731 Enterprise Drive
Lexington, KY 40510

Telephone: 859-226-1000
Facsimile: 859-226-1040
www.intertek-etlsemko.com

TEST REPORT

Report Number:	**102133662LEX-001**
Project Number:	**G102133662**
Report Issue Date:	**8/9/2015**
Product Name:	**Smoke Alarm**
FCC Standards:	**Title 47 CFR Part 15 Subpart C**
Industry Canada Standards:	**RSS-210 Issue 8**

Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Drive
Lexington, KY 40510

Client:
Bellman & Symfon Europe AB
Sodra Langebergsgatan 30
421 32 Vastra Frolunda, Sweden

Report prepared by

Bryan Taylor, Team Lead-Engineering

Report reviewed by

Jason Centers, Staff Engineer

TABLE OF CONTENTS

1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 3. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test method, a list of the actual test equipment used, documentation photos, results and raw data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested complied with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

The INTERTEK-Lexington is located at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1 and ANSI C63.4: 2009. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters. The test site is listed with the FCC under registration number 485103. The test site is listed with Industry Canada under site number IC 2042M-1.

2 Test Summary

Page	Test full name	FCC Reference	IC Reference	Result
8	Transmission Timing Measurements	§ 15.231(a)	RSS-210 (A1.1.1)	Pass
10	Duty Cycle Correction Factor	ANSI C63.10: 2013	ANSI C63.10: 2013	---
13	Occupied Bandwidth	§ 15.231(c)	RSS-210 (A1.1.3)	Pass
16	Radiated Spurious Emissions (Transmitter)	§ 15.231(b)	RSS-210 (A1.1.2)	Pass
21	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen (7.1.2)	Pass
---	Conducted Emission Limits	§ 15.207	RSS-Gen (7.2.4)	NA[1]

1 This device is battery powered and will never connect to the AC mains.

3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	Bellman & Symfon Europe AB
Model Number	BE1281
Serial Number	Test Sample 1
Receive Date	5/26/2015
Test Start Date	5/26/2015
Test End Date	8/9/2015
Device Received Condition	Good
Test Sample Type	Production
Transmission Control	Test Commands
Transmit Frequencies	433.92MHz, 434.33MHz
Antenna Type (15.203)	PCB Antenna
Operating Voltage	9V Battery

Description of Equipment Under Test
Optical Smoke Alarm

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmitting on 433.92MHz or 434.33MHz.
2	Receive mode / idle mode

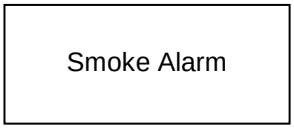
3.1 Photographs of Test Sample

Front

Back

3.2 System setup including cable interconnection details, support equipment and simplified block diagram

3.3 EUT Block Diagram:



3.4 Cables:

None

3.5 Support Equipment:

None

4 Transmission Timing

§ 15.231(a):

The provisions of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition

(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

4.1 Test Procedure

An alarm condition was simulated on the test sample. A timing plot was produced showing automatic shutoff of the transmitter after the alarm condition clears. A spectrum analyzer was used in zero span mode with video triggering enabled so that whenever a transmission was occurring the analyzer was sweeping.

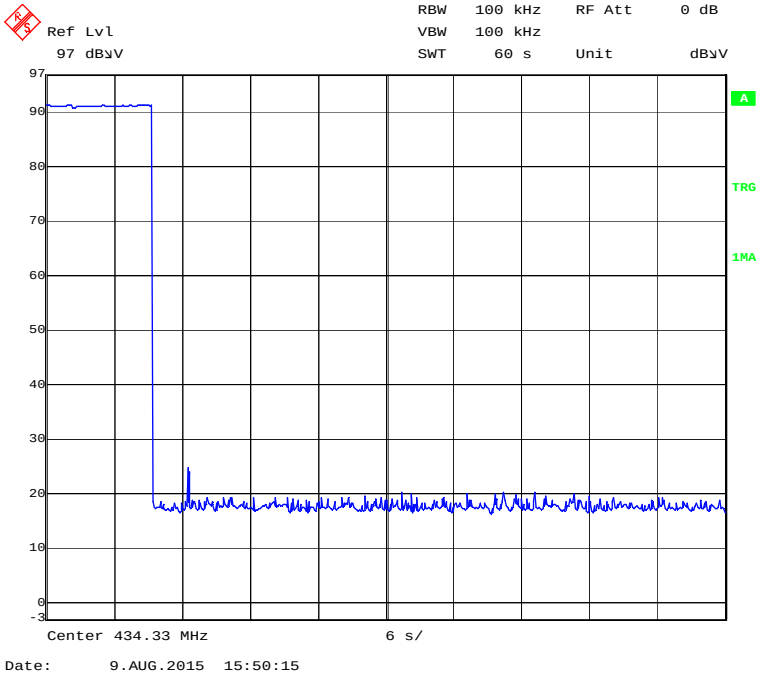
An additional plot was produced showing that no transmissions occur when there is no alarm condition present. A spectrum analyzer was used in free run mode to record any transmissions from the device over a 5 minute period.

