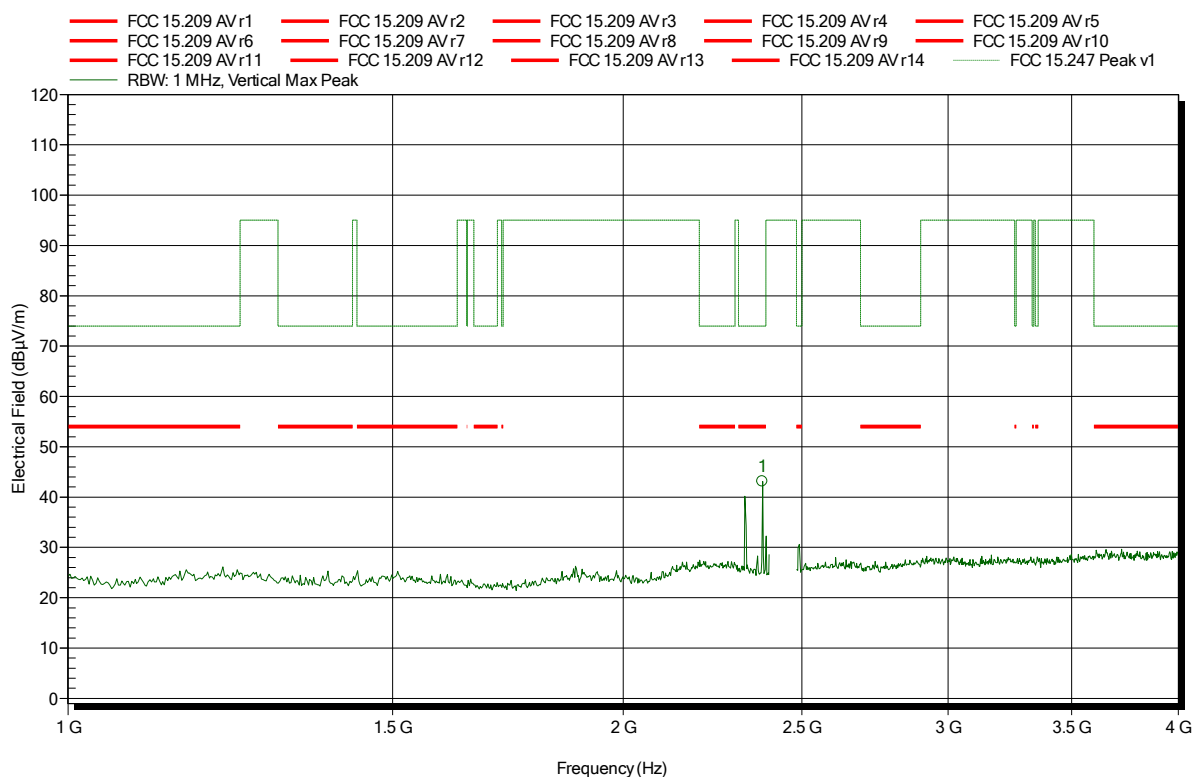
Frequency	Peak	Peak Limit	Peak Difference	Peak Status
2.3276 GHz	55.31 dBµV/m	74 dBµV/m	-18.69 dB	Pass
Frequency	RMS	RMS Limit	RMS Difference	RMS Status
2.3276 GHz	40.44 dBµV/m	54 dBµV/m	-13.56 dB	Pass

Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2440 MHz
 Test Date: 2019-04-24
 Note:

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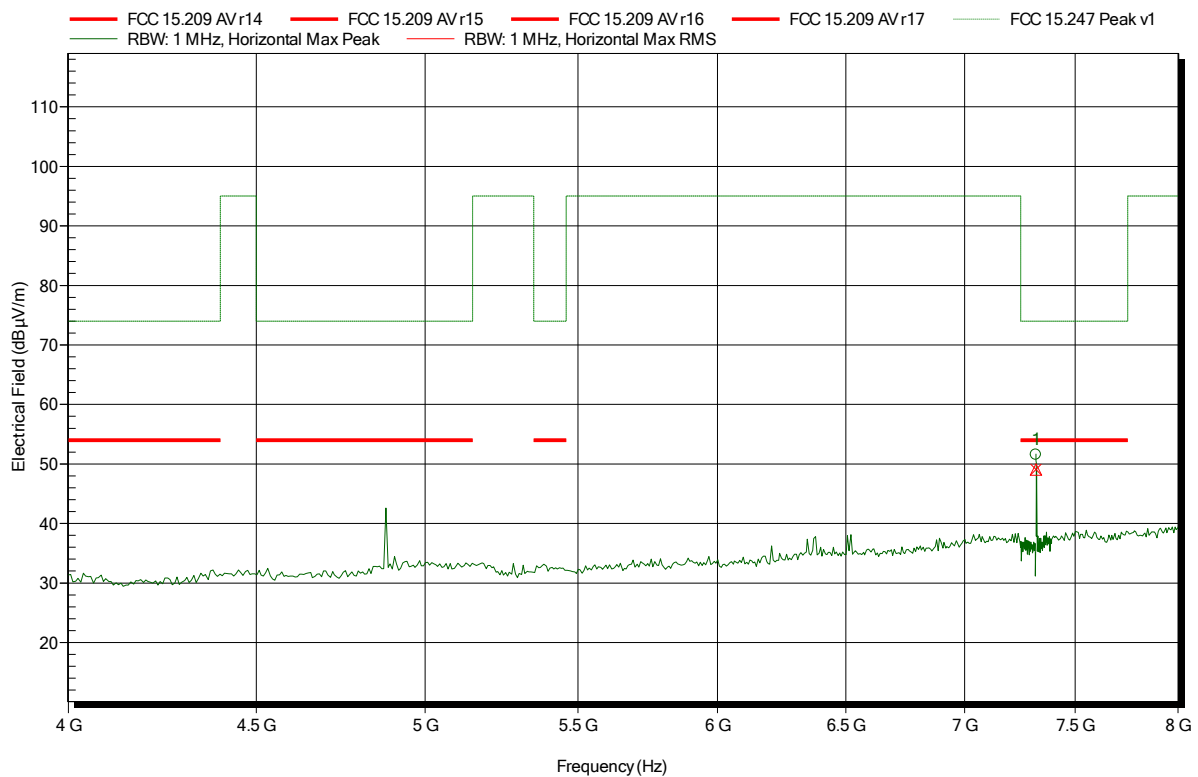
Frequency	Peak	Peak Limit	Peak Difference	Peak Status
2.3798 GHz	43.1 dBμV/m	74 dBμV/m	-30.9 dB	Pass

Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2440 MHz
 Test Date: 2019-04-24
 Note:

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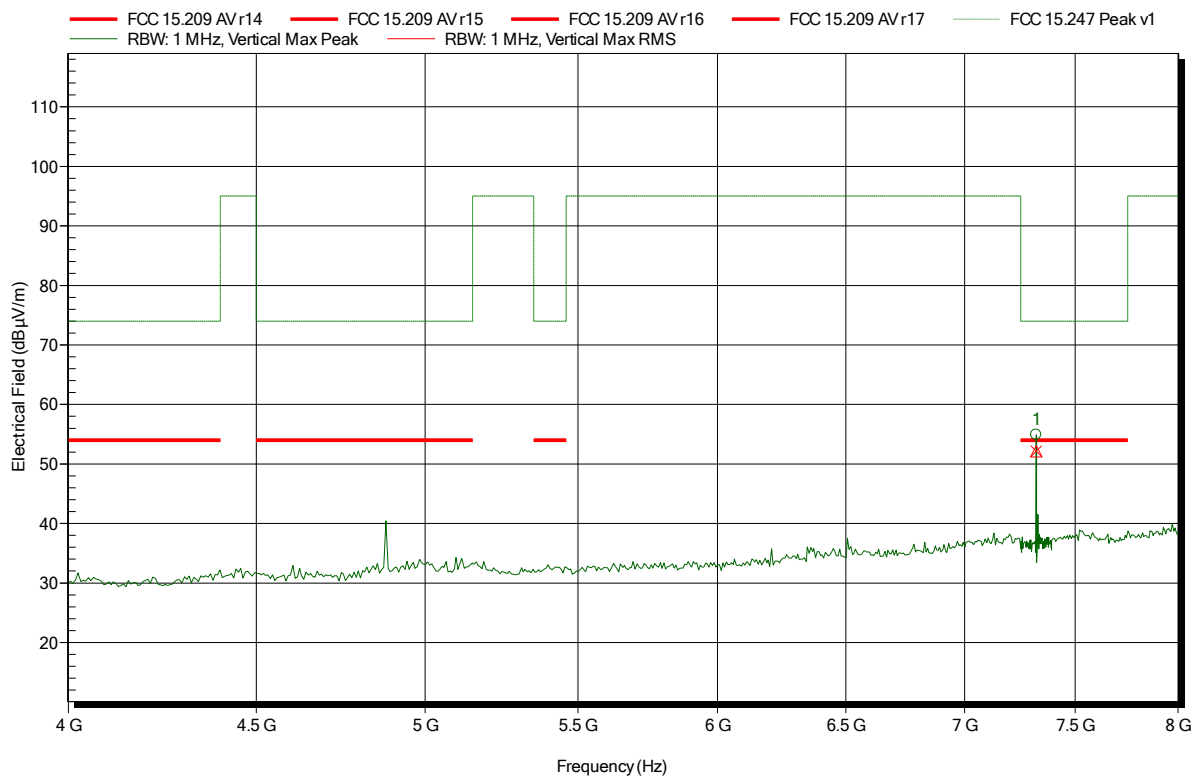
Frequency 7.319 GHz	Peak 51.53 dBµV/m	Peak Limit 74 dBµV/m	Peak Difference -22.47 dB	Peak Status Pass
Frequency 7.319 GHz	RMS 49.08 dBµV/m	RMS Limit 54 dBµV/m	RMS Difference -4.92 dB	RMS Status Pass

Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2440 MHz
 Test Date: 2019-04-24
 Note:

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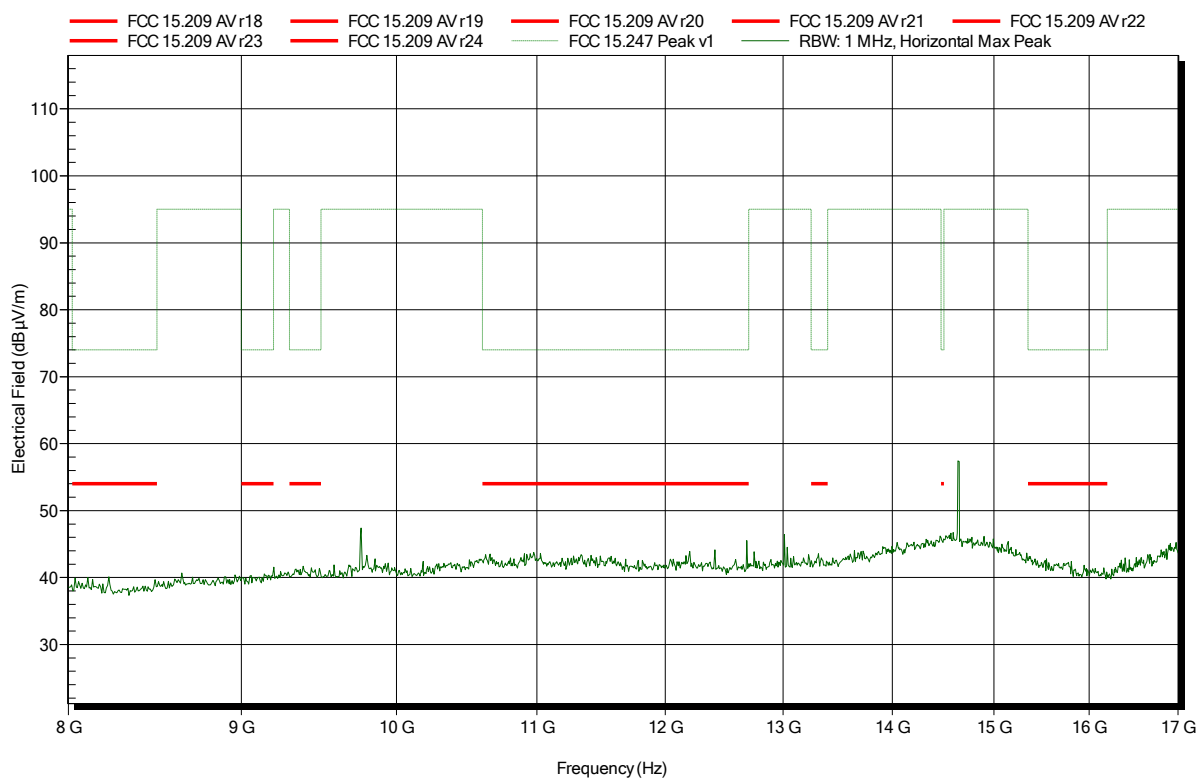
Frequency	Peak	Peak Limit	Peak Difference	Peak Status
7.321 GHz	54.92 dBµV/m	74 dBµV/m	-19.08 dB	Pass
Frequency	RMS	RMS Limit	RMS Difference	RMS Status
7.321 GHz	52.13 dBµV/m	54 dBµV/m	-1.87 dB	Pass

Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2440 MHz
 Test Date: 2019-04-24
 Note:

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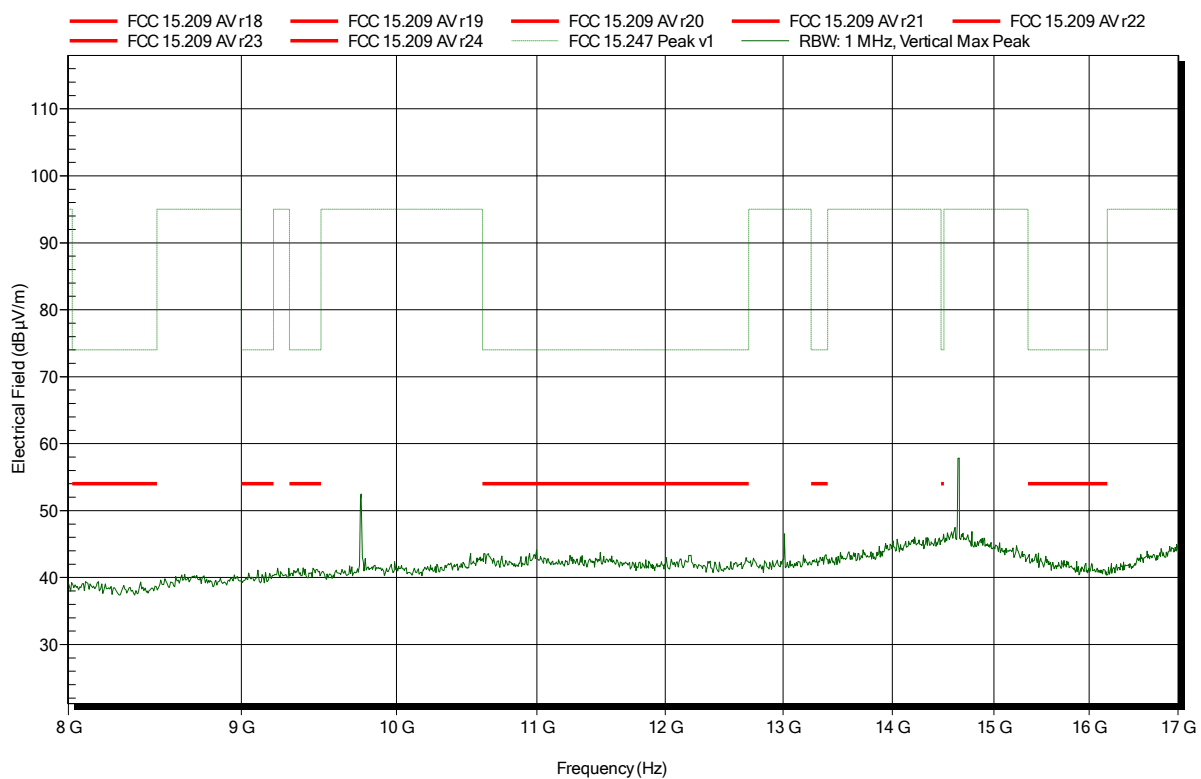


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2440 MHz
Test Date: 2019-04-24
Note:

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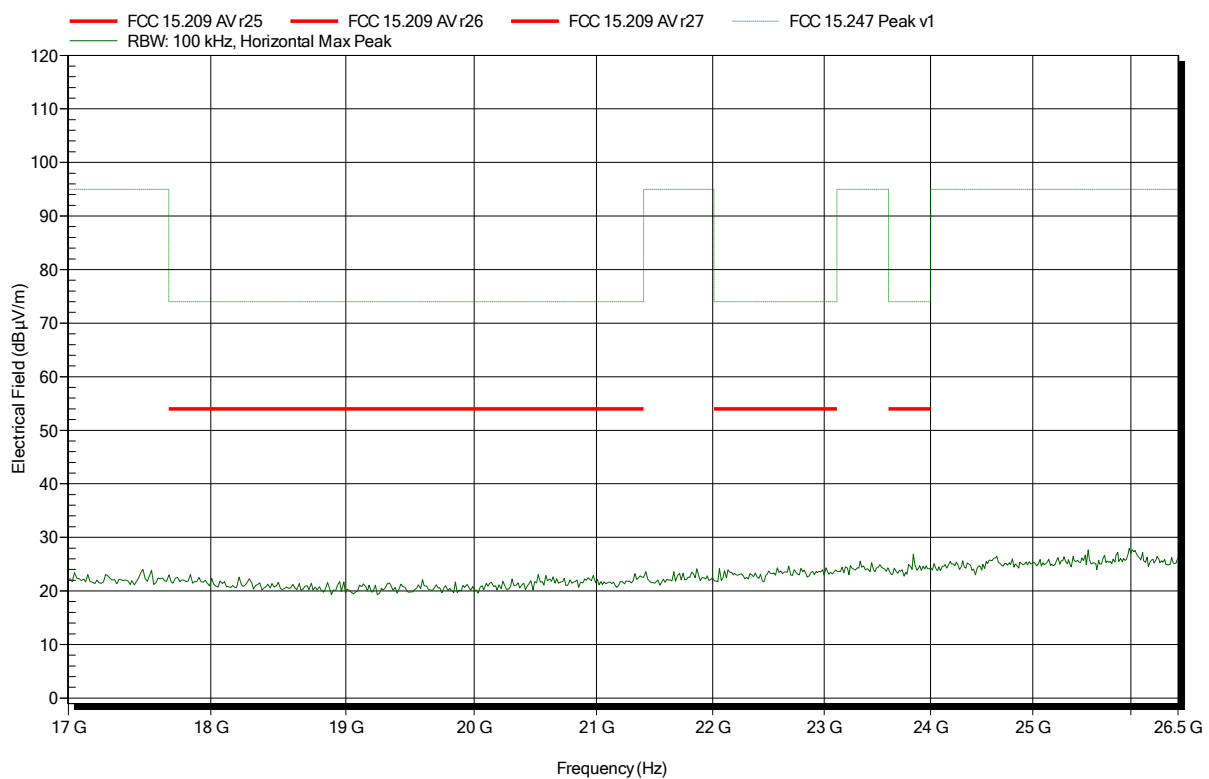


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Amplifier Research AT4560, Horizontal
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2440 MHz
Test Date: 2019-04-24
Note:

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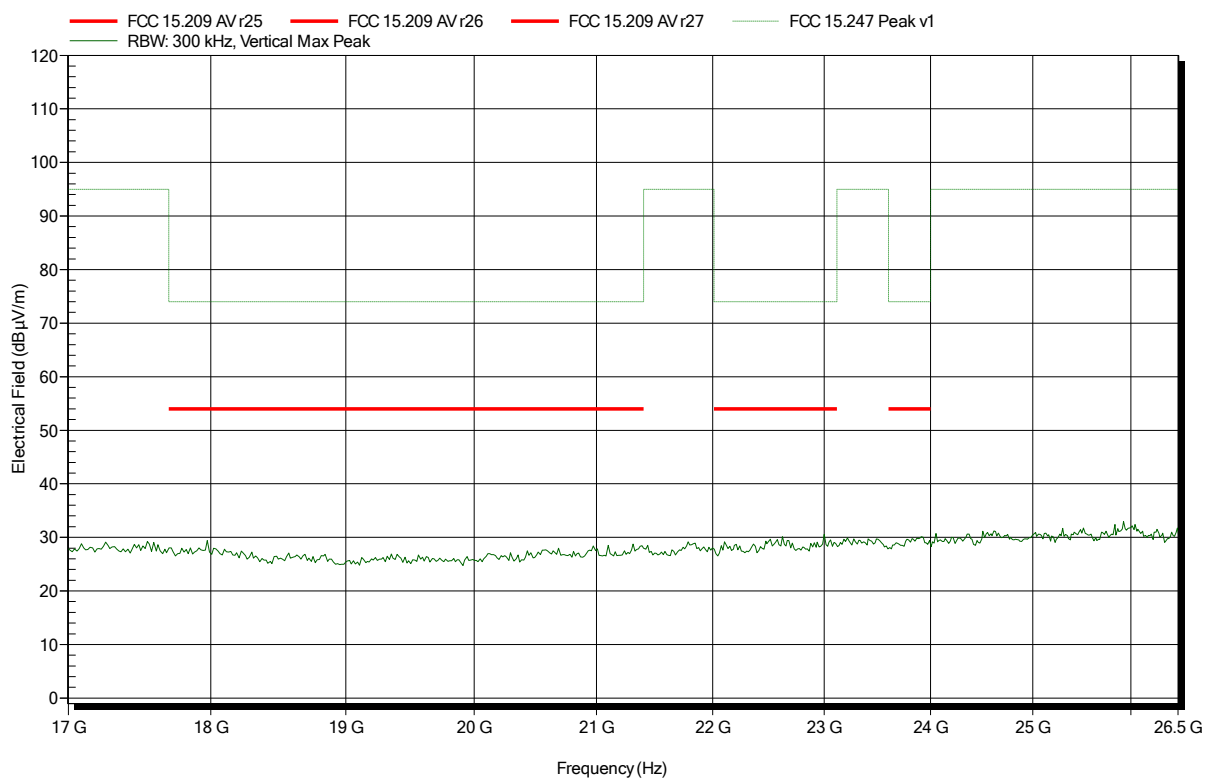


