

FCC TEST REPORT FCC 47 CFR Part 15C Industry Canada RSS-210 Digital transmission systems operating within the 902 – 928 MHz band	
Report Reference No.	G0M-1408-4082-TFC247DT-V03
Testing Laboratory	Eurofins Product Service GmbH
Address	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation	  A2LA Accredited Testing Laboratory, Certificate No.: 1983.01 FCC Filed Test Laboratory, Reg.-No.: 96970 IC OATS Filing assigned code: 3470A
Applicant's name	Kamstrup A/S
Address	Industrivej 28 8660 Skanderborg DENMARK
Test specification:	
Standard	47 CFR Part 15C KDB Publication No. 558074 D01 v03r02 RSS-210, Issue 8, 2010-12 RSS-Gen, Issue 3, 2010-12 ANSI C63.4:2009
Equipment under test (EUT):	
Product description	flowIQ 2100
Model No.	flowIQ 2100
Additional Model(s)	None
Brand Name(s)	None
Hardware version	5550 1367 + 55501379 + 55501350
Firmware / Software version	For pcb 55501379, where radio is located: SW : 50981053 A1, Eeprom config : 55141060; For pcb 55501367, where the piezo for flow calculation is placed: SW : 50981101 A1 FCC-ID: OUY-FLOW2100 IC: N/A
Test result	Passed

Possible test case verdicts:

- neither assessed nor tested : N/N
- required by standard but not appl. to test object..... : N/A
- required by standard but not tested..... : N/T
- not required by standard for the test object : N/R
- 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 : 2014-09-08

Date (s) of performance of tests : 2014-09-08

Compiled by : Wilfried Treffke

Tested by (+ signature)..... : Wilfried Treffke

(Responsible for Test)

Approved by (+ signature) : Christian Weber

Date of issue : 2014-11-25

Total number of pages : 32

W. Treffke

C. Weber

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:

Partial test for Class II Permissive change according to permissive change letter

Version History

Version	Issue Date	Remarks	Revised by
01	2014-11-10	Initial Release	
02	2014-11-11	Replaced document: G0M-1408-4082-TFC247DT-V01 Replaced by: G0M-1408-4082-TFC247DT-V02 Changes : Radio type and test modes corrected	C. Weber
03	2014-11-24	Replaced document: G0M-1408-4082-TFC247DT-V02 Replaced by: G0M-1408-4082-TFC247DT-V03 Changes : unintentional radiation compliance added	C. Weber

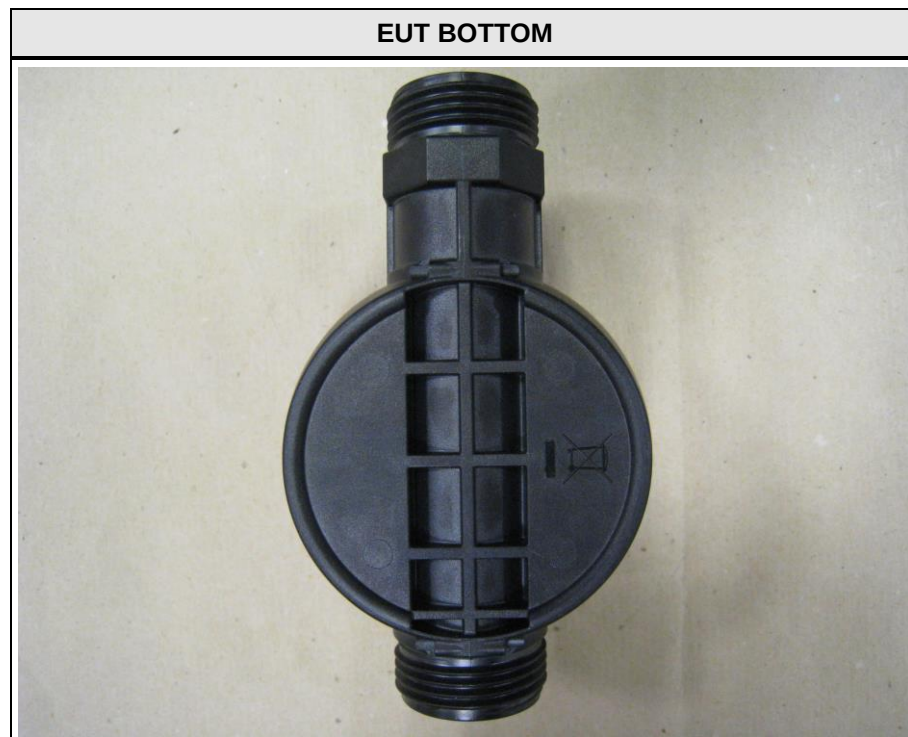
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1 Equipment (Test item) Description

Description	flowIQ 2100	
Model	flowIQ 2100	
Additional Model(s)	None	
Brand Name(s)	None	
Serial number	None	
Hardware version	5550 1367 + 55501379 + 55501350	
Software / Firmware version	For pcb 55501379, where radio is located: SW : 50981053 A1, Eeprom config : 55141060; For pcb 55501367, where the piezo for flow calculation is placed: SW : 50981101 A1	
FCC-ID	OUI-FLOW2100	
IC	N/A	
Equipment type	End product	
Radio type	Transmitter only	
Radio technology	custom	
Operating frequency range	915 MHz	
Assigned frequency band	902 - 928 MHz	
Frequency range	F _{MID}	915 MHz
Spreading	None	
Modulations	2FSK	
Number of channels	1 Channel	
Channel spacing	None	
Number of antennas	1	
Antenna	Type	integrated
	Model	PCB antenna 55501350
	Manufacturer	Kamstrup
	Gain	-1.2 dBi
Manufacturer	Kamstrup A/S Industrivej 28 8660 Skanderborg DENMARK	
Power supply	V _{NOM}	3.6 VDC lithium battery
	V _{MIN}	N/A
	V _{MIN}	N/A
AC/DC-Adaptor	Model	N/A
	Vendor	N/A
	Input	N/A
	Output	N/A

1.1 Photos – Equipment External



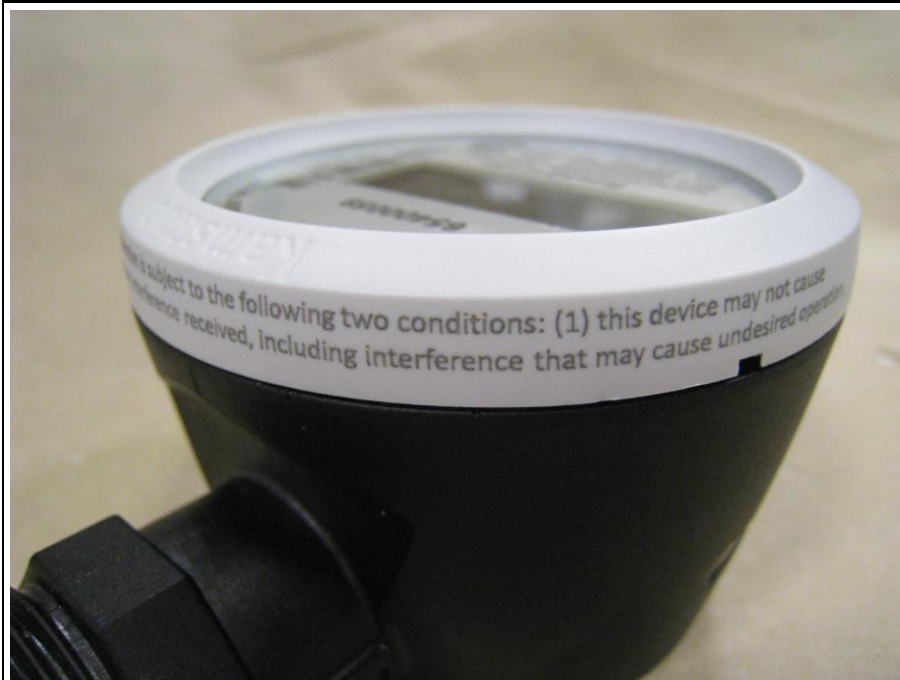
Test Report No.: GOM-1408-4082-TFC247DT-V03