4.2 Test Equipment Used:

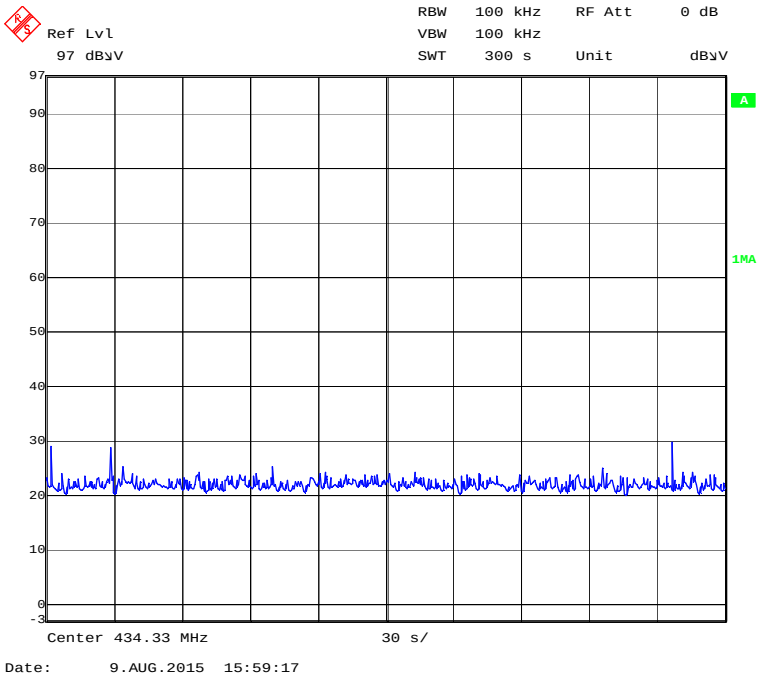
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK 30	9/15/2014	9/15/2015

4.3 Transmission Timing Results

The test sample was a smoke alarm that only transmits during an alarm condition. The plot below illustrates that after the alarm condition clears, the transmission also stops. Another plot is also provided showing that no transmissions occur during non-alarmed periods.



Plot showing th transmission stopping after the clearing of an alarm condition.



5 minute observation period showing no transmissions while in a non-alarmed state.