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Amplifier Research AT4560, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2440 MHz
Test Date: 2019-04-24
Note:

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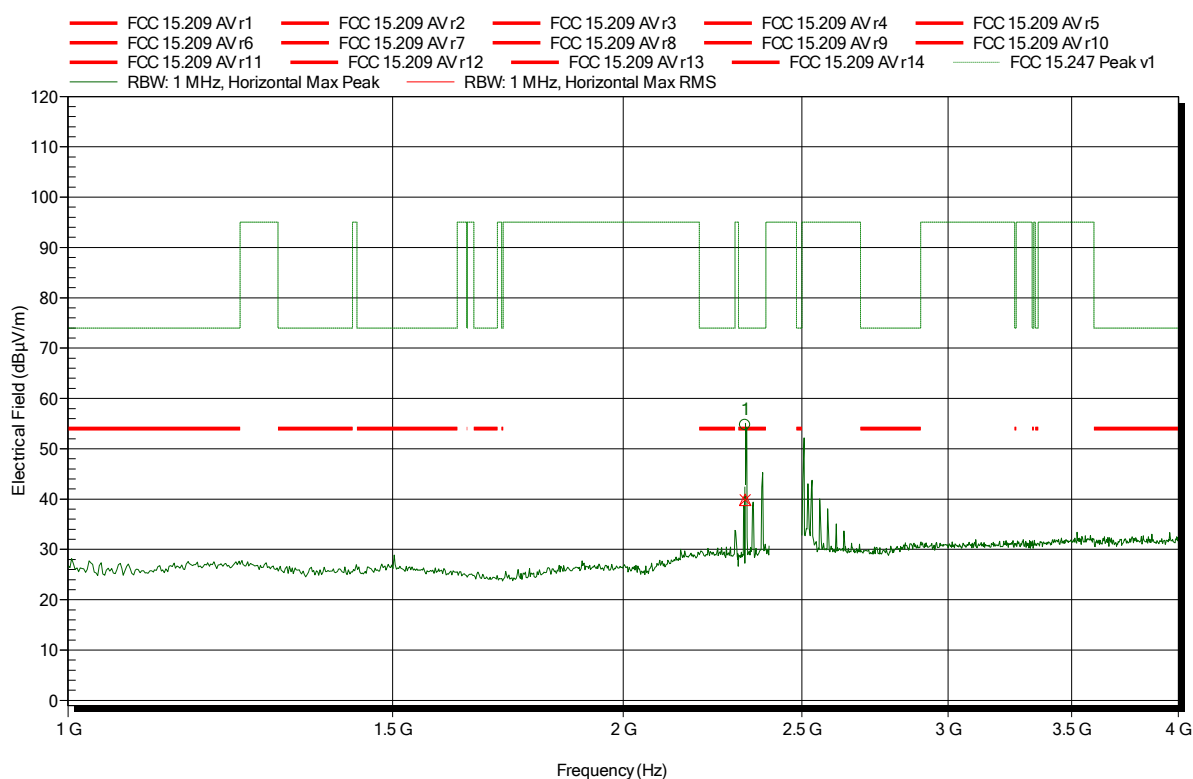


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2480 MHz
 Test Date: 2019-04-25
 Note:

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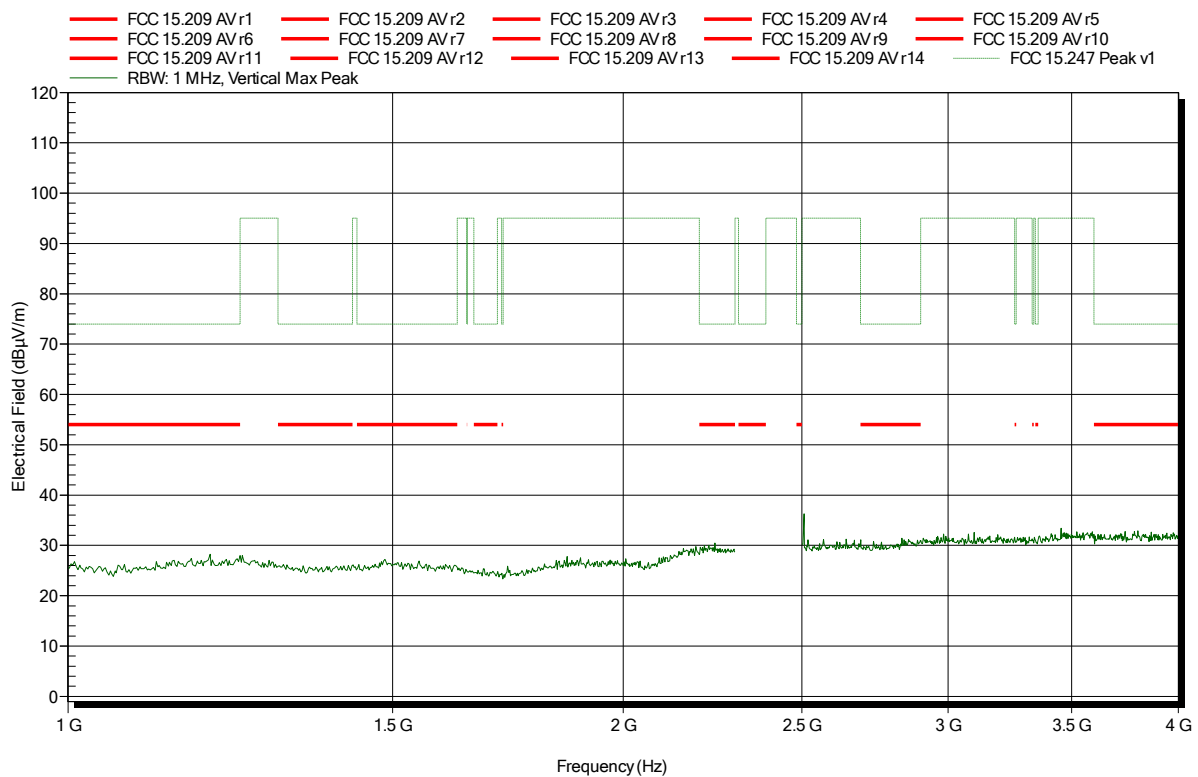
Frequency	Peak	Peak Limit	Peak Difference	Peak Status
2.33 GHz	54.74 dBµV/m	74 dBµV/m	-19.26 dB	Pass
Frequency	RMS	RMS Limit	RMS Difference	RMS Status
2.33 GHz	39.86 dBµV/m	54 dBµV/m	-14.14 dB	Pass

Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2480 MHz
Test Date: 2019-04-25
Note:

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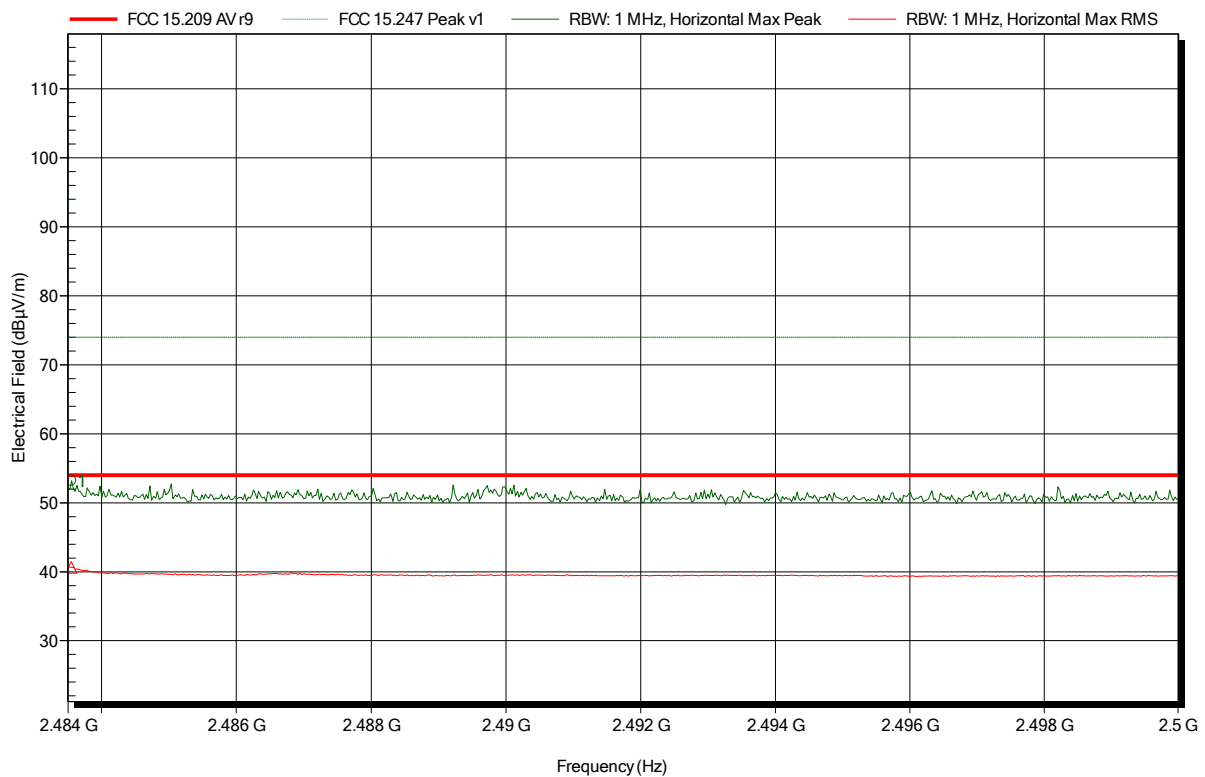