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

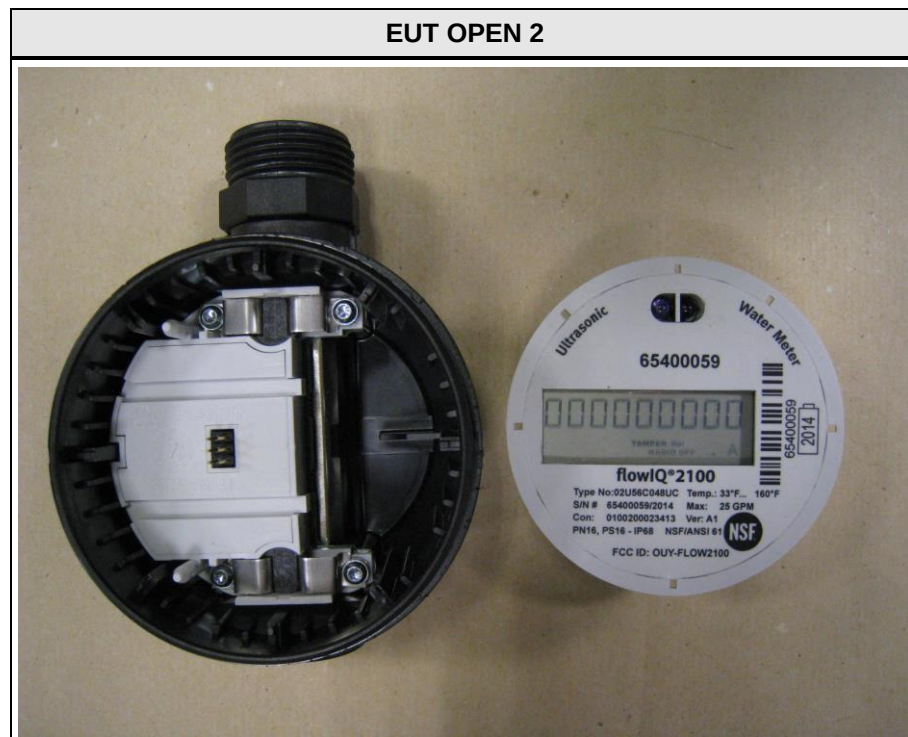
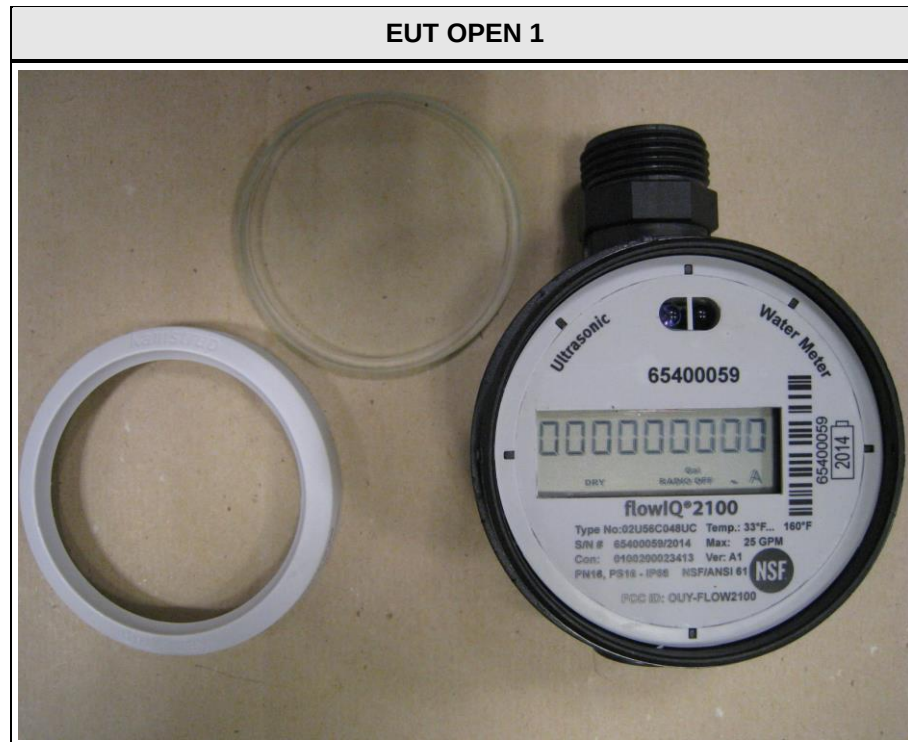
EUT LEFT



EUT RIGHT



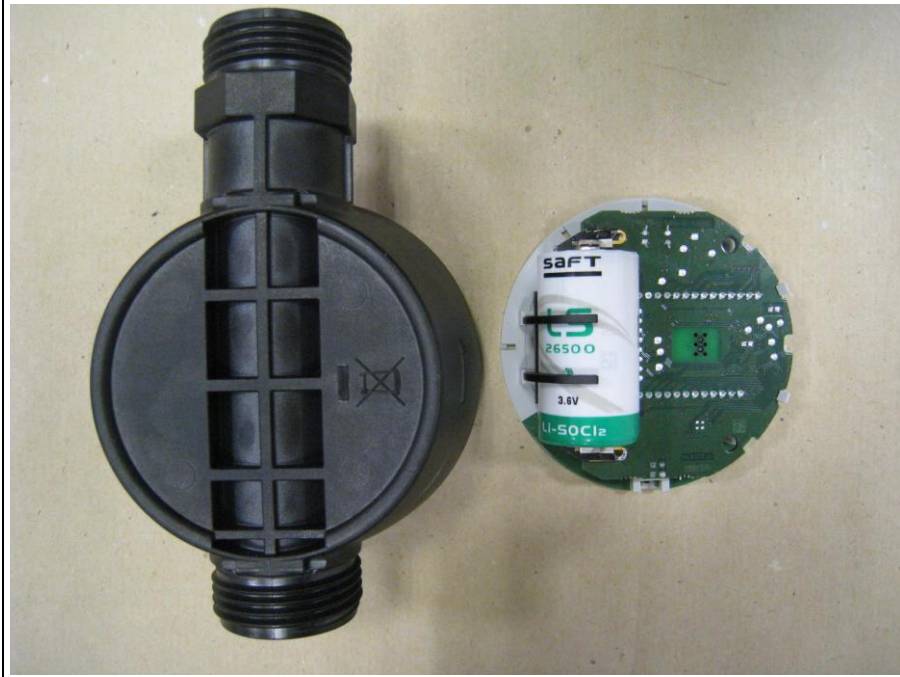
1.2 Photos – Equipment internal



Test Report No.: G0M-1408-4082-TFC247DT-V03

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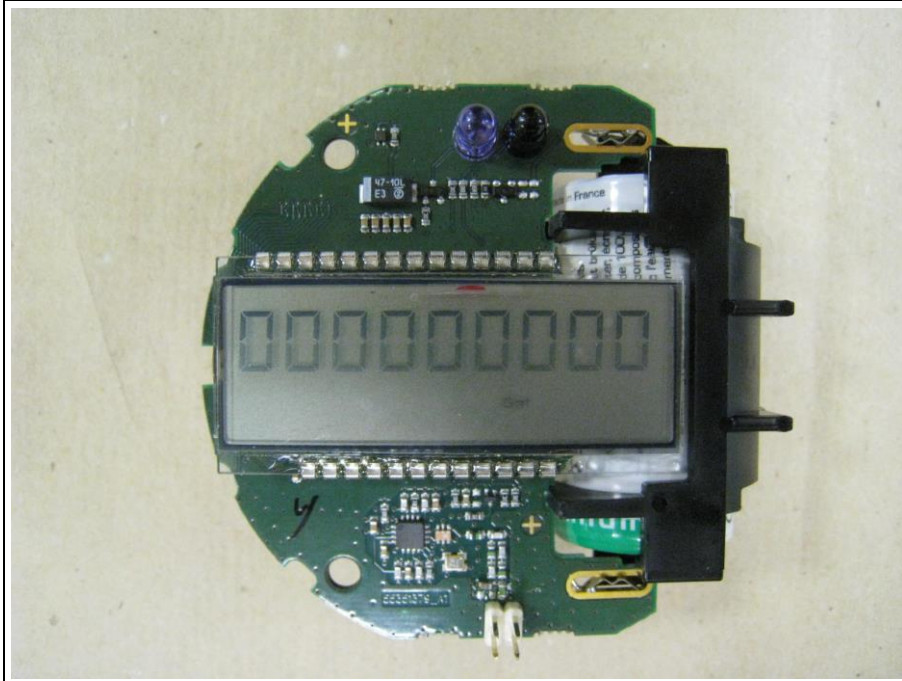
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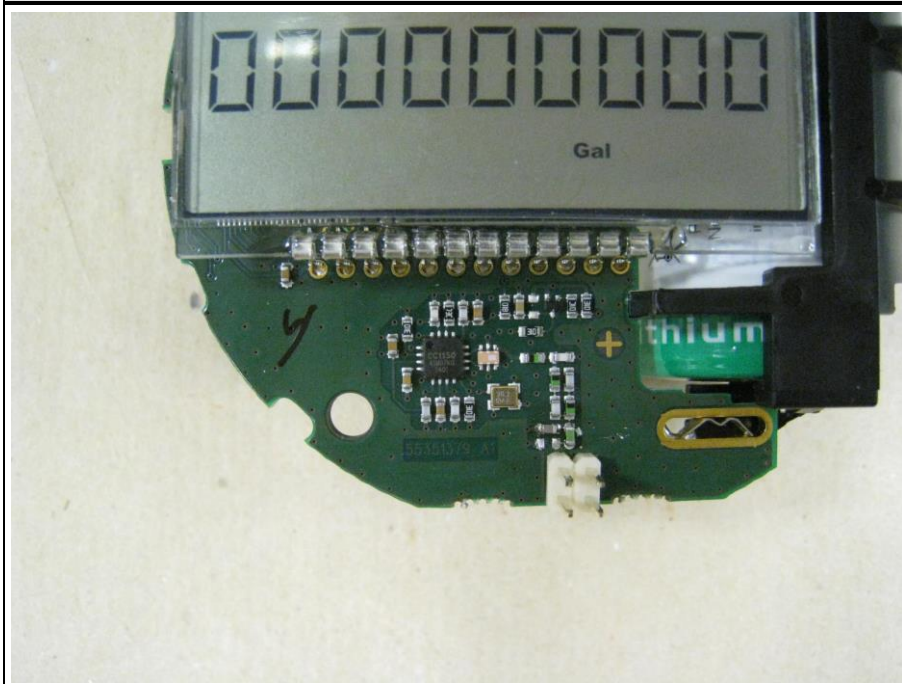
EUT OPEN 4