5 Duty Cycle Correction Factor

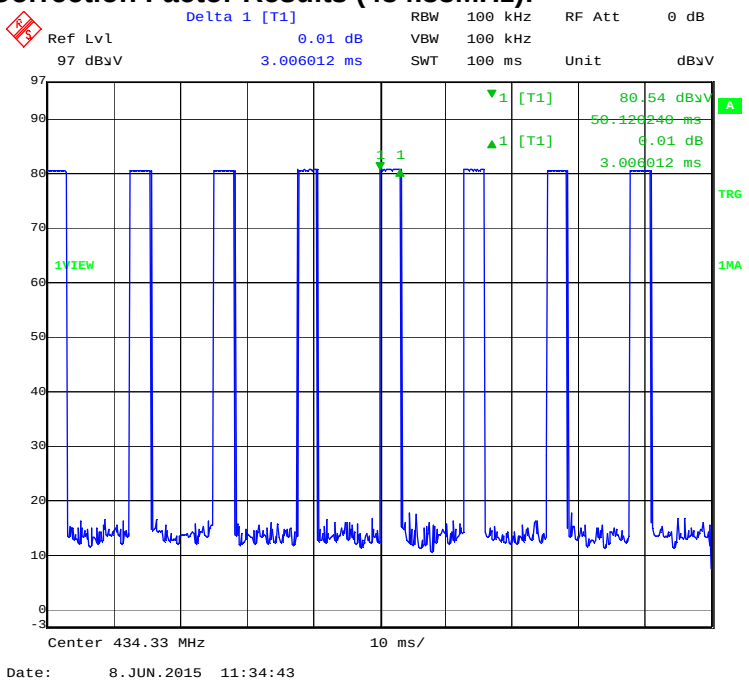
5.1 Test Procedure

ANSI C63.10: 2013 Section 7.5 was followed for measuring the duty cycle and calculating the duty cycle correction factor. When necessary the duty cycle correction factor was used to compute the average value of pulsed emissions during the radiated testing.

5.2 Test Equipment Used:

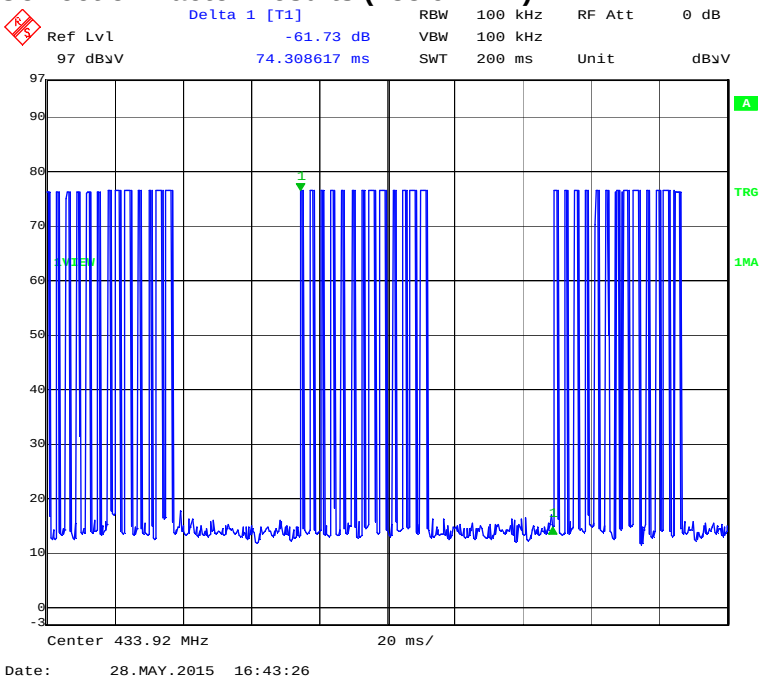
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK 30	9/15/2014	9/15/2015

5.3 Duty Cycle Correction Factor Results (434.33MHz):

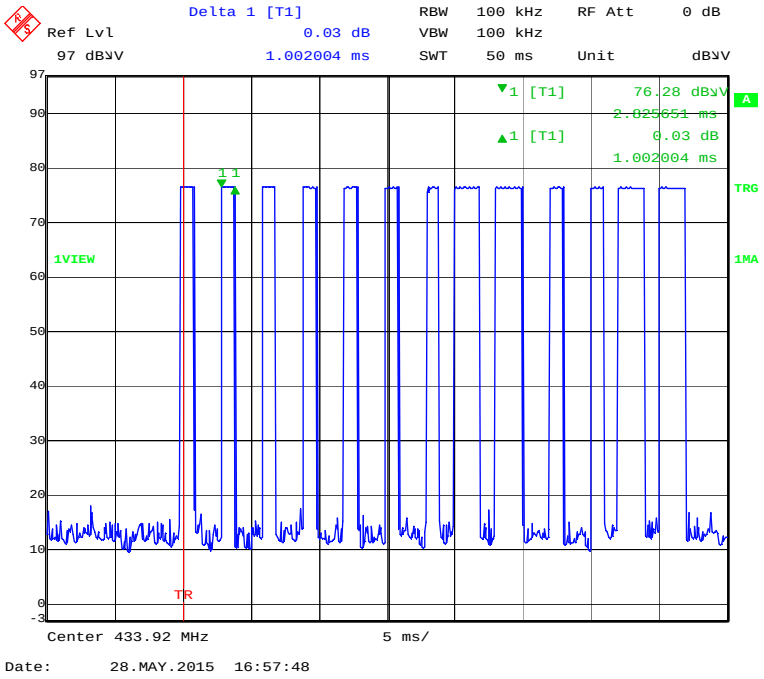


434.33MHz Pulse On Time (over 100mS) = 3mS X 8 Pulses = 24mS
Duty Cycle Correction Factor (at 434.33MHz) = 20log(24mS/100mS)
Duty Cycle Correction Factor (at 434.33MHz) = -12.39dB