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2480 MHz
 Test Date: 2019-04-25
 Note: upper bandedge

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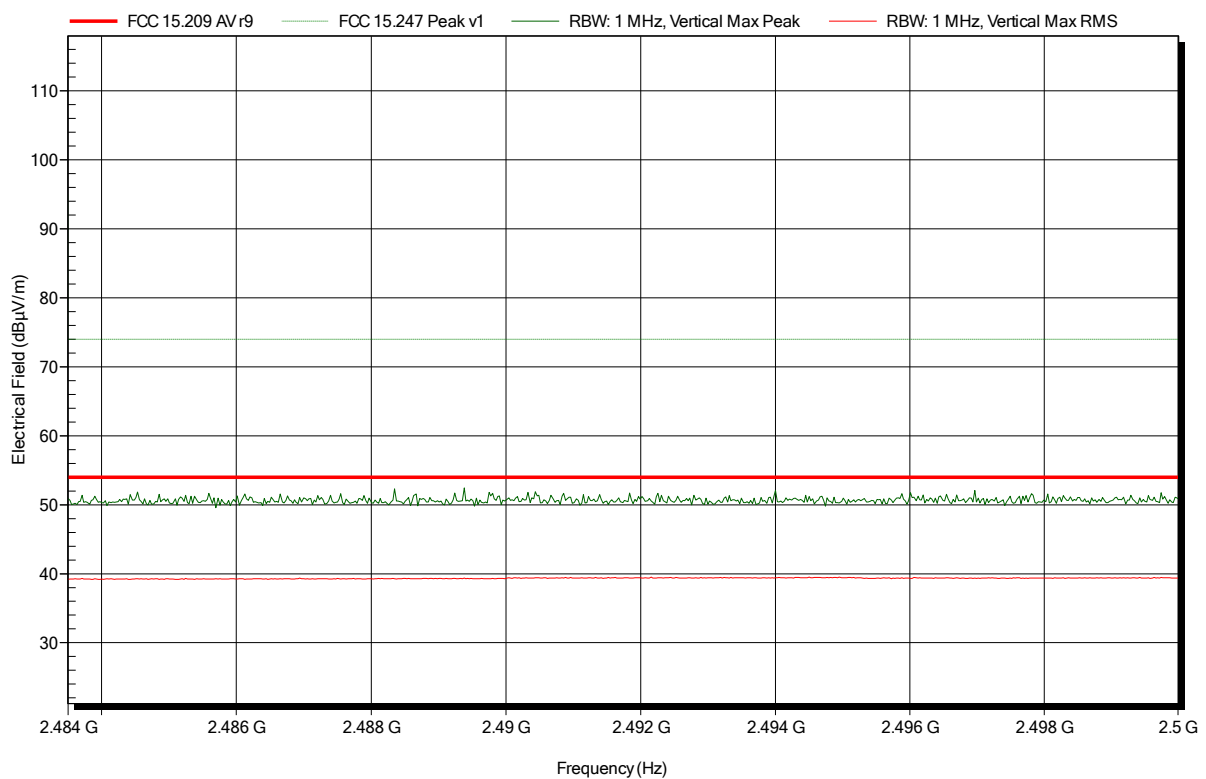
Frequency	Peak	Peak Limit	Peak Difference	Peak Status
2.4836 GHz	53.21 dBµV/m	74 dBµV/m	-20.79 dB	Pass
Frequency	RMS	RMS Limit	RMS Difference	RMS Status
2.4836 GHz	40.64 dBµV/m	54 dBµV/m	-13.36 dB	Pass

Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2480 MHz
Test Date: 2019-04-25
Note: upper bandedge

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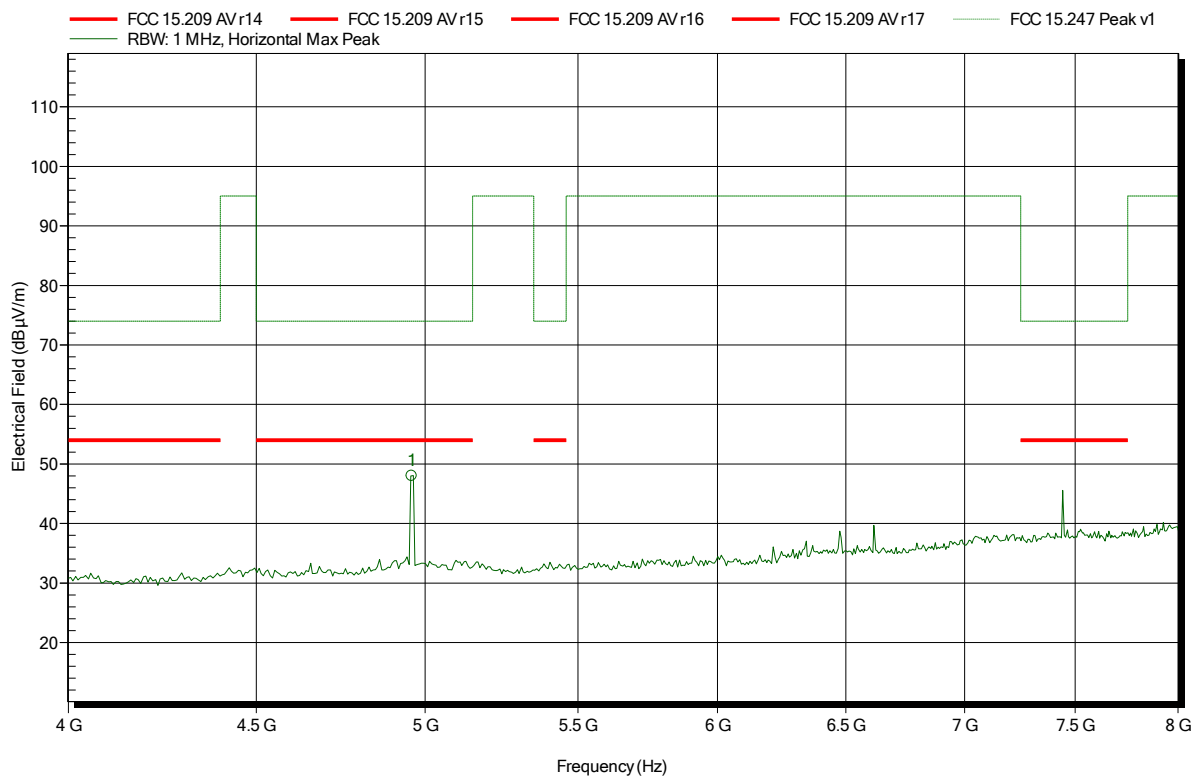


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2480 MHz
 Test Date: 2019-04-25
 Note:

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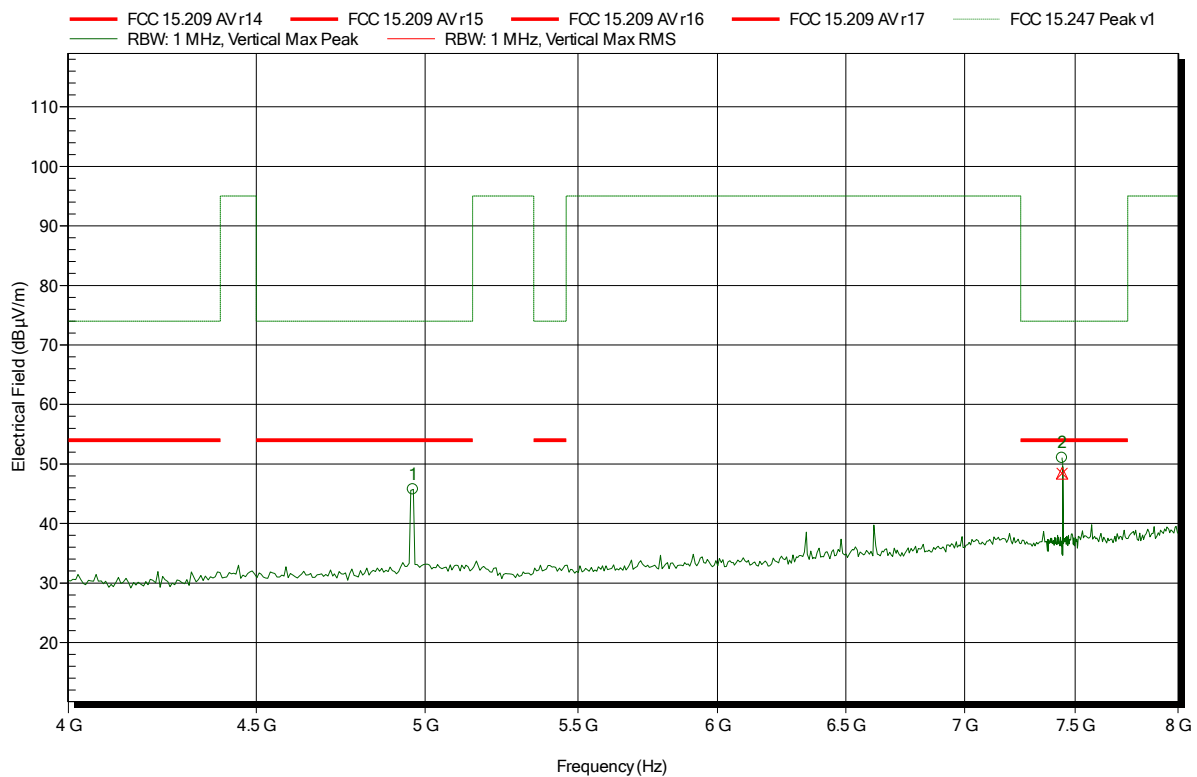
Frequency	Peak	Peak Limit	Peak Difference	Peak Status
4.958 GHz	48 dBµV/m	74 dBµV/m	-26 dB	Pass

Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2480 MHz
 Test Date: 2019-04-25
 Note:

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Frequency	Peak	Peak Limit	Peak Difference	Peak Status
4.962 GHz	45.73 dBµV/m	74 dBµV/m	-28.27 dB	Pass
7.439 GHz	51.04 dBµV/m	74 dBµV/m	-22.96 dB	Pass