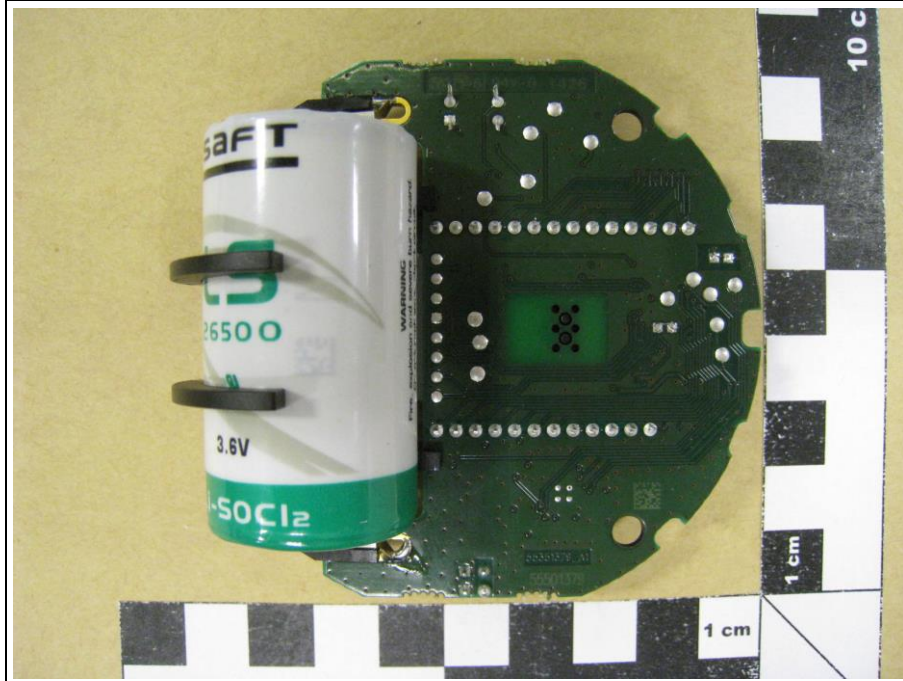
PCB TOP



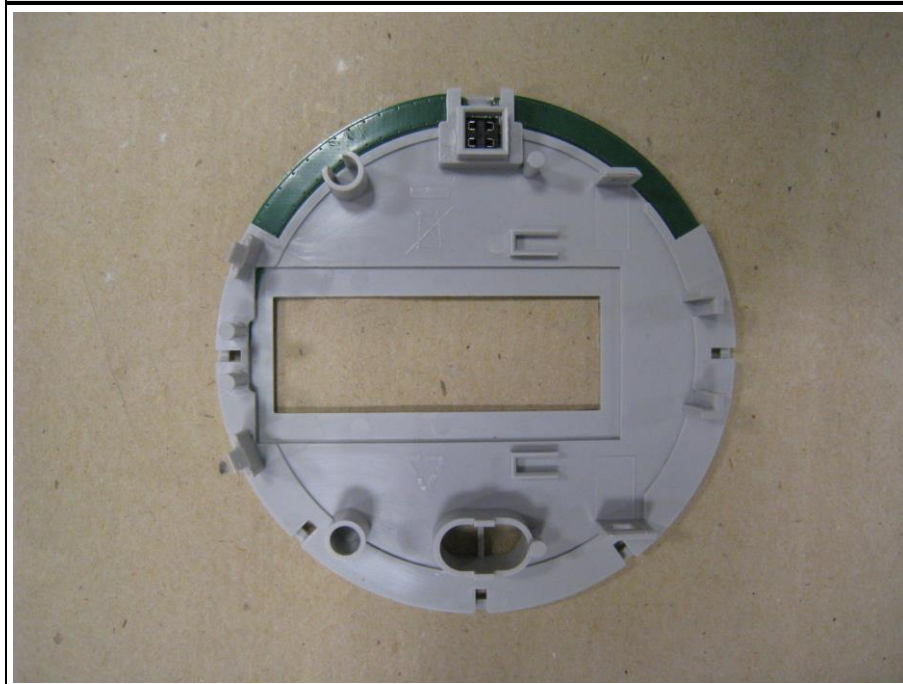
PCB RF-PART



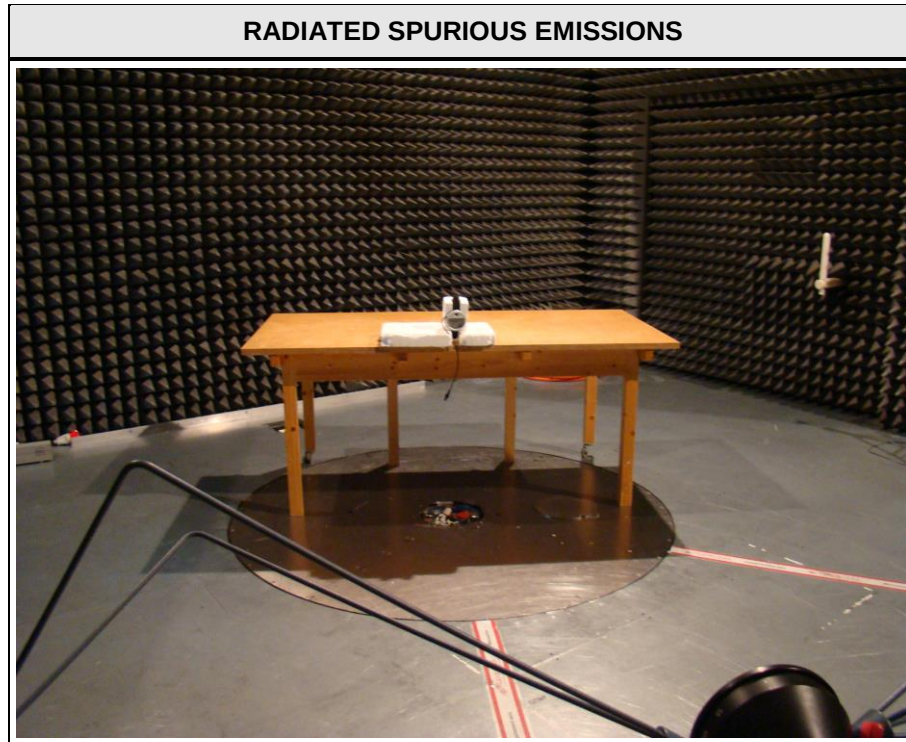
PCB BOTTOM



PCB ANTENNA



1.3 Photos – Test setup



1.4 Supporting Equipment Used During Testing

Product Type*	Device	Manufacturer	Model No.	Comments
None				
*Note: Use the following abbreviations: AE : Auxiliary/Associated Equipment, or SIM : Simulator (Not Subjected to Test) CABL : Connecting cables				

1.5 Test Modes

Mode #	Description	
Single	General conditions:	EUT powered by battery
	Radio conditions:	Mode = standalone transmit Spreading = None Modulation = FSK Duty cycle = 10 % Power level = Maximum

1.6 Test Equipment Used During Testing

Measurement Software			
Description	Manufacturer	Name	Version
EMC Test Software	Dare Instruments	Radimation	2014.1.15

Maximum peak conducted power					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSP 30	EF00312	2014-02	2015-02

Radiated spurious emissions					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Semi-anechoic chamber	Frankonia	AC 1	EF00062	2013-01	2015-01
Spectrum Analyzer	R&S	FSIQ26	EF00242	2014-03	2015-03
Biconical Antenna	R&S	HK 116	EF00012	2013-02	2016-02
LPD Antenna	R&S	HL 223	EF00187	2014-03	2017-03
LPD Antenna	R&S	HL 025	EF00327	2013-02	2016-02

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:

$$\begin{array}{rclcl} \text{Reading} & + & \text{AF} & = & \text{Net Reading} & : & \text{Net reading - FCC limit} & = & \text{Margin} \\ 21.5 \text{ dB}\mu\text{V} & + & 26 \text{ dB} & = & 47.5 \text{ dB}\mu\text{V/m} & : & 47.5 \text{ dB}\mu\text{V/m} - 57.0 \text{ dB}\mu\text{V/m} & = & -9.5 \text{ dB} \end{array}$$