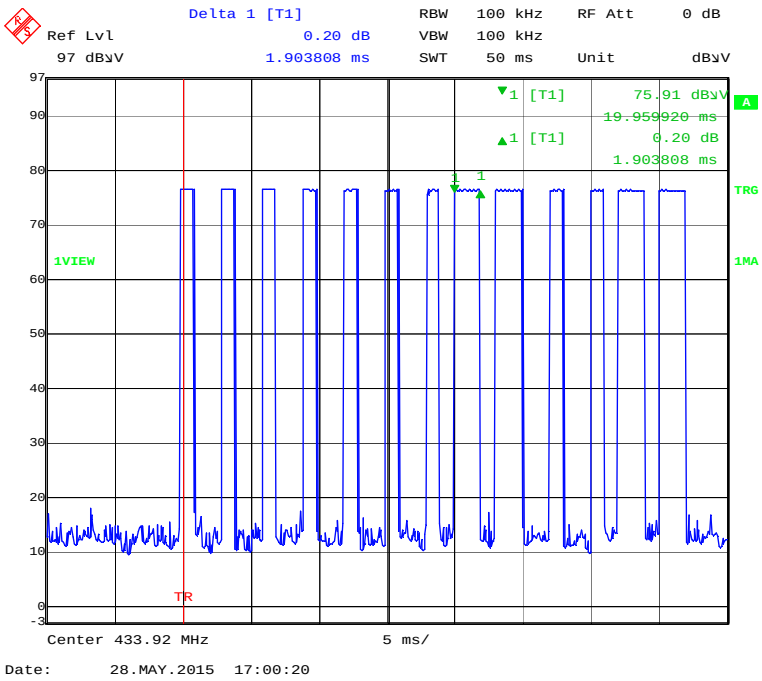
5.4 Duty Cycle Correction Factor Results (433.92MHz):



Pulse Train Period (at 433.92MHz) = 74.3mS



9 Short Pulses X 1mS Each = 9mS



4 Long Pulses X 1.9mS Each = 7.6mS

Duty Cycle Correction Factor (at 433.92MHz) = 20log([7.6mS+9mS]/74.3mS)
Duty Cycle Correction Factor (at 433.92MHz) = -13.01dB