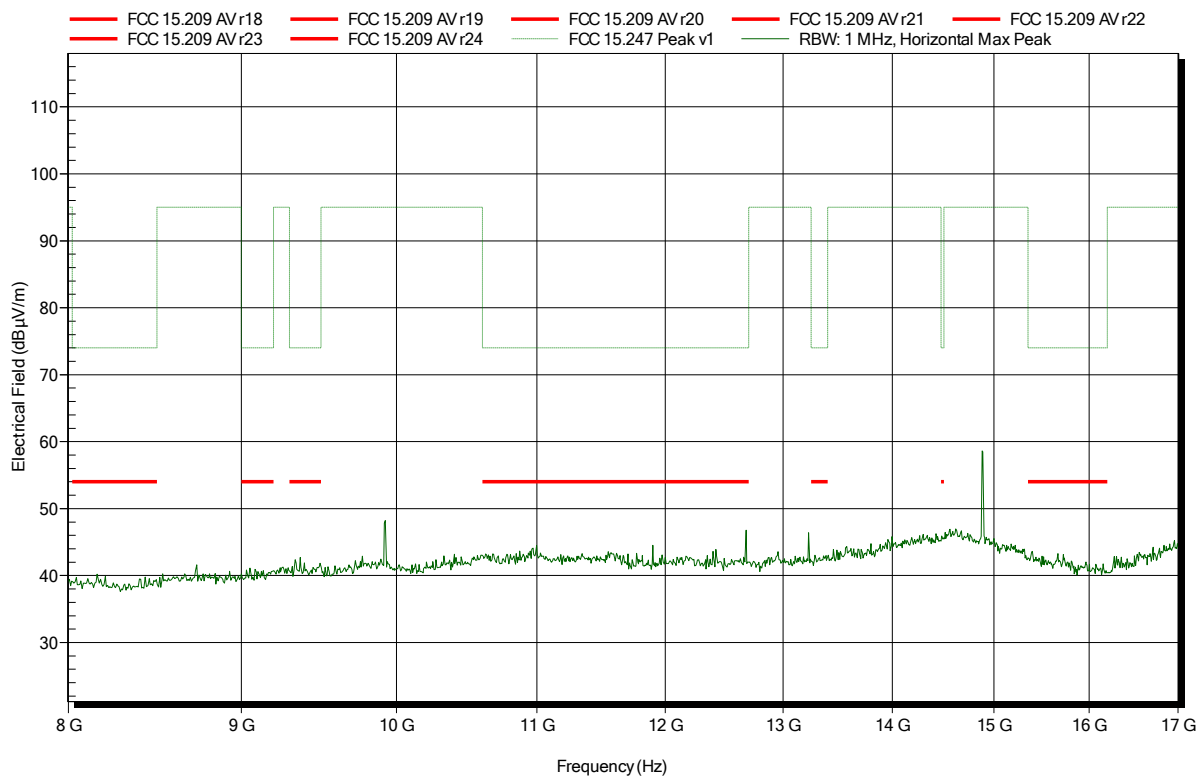
Frequency	RMS	RMS Limit	RMS Difference	RMS Status
7.439 GHz	48.4 dBµV/m	54 dBµV/m	-5.6 dB	Pass

Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2480 MHz
 Test Date: 2019-04-25
 Note:

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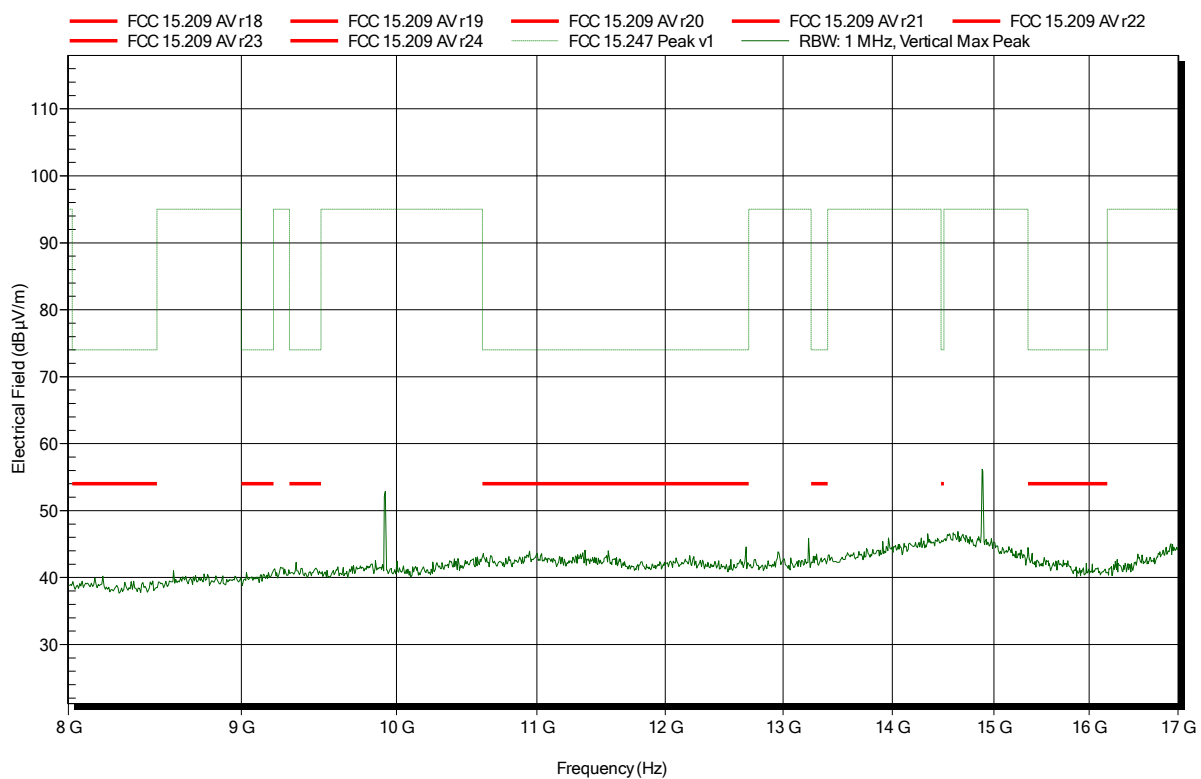


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2480 MHz
Test Date: 2019-04-25
Note:

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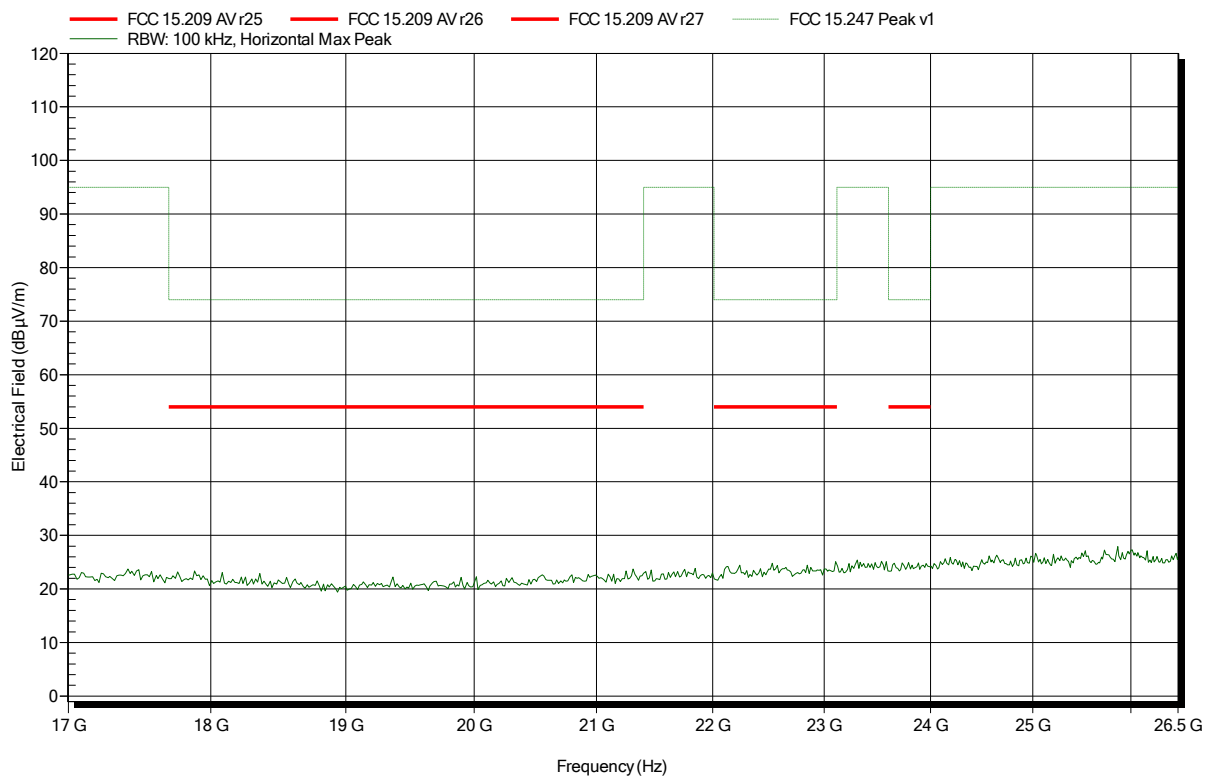


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Amplifier Research AT4560, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; BLE; 2480 MHz
 Test Date: 2019-04-25
 Note:

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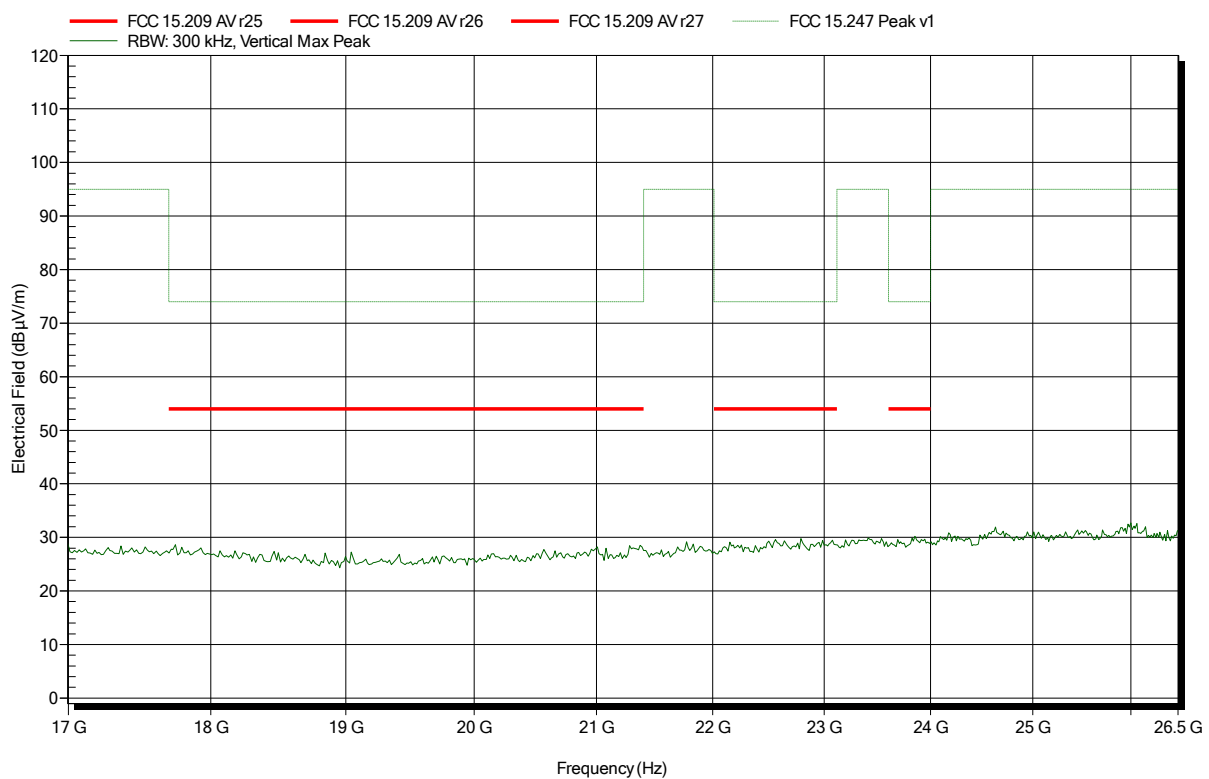