2 Result Summary

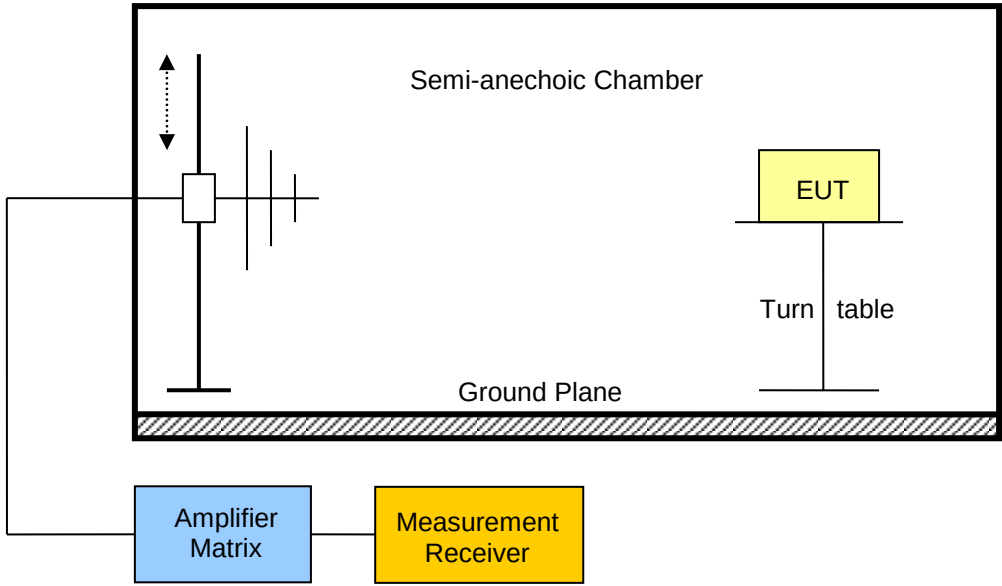
FCC 47 CFR Part 15C, IC RSS-210				
Product Specific Standard Section	Requirement – Test	Reference Method	Result	Remarks
RSS-Gen 4.6.1	Occupied Bandwidth	RSS-Gen 4.6.1	N/N	
FCC § 15.247(a)(2) IC RSS-210 § A8.2	6 dB Bandwidth	KDB Publication No. 558074	N/N	
FCC § 15.247(b)(3) IC RSS-210 § A8.4	Maximum peak conducted power	KDB Publication No. 558074	PASS	
FCC § 15.247(e) IC RSS-210 § A8.2	Power spectral density	KDB Publication No. 558074	N/N	
47 CFR 15.207 RSS-Gen 7.2.4	AC power line conducted emissions	KDB Publication No. 558074 / ANSI C63.4	N/N	
FCC § 15.247(d) IC RSS-210 § A8.5	Band edge compliance	KDB Publication No. 558074	N/N	
FCC § 15.247(d) IC RSS-210 § A8.5	Conducted spurious emissions	KDB Publication No. 558074	N/N	
FCC § 15.247(d) FCC § 15.209 FCC § 15.109 IC RSS-210 A8.5 IC RSS-Gen 4.9 IC RSS-Gen 7.2.5	Transmitter radiated spurious emissions	KDB Publication No. 558074 / ANSI C 63.4	PASS	
IC RSS-Gen 4.10 IC RSS-Gen 6.1	Receiver radiated spurious emissions	ANSI C 63.4	N/N	
Remarks: Test selection for Class II Permissive change according to permissive change letter. The radiated emission measurements cover the intentional and unintentional radiator parts of the EUT.				

3 Test Conditions and Results

3.1 Test Conditions and Results – Maximum peak conducted power

Maximum peak conducted power acc. to FCC 15.247 / IC RSS-210					Verdict: PASS		
EUT requirement rule parts and clause		Reference					
		FCC 15.247(b)(3) / IC RSS-210 A8.4					
Test according to measurement reference		Reference Method					
		FCC KDB Publication No. 558074					
Test frequency range		Tested frequencies					
		F _{MID}					
EUT test mode		Single					
Measurement mode		Peak					
Maximum antenna gain		-1.2 dBi ⇒ Limit correction = 0 dB					
Limits							
1W (30dBm)							
The conducted output power limit specified above is based on the use of antennas with directional gains that do not exceed 6dBi. If transmitting antennas of directional gain greater than 6dBi 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 6dBi.							
Test setup							
Spectrum Analyzer EUT							
Test procedure							
1. EUT set to test mode (Communication tester is used if needed) 2. Center frequency set to test channel center frequency 3. Span is set to be larger than the 6 dB bandwidth and RBW is set to be at least the 6 dB bandwidth 4. Peak output power is determined from the maximum of the emission envelope							
Test results							
Channel	Frequency [MHz]	Voltage	Peak power [dbm]	Peak power [W]	Limit [dBm]	Margin [dB]	Result
F _{MID}	915	3.6 VDC	8.6	0.01	30	-21.4	PASS
Comments:							

3.2 Test Conditions and Results – Transmitter radiated emissions

Transmitter radiated emissions acc. to FCC 47 CFR 15.247 / IC RSS-210				Verdict: PASS
Test according referenced standards	Reference Method			
	FCC 15.247(d) / FCC 15.109 / FCC 15.209 / IC RSS-210 A8.5			
Test according to measurement reference	Reference Method			
	FCC KDB Publication No. 558074 / ANSI C63.4			
Test frequency range	Tested frequencies			
	30 MHz – 10 th Harmonic			
EUT test mode	Single			
Limits				
Frequency range [MHz]	Detector	Limit [µV/m]	Limit [dBµV/m]	Limit Distance [m]
30 – 88	Quasi-Peak	100	40	3
88 – 216	Quasi-Peak	150	43.5	3
216 – 960	Quasi-Peak	200	46	3
960 – 1000	Quasi-Peak	500	54	3
> 1000	Average	500	54	3
Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)). When average radiated emission measurements are specified, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.				
Test setup				
				

Test procedure								
1. EUT set to test mode (Communication tester is used if needed) 2. Span it set according to measurement range 3. Resolution bandwidth below 1 GHz is set according to CISPR 16 with peak/quasi-peak detector and RBW of 1 MHz with peak/average detector is used above 1 GHz 4. Markers are set to peak emission levels within restricted bands								
Test results – Internal Antenna								
Channel	Frequency [MHz]	Emission [MHz]	Level [dBμV/m]	Detector	Pol.	Limit [dBμV/m]	Limit distance [m]*	Margin [dB]
F _{MID}	915	2745	48.55	pk	ver	74.00	3	-25.45
F _{MID}	915	2745	42.09	avg	ver	54.00	3	-11.91
F _{MID}	915	2746	52.51	pk	hor	74.00	3	-21.49
F _{MID}	915	2746	46.62	avg	hor	54.00	3	-07.38
F _{MID}	915	3661	51.98	pk	ver	74.00	3	-22.02
F _{MID}	915	3661	44.70	avg	ver	54.00	3	-09.30
F _{MID}	915	3661	57.71	pk	hor	74.00	3	-16.29
F _{MID}	915	3661	50.85	avg	hor	54.00	3	-03.15
F _{MID}	915	4574	47.72	pk	ver	74.00	3	-26.28
F _{MID}	915	4574	38.11	avg	ver	54.00	3	-15.89
F _{MID}	915	4576	54.45	pk	hor	74.00	3	-19.55
F _{MID}	915	4576	46.71	avg	hor	54.00	3	-07.29
Comments: * Physical distance between EUT and measurement antenna.								

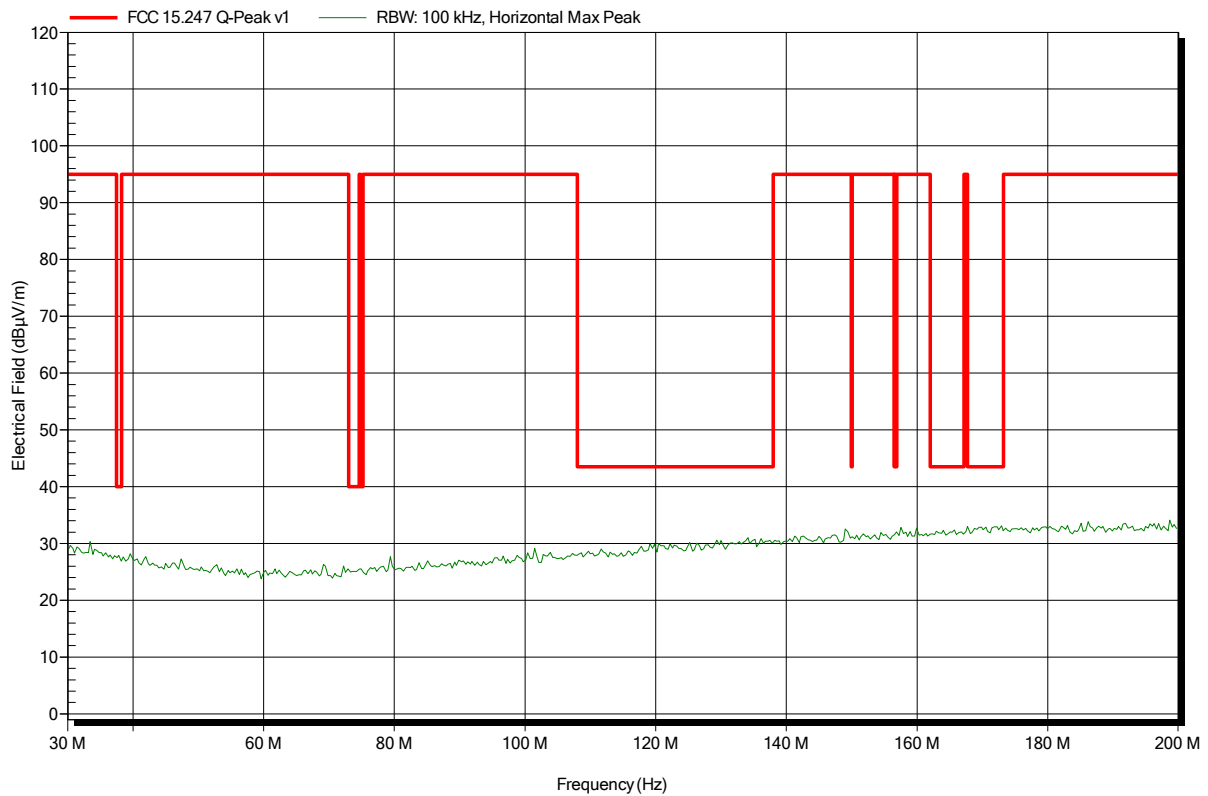
ANNEX A Transmitter radiated spurious emissions