6 Occupied Bandwidth

6.1 Test Limits

§ 15.231(c): The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

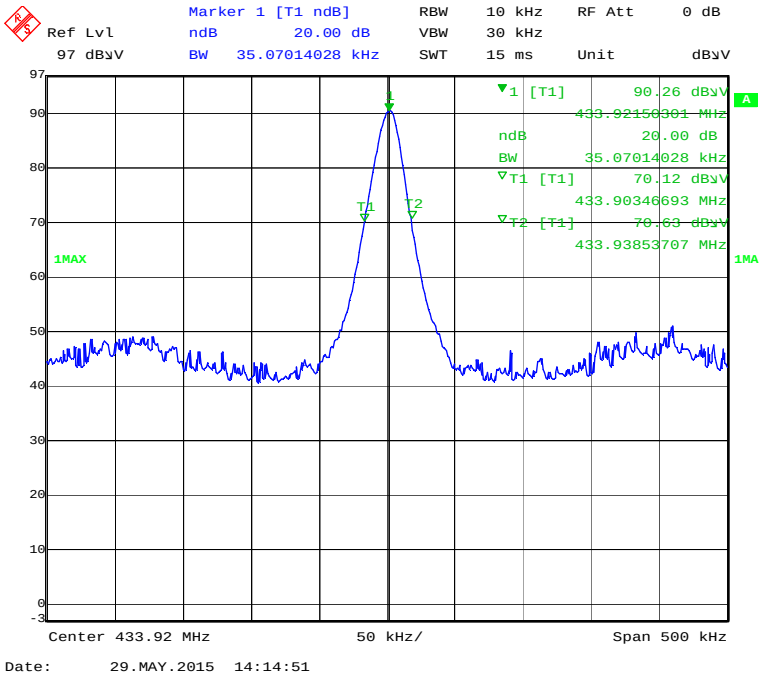
6.2 Test Procedure

ANSI C63.10: 2013

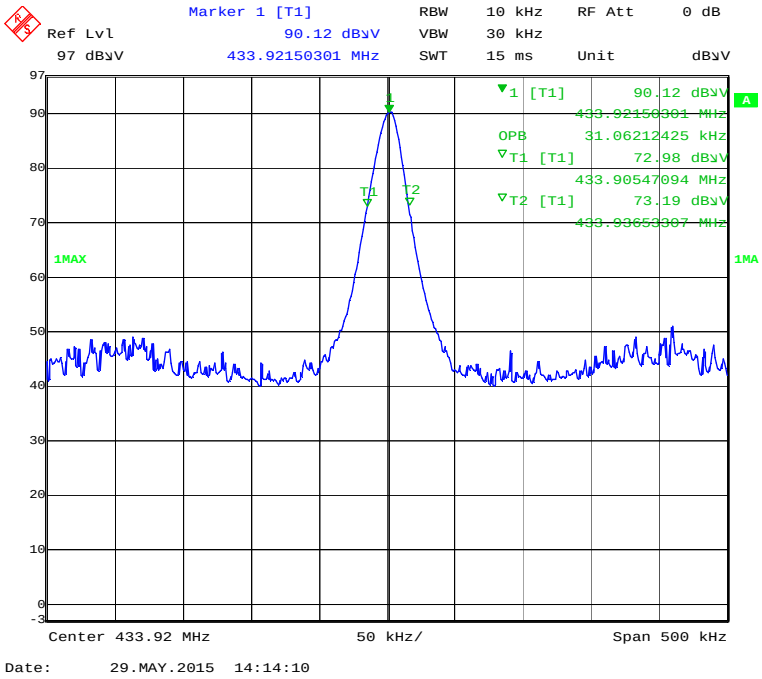
6.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK 30	9/15/2014	9/15/2015

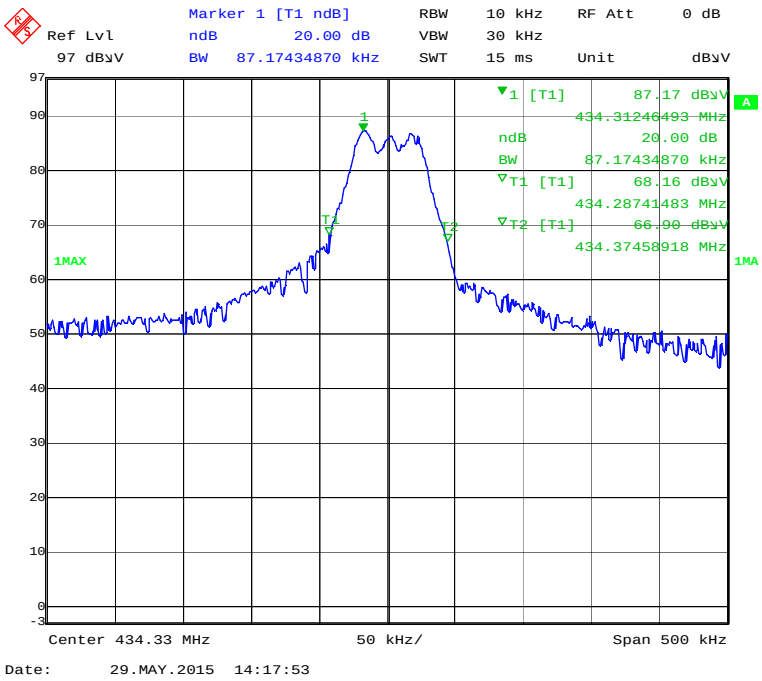
6.4 Results:



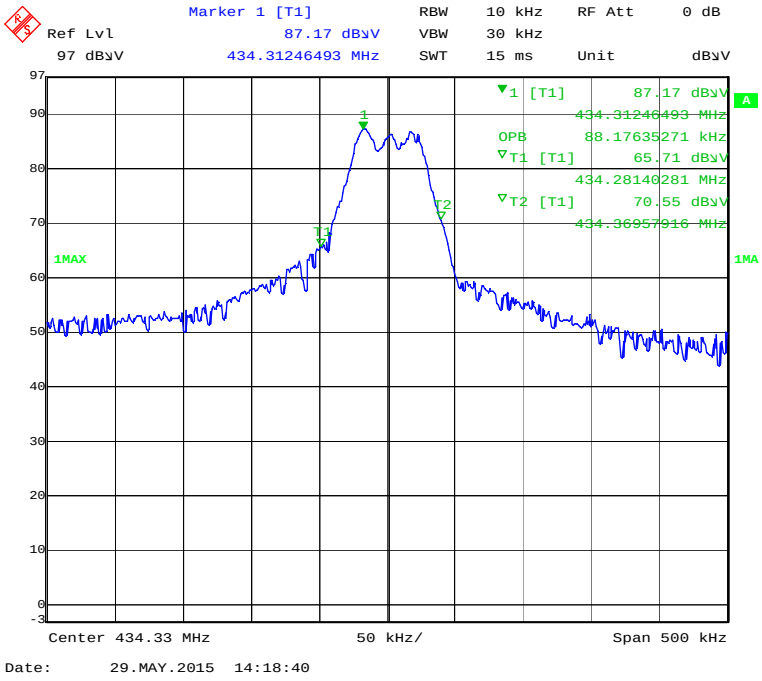
(433.92MHz) 20dB Bandwidth = 35.07kHz



(433.92MHz) 99% Power Bandwidth = 31.06kHz



(434.33MHz) 20dB Bandwidth = 87.17kHz



(434.33MHz) 99% Bandwidth = 88.17kHz

7 Radiated Spurious Emissions (Transmitter)

7.1 Test Limits

§ 15.231(a): The provisions of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

(b) In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	[1]1,250 to 3,750	[1]125 to 375
174-260	3,750	375
260-470	[1]3,750 to 12,500	[1]375 to 1,250
Above 470	12,500	1,250

[1]Linear interpolations.

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

Part 15.205(a): Restricted Bands of Operations

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	[2]
13.36–13.41.			

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

Part 15.209(a): Field Strength Limits for Restricted Bands of Operation

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

7.2 Test Procedure

ANSI C63.10: 2013

7.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:
FS = RA + AF + CF

FS = Field Strength in dBμV/m
RA = Receiver Amplitude in dBμV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dBμV
AF = 18.52 dB
CF = 0.78 dB

FS = 19.48 + 18.52 + 0.78 = 38.78 dBμV/m
Level in μV/m = Common Antilogarithm [(38.78 dBμV/m)/20] = 86.89 μV/m

7.1 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	1302.6005.40	Rohde & Schwarz	ESU40	9/17/2014	9/17/2015
Preamplifier	122005	Rohde&Schwarz	TS-PR18	11/26/2014	11/26/2015
Biconnilog Antenna	00051864	ETS	3142C	1/20/2015	1/20/2016
Horn Antenna	00154521	ETS	3117	10/21/2014	10/21/2015
System Controller	121701-1	Sunol Sciences	SC99V	Time of Use	Time of Use
EMC Software	Version 9.15.02	Rohde&Schwarz	EMC32	Time of Use	Time of Use
High Pass Filter	1	Wainwright	WHKX12-2533.85-2710-18000-40SS	Time of Use	Time of Use

7.2 Results:

All fundamental and spurious emissions not falling into the restricted bands met the limits outlined in FCC Part 15.231(b). Additionally, all emissions falling within restricted bands of operation were found to be below the limit specified in Part 15.209(a). The emissions listed in the following tables are the worst case emissions and were investigated with the sample positioned in three orthogonal axis in order to report the highest possible field strength. Emissions falling in restricted bands are highlighted in blue text.

Bilog Worst Case Spurious Measurements (433.92MHz)

EUT Name:	Smoke Alarm
Manufacturer:	Bellman & Symfon Europe AB
Test Engineer:	Carmen Davis
Date:	5/27/2015
Temp/Humdiity/Pressure:	21.6C/68.7%/989.4mbar
Comment:	433.92Mhz Bilog Scan