Spurious emissions according to FCC 47 e-CFR §15.247

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Amplifier Research AT4560, Vertical
Measurement distance: 1 m converted to 3m
Mode: TX; BLE; 2480 MHz
Test Date: 2019-04-25
Note:

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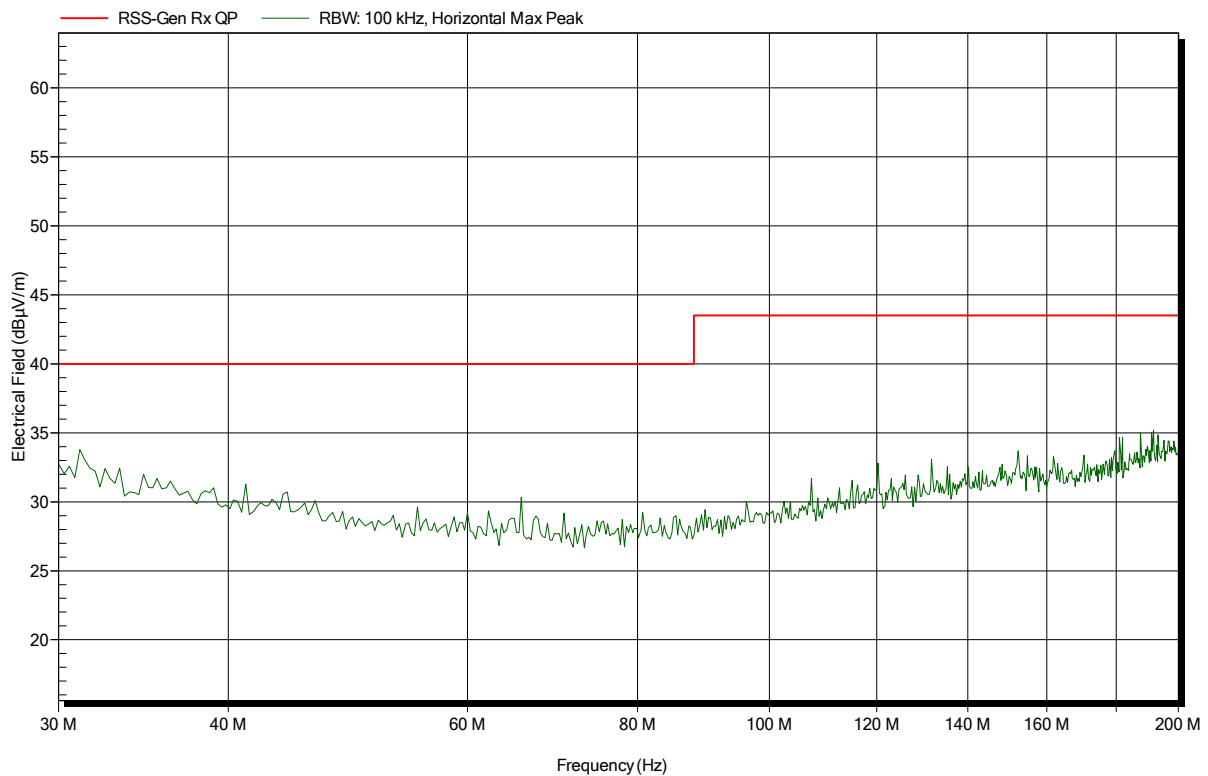
ANNEX B Receiver spurious emissions

Spurious emissions according to RSS-247 Issue 2

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Rohde & Schwarz HK 116, Horizontal
 Measurement distance: 3 m
 Mode: RX; BLE; 2440 MHz
 Test Date: 2019-04-25
 Note:

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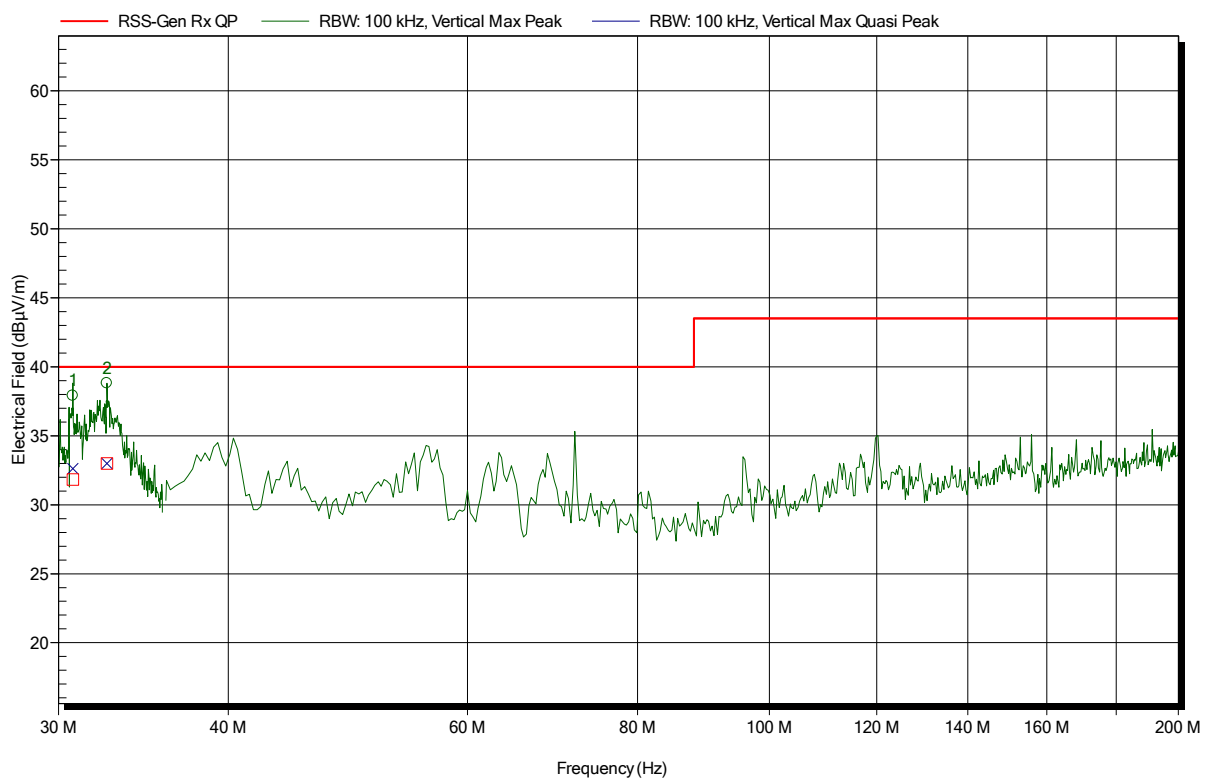


Spurious emissions according to RSS-247 Issue 2

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Rohde & Schwarz HK 116, Vertical
Measurement distance: 3 m
Mode: RX; BLE; 2440 MHz
Test Date: 2019-04-25
Note:

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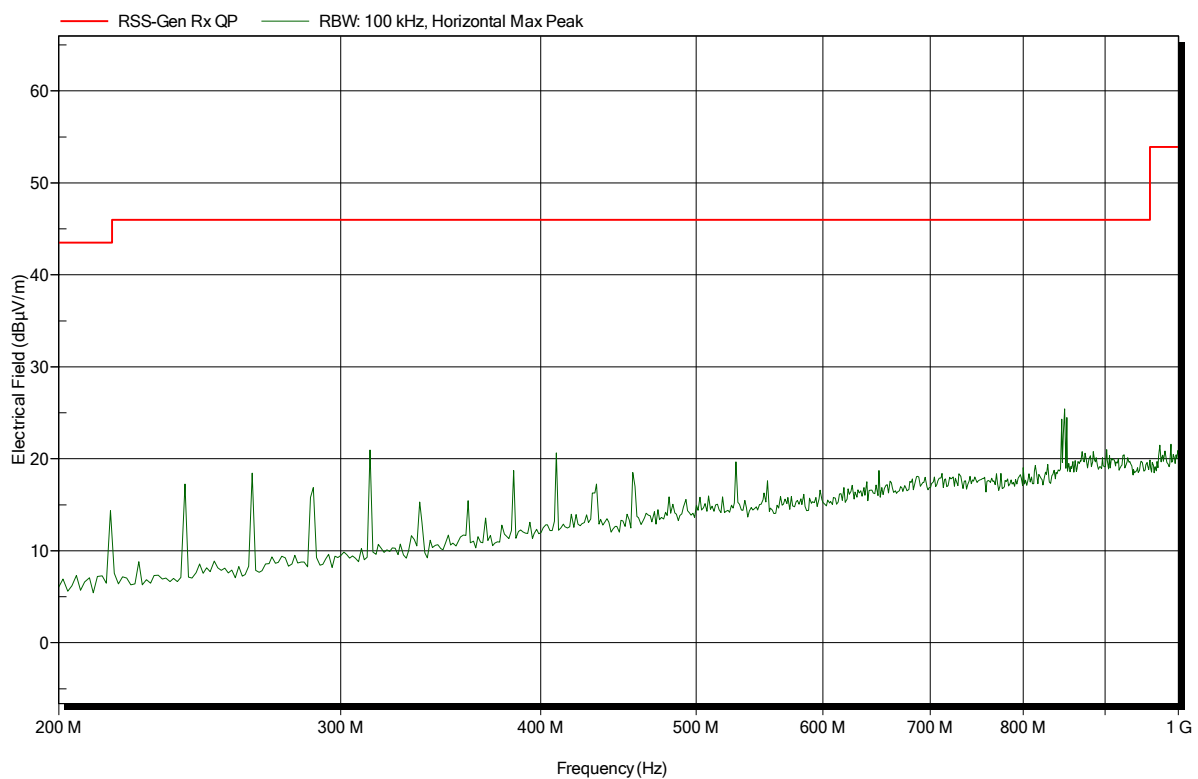
Frequency	Peak	Peak Limit	Peak Difference	Status	Angle	Height
30.742 MHz	37.9 dBμV/m	-	-	-	49 Degree	1.2 m
32.577 MHz	38.81 dBμV/m	-	-	-	4 Degree	1.2 m

Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
30.742 MHz	31.83 dBμV/m	40 dBμV/m	-8.17 dB	Pass	49 Degree	1.2 m
32.577 MHz	32.98 dBμV/m	40 dBμV/m	-7.02 dB	Pass	4 Degree	1.2 m

Spurious emissions according to RSS-247 Issue 2

Project number: G0M-1902-8046
 Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Rohde & Schwarz HL 223, Horizontal
 Measurement distance: 3 m
 Mode: RX; BLE; 2440 MHz
 Test Date: 2019-04-25
 Note:

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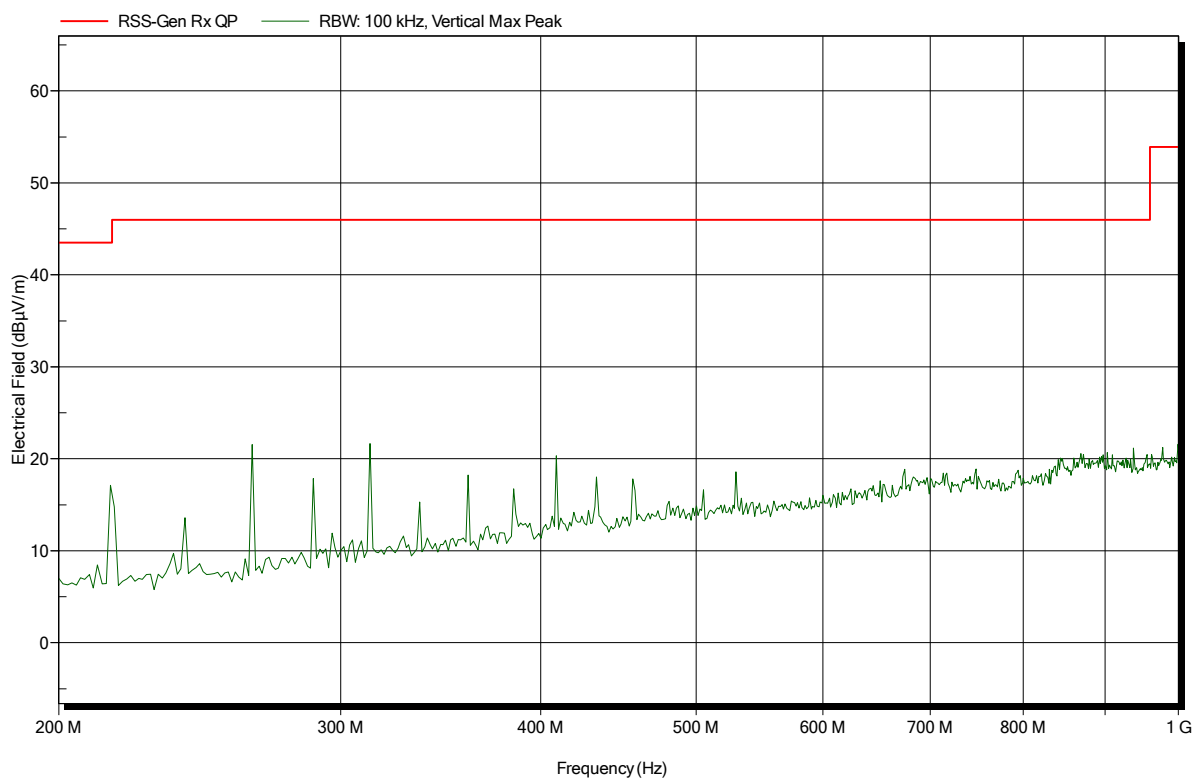


Spurious emissions according to RSS-247 Issue 2

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Rohde & Schwarz HL 223, Vertical
 Measurement distance: 3 m
 Mode: RX; BLE; 2440 MHz
 Test Date: 2019-04-25
 Note:

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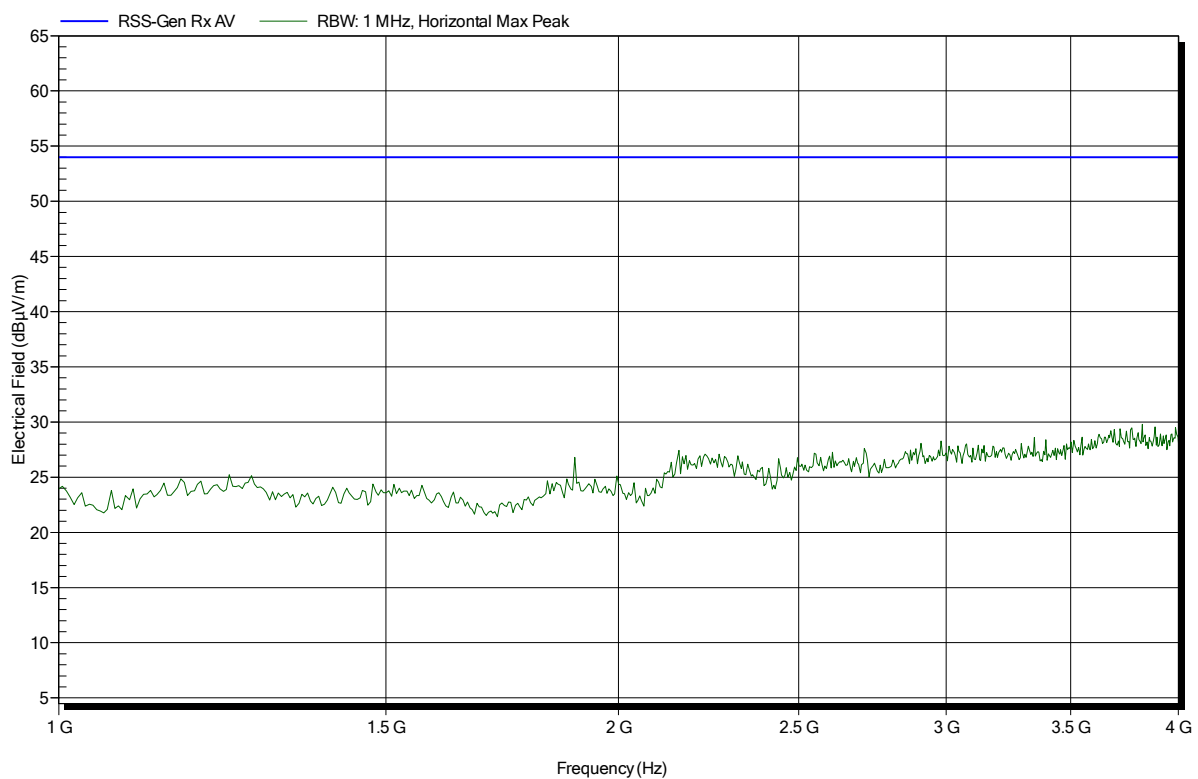


Spurious emissions according to RSS-247 Issue 2

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 1 m
 Mode: RX; BLE; 2440 MHz
 Test Date: 2019-04-25
 Note:

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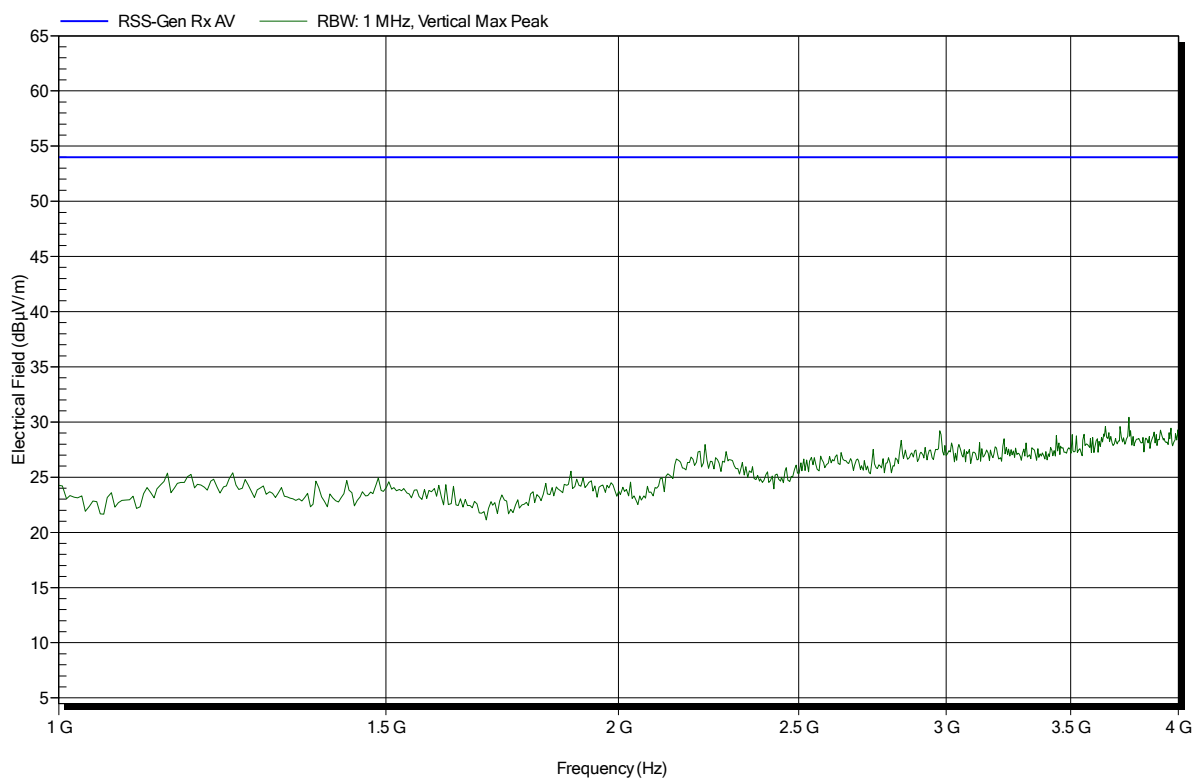


Spurious emissions according to RSS-247 Issue 2

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 1 m
 Mode: RX; BLE; 2440 MHz
 Test Date: 2019-04-25
 Note:

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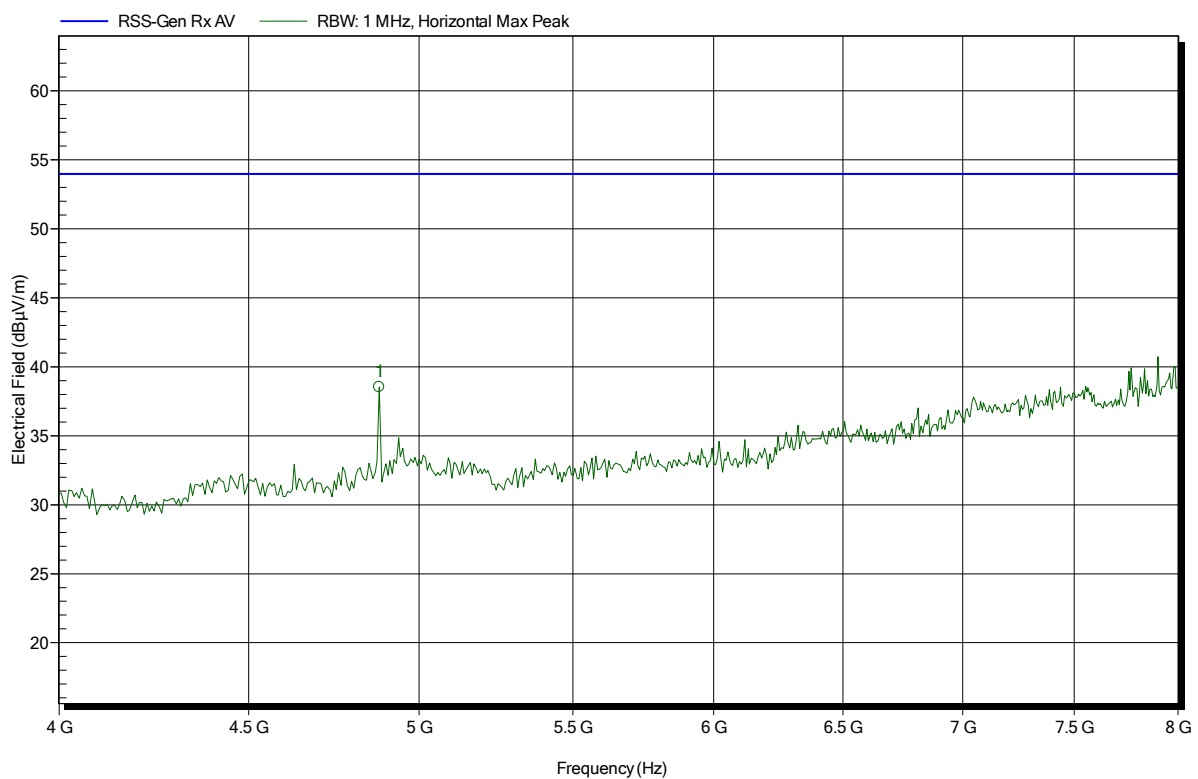


Spurious emissions according to RSS-247 Issue 2

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m
Mode: RX; BLE; 2440 MHz
Test Date: 2019-04-25
Note:

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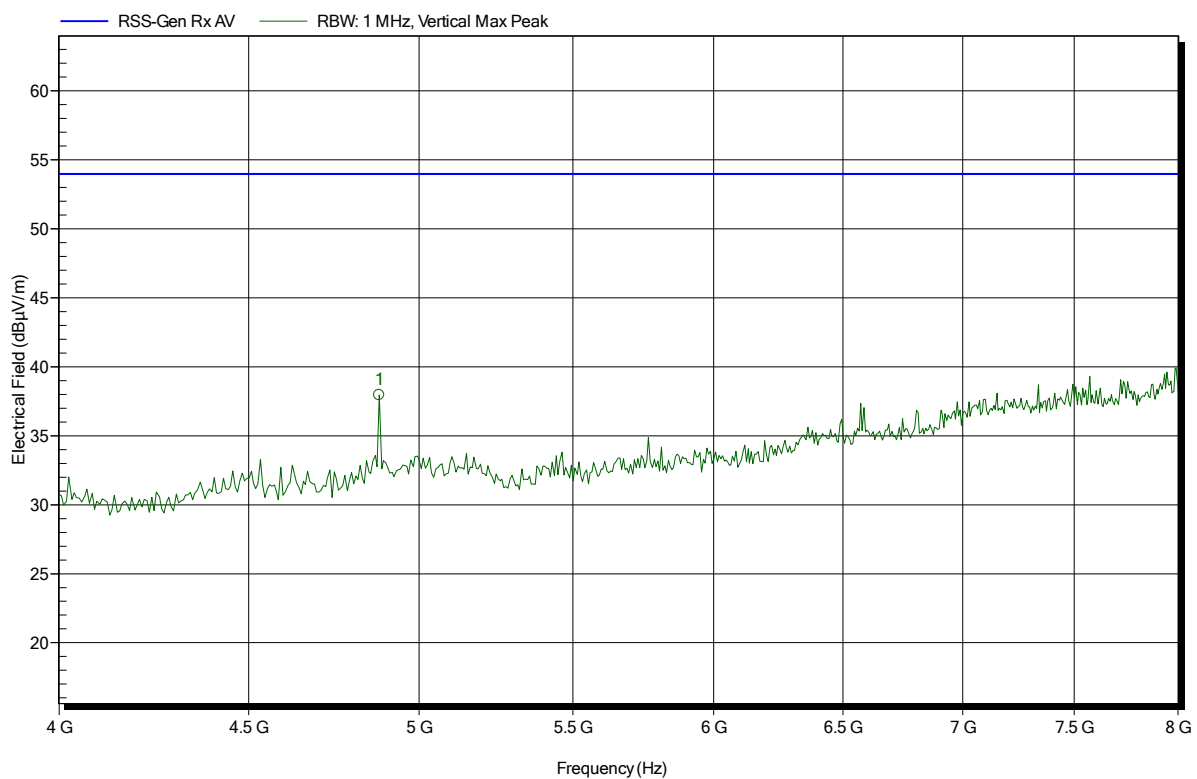
Frequency	Peak	Peak Limit	Peak Difference	Peak Status
4.878 GHz	38.52 dBµV/m	53.98 dBµV/m	-15.46 dB	Pass

Spurious emissions according to RSS-247 Issue 2

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Schwarzbeck BBHA 9120D, Vertical
Measurement distance: 1 m
Mode: RX; BLE; 2440 MHz
Test Date: 2019-04-25
Note:

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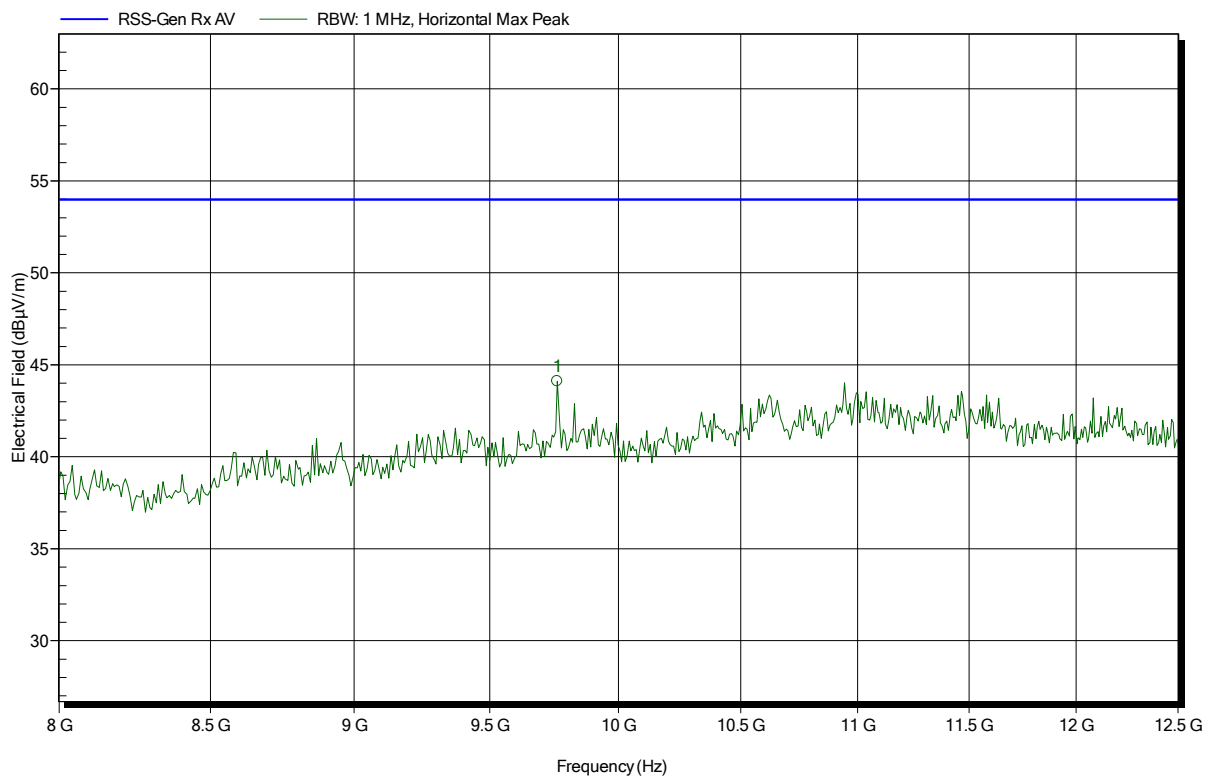
Frequency	Peak	Peak Limit	Peak Difference	Peak Status
4.878 GHz	37.94 dBµV/m	53.98 dBµV/m	-16.04 dB	Pass

Spurious emissions according to RSS-247 Issue 2

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
EUT Name: Bluetooth Low Energy Module
Model: ENW89823A5KF
Test Site: Eurofins Product Service GmbH
Operator: Wilfried Treffke
Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
Antenna: Schwarzbeck BBHA 9120D, Horizontal
Measurement distance: 1 m converted to 3m
Mode: RX; BLE; 2440 MHz
Test Date: 2019-04-25
Note:

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Frequency	Peak	Peak Limit	Peak Difference	Status
9.76 GHz	44.11 dBµV/m	53.98 dBµV/m	-9.87 dB	Pass

Spurious emissions according to RSS-247 Issue 2

Project number: G0M-1902-8046

Applicant: Panasonic Industrial Devices Europe GmbH
 EUT Name: Bluetooth Low Energy Module
 Model: ENW89823A5KF
 Test Site: Eurofins Product Service GmbH
 Operator: Wilfried Treffke
 Test Conditions: Tnom: 23°C, Vnom: 5.0 VDC (USB powered)
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 1 m converted to 3m
 Mode: RX; BLE; 2440 MHz
 Test Date: 2019-04-25
 Note:

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