Spurious emissions according to FCC 15.247

Project number: G0M-1408-4082

Applicant: Kampstrup
 EUT Name: flowQ2100
 Model: flowQ2100
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Vnom: 3.6 V DC lithium battery
 Antenna: Rohde & Schwarz HK 116, Horizontal
 Measurement distance: 3 m
 Mode: TX; 2FSK; 915 MHz
 Test Date: 2014-09-08
 Note: worst case

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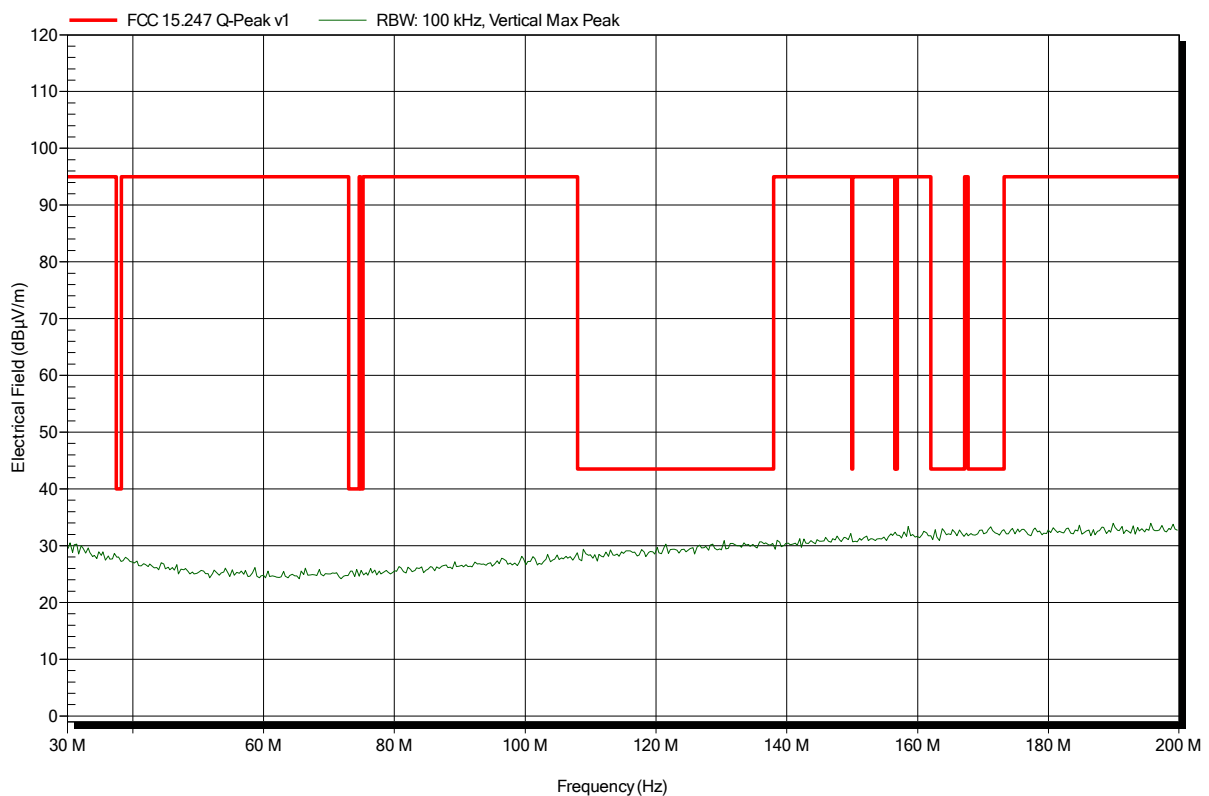


Spurious emissions according to FCC 15.247

Project number: G0M-1408-4082

Applicant: Kampstrup
 EUT Name: flowQ2100
 Model: flowQ2100
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Vnom: 3.6 V DC lithium battery
 Antenna: Rohde & Schwarz HK 116, Vertical
 Measurement distance: 3 m
 Mode: TX; 2FSK; 915 MHz
 Test Date: 2014-09-08
 Note: worst case

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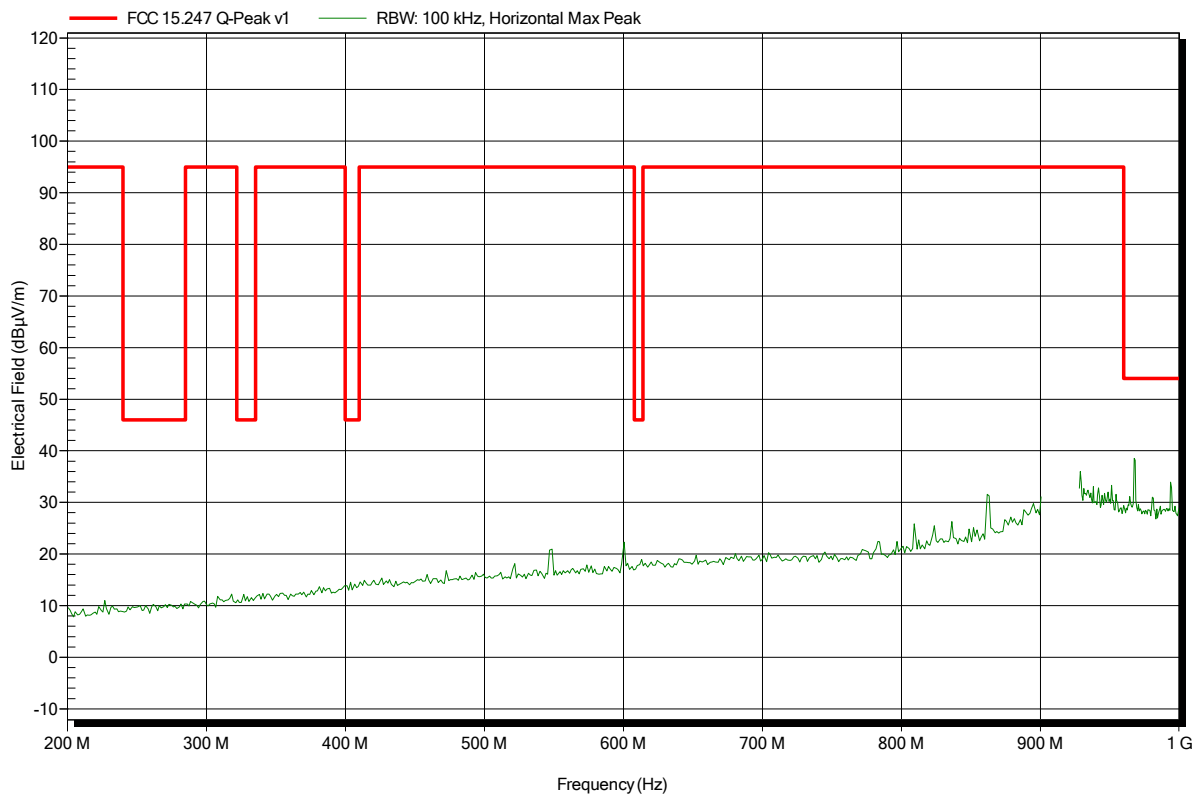


Spurious emissions according to FCC 15.247

Project number: G0M-1408-4082

Applicant: Kampstrup
 EUT Name: flowQ2100
 Model: flowQ2100
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Vnom: 3.6 V DC lithium battery
 Antenna: Rohde & Schwarz HL 223, Horizontal
 Measurement distance: 3 m
 Mode: TX; 2FSK; 915 MHz
 Test Date: 2014-09-08
 Note:

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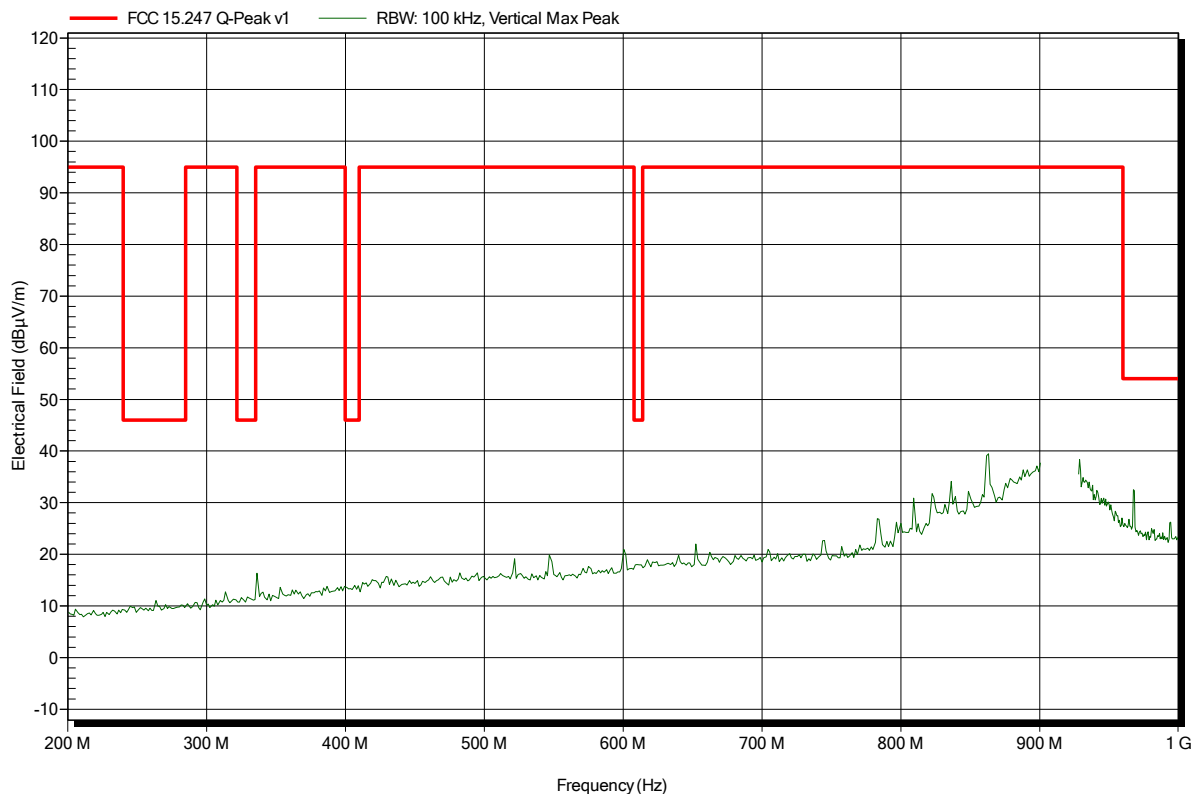