Frequency (MHz)	Average* (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol (H/V)	Azimuth (deg)	AF/Cab/PA Corr. (dB)	DCF (dB)
30	13.07	60.83	-47.76	120	189.1	V	345	19.1	-13.01
40.419	7.37	60.83	-53.46	120	295.5	V	208	13.4	-13.01
114.54	10.16	43.52	-33.36	120	251.5	V	308	10	-13.01
433.92 (Fund)	79.33	80.83	-1.5	120	189.3	H	302	21.3	-13.01
663.53	21.82	60.83	-39.01	120	110.7	H	262	26.1	-13.01
867.84	49.62	60.83	-11.21	120	146.5	H	333	29	-13.01

*Additional Duty Cycle Correction Factor Applied

Horn Worst Case Spurious Measurements (433.92MHz)

EUT Name:	Smoke Alarm
Manufacturer:	Bellman & Symfon Europe AB
Test Engineer:	Carmen Davis
Date:	5/26/2015
Temp/Humdiity/Pressure:	21.5℃ 57.8% 986.4 mbar
Comment:	433.92Mhz Transmission

Frequency (MHz)	Average* (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	DCF (dB)
1301.251100	33.00	54.00	-21.00	1000.000	183.0	H	0.0	-1.2	-13.01
1732.728900	23.55	60.83	-37.28	1000.000	235.0	H	52.0	-0.1	-13.01
2169.310400	45.67	60.83	-15.16	1000.000	300.0	H	162.0	3.1	-13.01
4708.697900	30.37	54.00	-23.63	1000.000	268.0	H	196.0	7.7	-13.01
5207.047700	44.96	60.83	-15.87	1000.000	200.0	H	259.0	8.3	-13.01

*Additional Duty Cycle Correction Factor Applied

Bilog Worst Case Spurious Measurements (434.33MHz)

EUT Name: Smoke Alarm
Manufacturer: Bellman & Symfon Europe AB
Test Engineer: Carmen Davis
Date: 5/27/2015
Temp/Humdiity/Pressure: 21.6C/68.7%/989.4mbar
Comment: 434.33Mhz Bilog Scan

Frequency (MHz)	Average* (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol (H/V)	Azimuth (deg)	AF/Cab/PA Corr. (dB)	DCF (dB)
30.28	13.64	60.84	-47.2	120	296	V	180	18.9	-12.39
38.239	9.07	40	-30.93	120	107	H	271	14.4	-12.39
114.56	10.49	43.52	-33.03	120	251.4	V	310	10	-12.39
434.33 (Fund)	80.57	80.84	-0.27	120	201.1	H	302	21.3	-12.39
697.8	23.06	60.84	-37.78	120	104.9	H	291	27	-12.39
868.64	50.21	60.84	-10.63	120	147.7	H	326	29	-12.39

*Additional Duty Cycle Correction Factor Applied

Horn Worst Case Spurious Measurements (434.33MHz)

EUT Name: Smoke Alarm
Manufacturer: Bellman & Symfon Europe AB
Test Engineer: Carmen Davis
Date: 5/26/2015
Temp/Humdiity/Pressure: 21.5℃ 57.8% 986.4 mbar
Comment: 434.33Mhz Transmission

Frequency (MHz)	Average* (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	DCF (dB)
1303.067300	36.91	54.00	-17.09	1000.000	231.0	H	309.0	-1.2	-12.39
2171.701200	47.40	60.84	-13.44	1000.000	200.0	H	234.0	3.1	-12.39
5189.480900	30.55	60.84	-30.29	1000.000	174.0	H	346.0	8.2	-12.39
5212.095900	45.85	60.84	-14.99	1000.000	300.0	H	320.0	8.3	-12.39
5231.259400	40.54	60.84	-20.3	1000.000	264.0	H	314.0	8.4	-12.39
5304.802700	31.30	60.84	-29.54	1000.000	176.0	H	27.0	8.7	-12.39

*Additional Duty Cycle Correction Factor Applied

8 Antenna Requirement per FCC Part 15.203

8.1 Test Limits

§ 15.203: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

8.2 Results:

The sample tested met the antenna requirement. The antenna used was permanently attached and integral to the PCB.

9 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of k = 2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty	Notes
Radiated emissions, 30 to 1000 MHz	±3.9dB	
Radiated emissions, 1 to 18 GHz	±4.2dB	
Radiated emissions, 18 to 40 GHz	±4.3dB	
Power Port Conducted emissions, 150kHz to 30 MHz	±2.8dB	

10 Revision History

Revision Level	Date	Report Number	Notes
0	8/9/2015	102133662LEX-001	Original Issue