Spurious emissions according to FCC 15.247

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Applicant: Kampstrup
 EUT Name: flowQ2100
 Model: flowQ2100
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Vnom: 3.6 V DC lithium battery
 Antenna: Rohde & Schwarz HL 223, Vertical
 Measurement distance: 3 m
 Mode: TX; 2FSK; 915 MHz
 Test Date: 2014-09-08
 Note:

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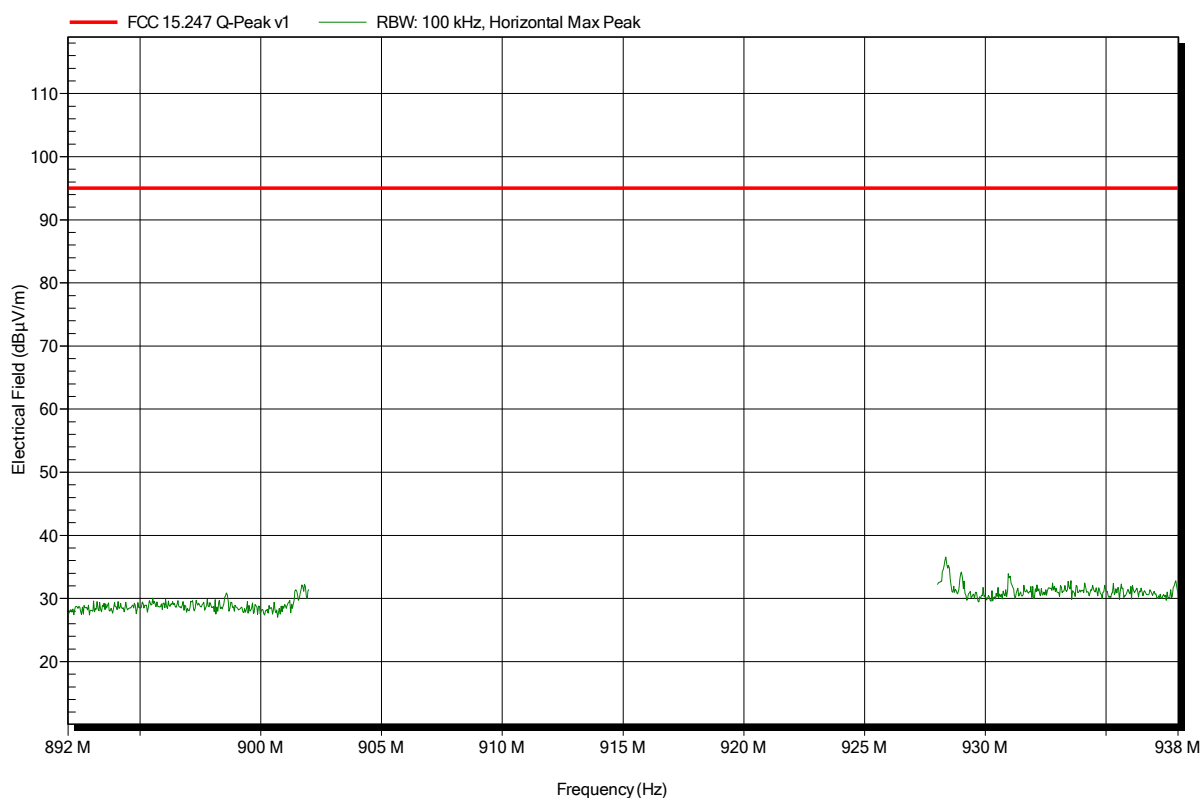


Spurious emissions according to FCC 15.247

Project number: G0M-1408-4082

Applicant: Kampstrup
 EUT Name: flowQ2100
 Model: flowQ2100
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Vnom: 3.6 V DC lithium battery
 Antenna: Rohde & Schwarz HL 223, Horizontal
 Measurement distance: 3 m
 Mode: TX; 2FSK; 915 MHz
 Test Date: 2014-09-08
 Note:

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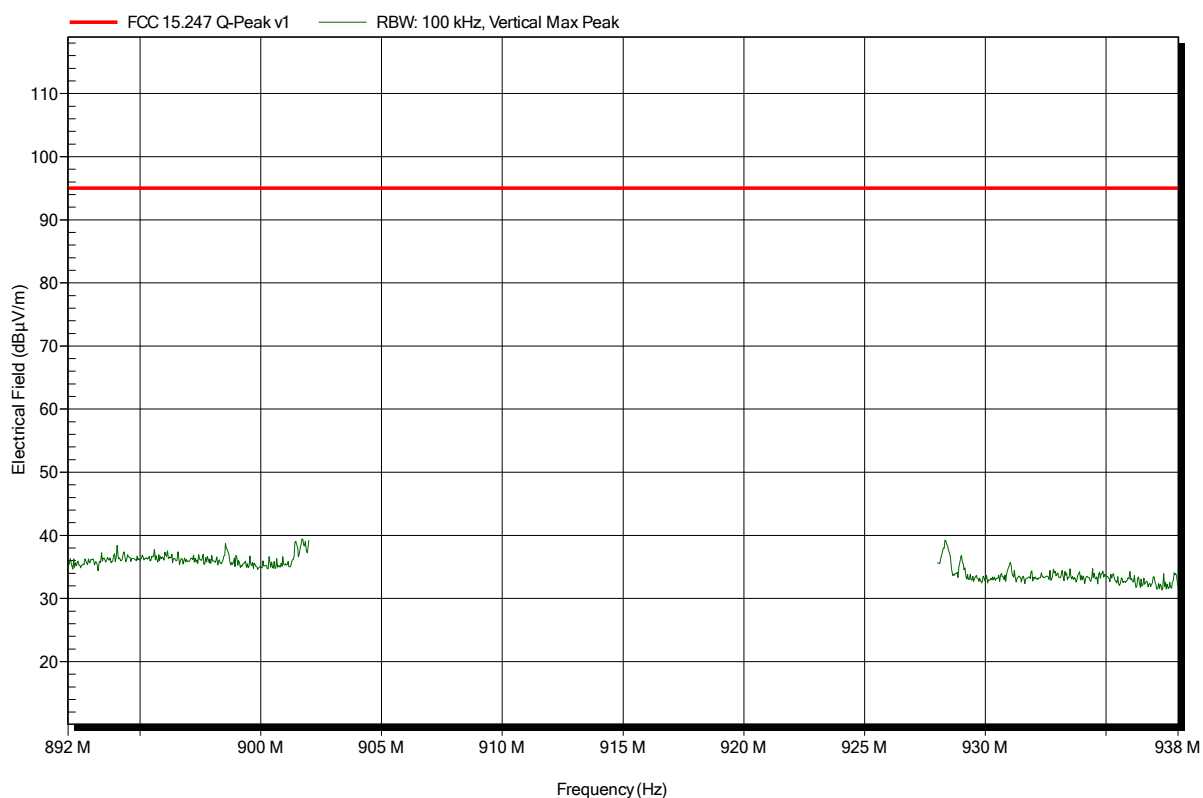


Spurious emissions according to FCC 15.247

Project number: G0M-1408-4082

Applicant: Kampstrup
 EUT Name: flowQ2100
 Model: flowQ2100
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Vnom: 3.6 V DC lithium battery
 Antenna: Rohde & Schwarz HL 223, Vertical
 Measurement distance: 3 m
 Mode: TX; 2FSK; 915 MHz
 Test Date: 2014-09-08
 Note:

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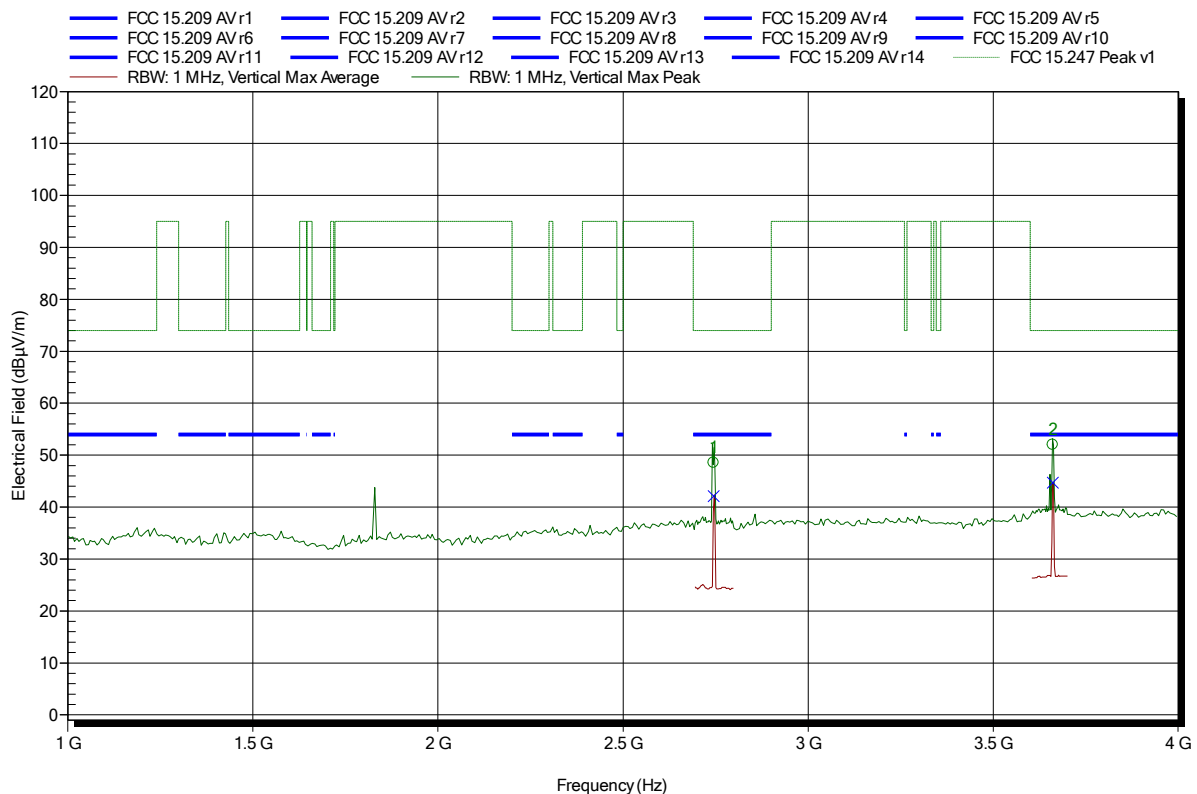


Spurious emissions according to FCC 15.247

Project number: GOM-1408-4082

Applicant: Kampstrup
 EUT Name: flowQ2100
 Model: flowQ2100
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Vnom: 3.6 V DC lithium battery
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 3 m
 Mode: TX; 2FSK; 915 MHz
 Test Date: 2014-09-08
 Note:

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Frequency	Peak	Peak Limit	Peak Difference	Peak Status
2.745 GHz	48.55 dBμV/m	74 dBμV/m	-25.45 dB	Pass
3.661 GHz	51.98 dBμV/m	74 dBμV/m	-22.02 dB	Pass

Frequency	Average	Average Limit	Average Difference	Average Status
2.745 GHz	42.09 dBμV/m	54 dBμV/m	-11.91 dB	Pass
3.661 GHz	44.7 dBμV/m	54 dBμV/m	-9.3 dB	Pass

Test Report No.: GOM-1408-4082-TFC247DT-V03

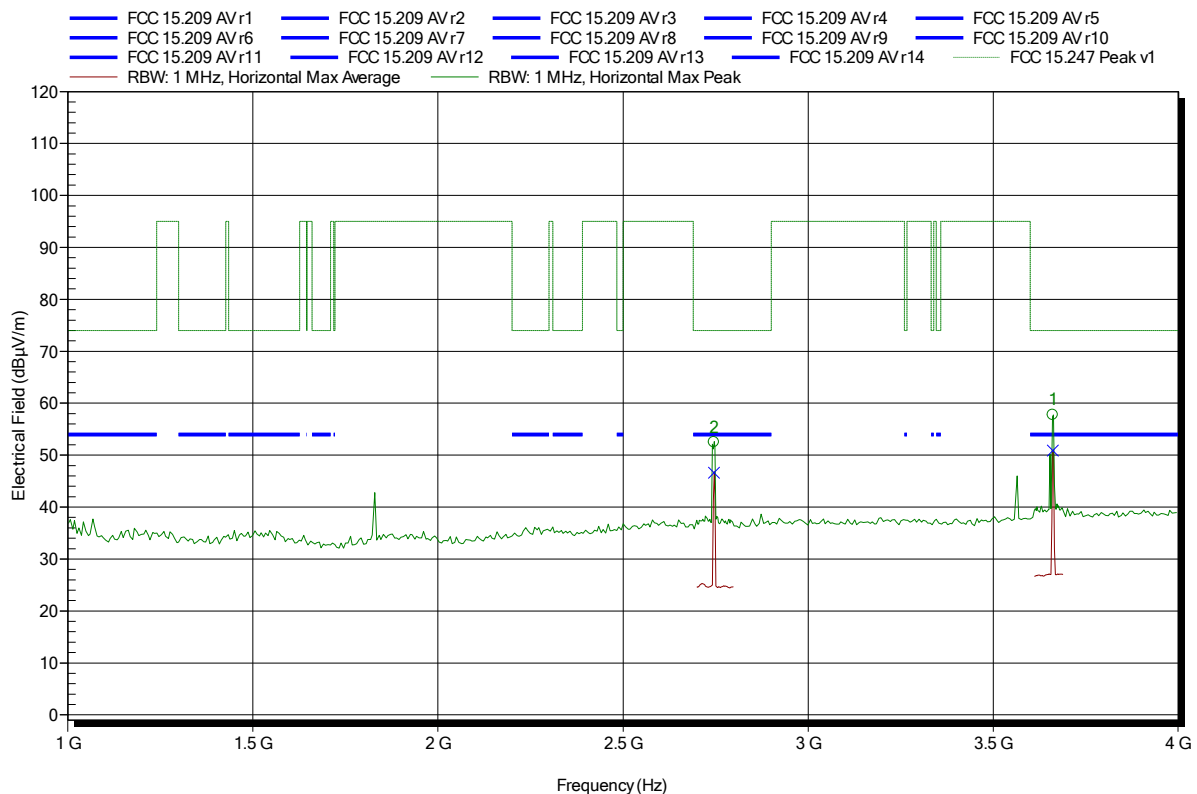
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

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 EUT Name: flowQ2100
 Model: flowQ2100
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Vnom: 3.6 V DC lithium battery
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 3 m
 Mode: TX; 2FSK; 915 MHz
 Test Date: 2014-09-08
 Note:

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Frequency	Peak	Peak Limit	Peak Difference	Peak Status
2.746 GHz	52.51 dBµV/m	74 dBµV/m	-21.49 dB	Pass
3.661 GHz	57.71 dBµV/m	74 dBµV/m	-16.29 dB	Pass

Frequency	Average	Average Limit	Average Difference	Average Status
2.746 GHz	46.62 dBµV/m	54 dBµV/m	-7.38 dB	Pass
3.661 GHz	50.85 dBµV/m	54 dBµV/m	-3.15 dB	Pass

Test Report No.: GOM-1408-4082-TFC247DT-V03

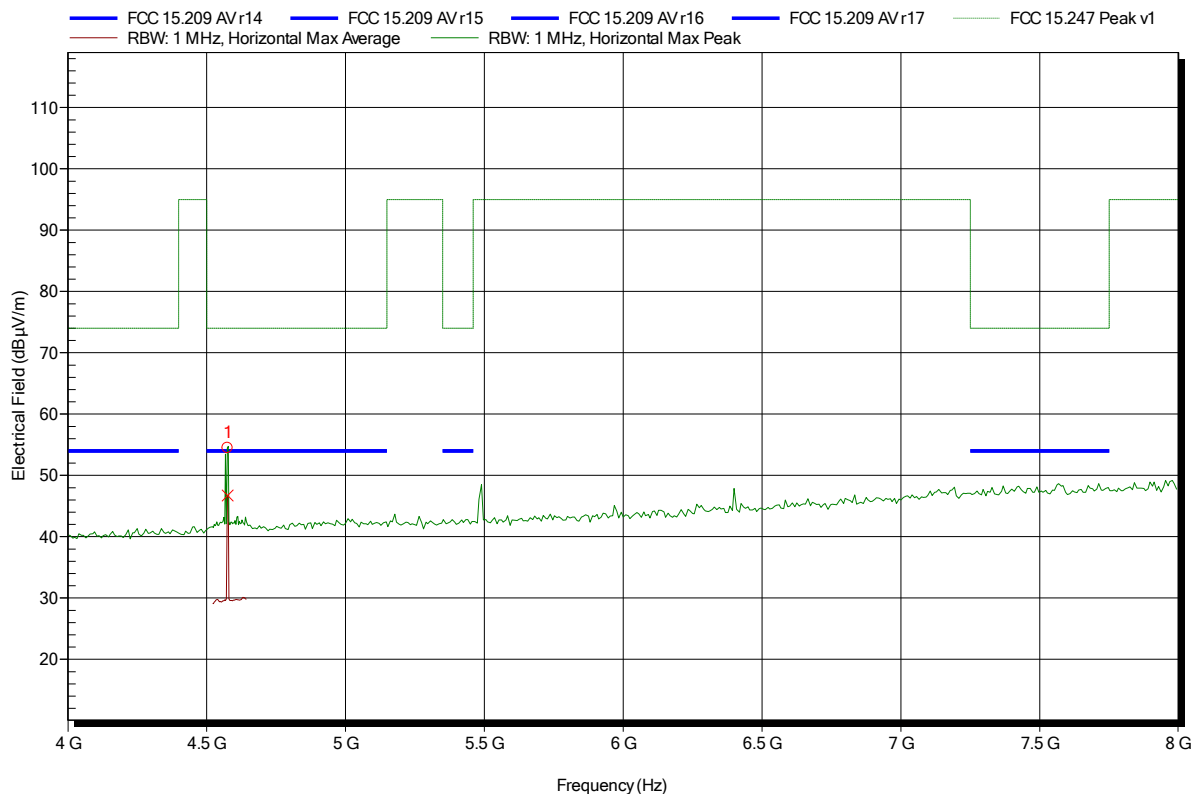
Eurofins Product Service GmbH
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 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Vnom: 3.6 V DC lithium battery
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 3 m
 Mode: TX; 2FSK; 915 MHz
 Test Date: 2014-09-08
 Note:

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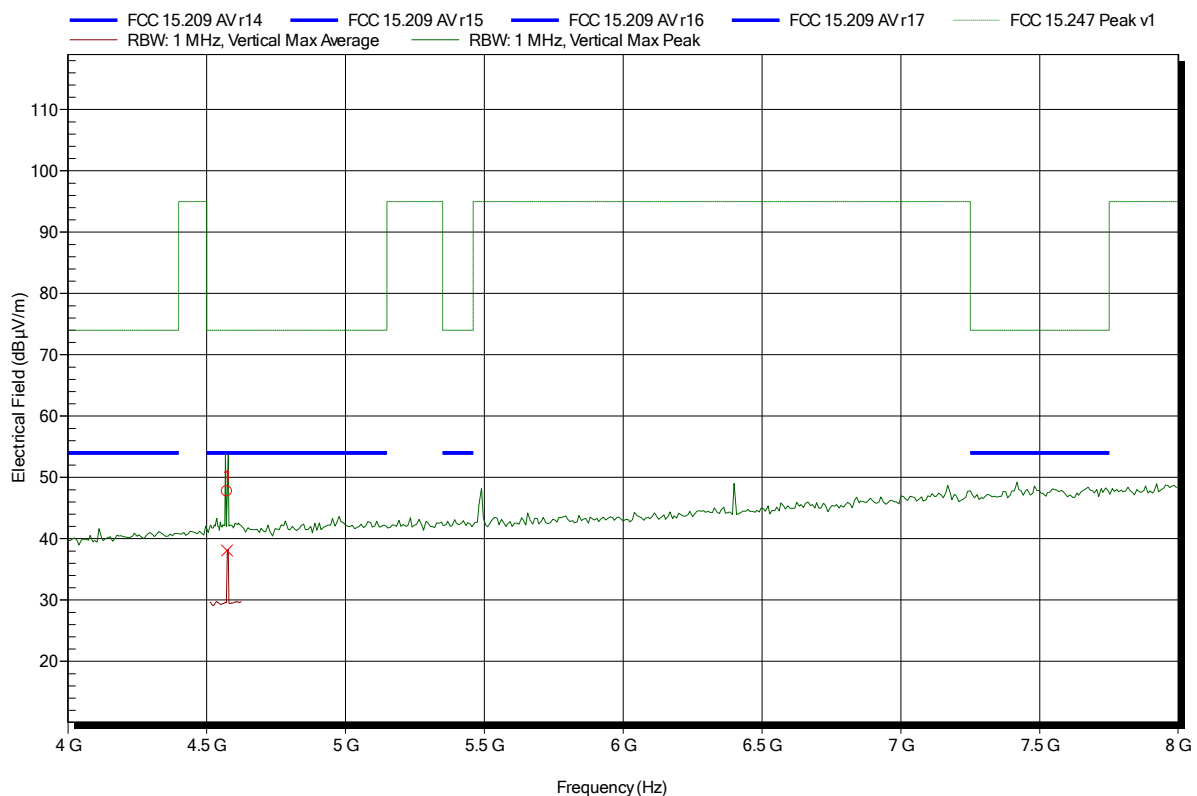
Frequency 4.576 GHz	Peak 54.45 dBµV/m	Peak Limit 74 dBµV/m	Peak Difference -19.55 dB	Peak Status Pass
Frequency 4.576 GHz	Average 46.71 dBµV/m	Average Limit 54 dBµV/m	Average Difference -7.29 dB	Average Status Pass

Spurious emissions according to FCC 15.247

Project number: GOM-1408-4082

Applicant: Kampstrup
 EUT Name: flowQ2100
 Model: flowQ2100
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Vnom: 3.6 V DC lithium battery
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 3 m
 Mode: TX; 2FSK; 915 MHz
 Test Date: 2014-09-08
 Note:

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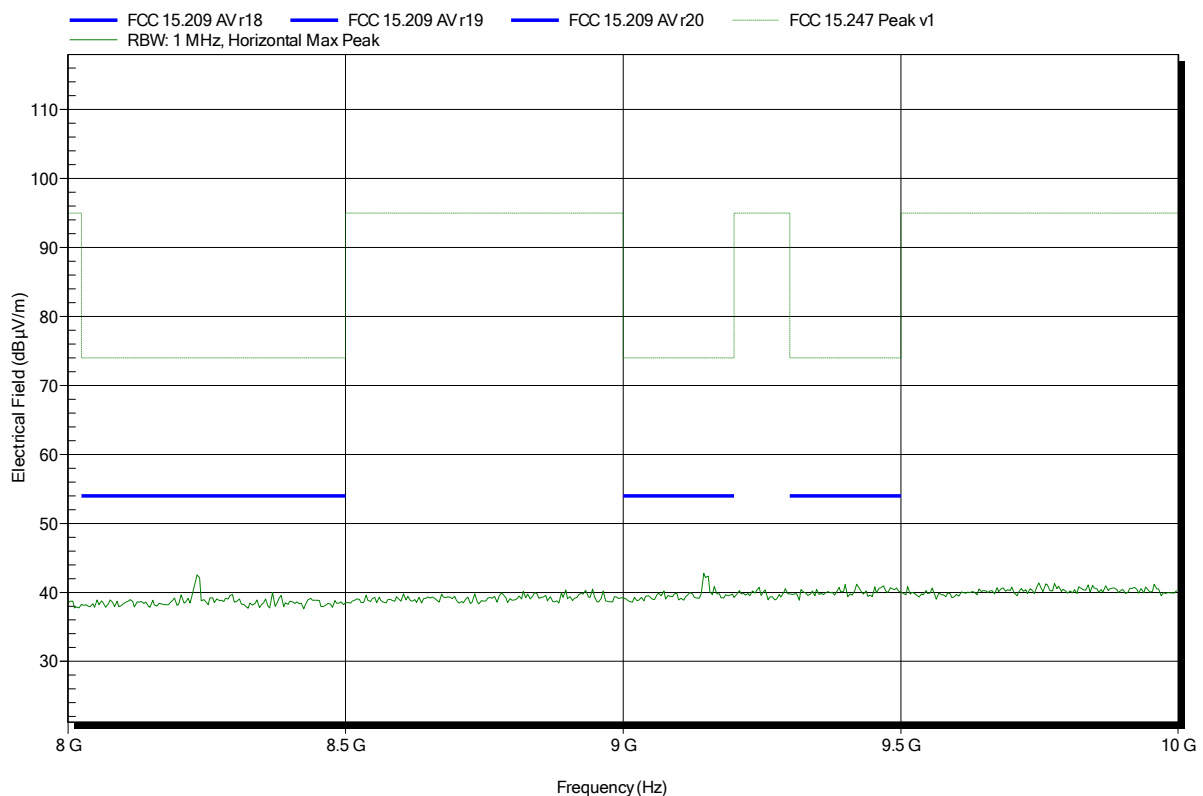
Frequency 4.574 GHz	Peak 47.72 dBµV/m	Peak Limit 74 dBµV/m	Peak Difference -26.28 dB	Peak Status Pass
Frequency 4.574 GHz	Average 38.11 dBµV/m	Average Limit 54 dBµV/m	Average Difference -15.89 dB	Average Status Pass

Spurious emissions according to FCC 15.247

Project number: G0M-1408-4082

Applicant: Kampstrup
 EUT Name: flowQ2100
 Model: flowQ2100
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Vnom: 3.6 V DC lithium battery
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 1 m converted to 3m
 Mode: TX; 2FSK; 915 MHz
 Test Date: 2014-09-08
 Note:

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Spurious emissions according to FCC 15.247

Project number: GOM-1408-4082

Applicant: Kampstrup
 EUT Name: flowQ2100
 Model: flowQ2100
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Treffke
 Test Conditions: Tnom: 24°C, Vnom: 3.6 V DC lithium battery
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 1 m converted to 3m
 Mode: TX; 2FSK; 915 MHz
 Test Date: 2014-09-08
 Note:

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