

TEST REPORT

Report Number: 102839440LEX-001
Project Number: G102839440

Report Issue Date: 1/16/2017

Product Name: Sandtrap

FCC Standards: FCC 15.231

Industry Canada Standards: RSS-210 Issue 9:2016

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

Client:
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Auburn Hills, MI 48326-2919

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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 |
|------|---|-------------------|-------------------|------------------|
| 7 | 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 | --- |
| 14 | Occupied Bandwidth | § 15.231(c) | RSS-210 (A1.1.3) | Pass |
| 17 | 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) | N/A ¹ |

1: The test is not applicable because the device is battery powered and does not connect to the AC Mains

3 Description of Equipment Under Test

| Equipment Under Test | |
|---------------------------|--------------------------------|
| Manufacturer | Apollo America Inc. |
| Model Number | Sandtrap |
| Serial Number | 1001 |
| Receive Date | 12/12/2016 |
| Test Start Date | 12/12/2016 |
| Test End Date | 1/11/2017 |
| Device Received Condition | Good |
| Test Sample Type | Production |
| Transmission Control | Firmware |
| Transmit Frequencies | 345MHz |
| Transmit Output Power | 0.0000067 W |
| Antenna Type (15.203) | Permanent internal PCB antenna |
| Operating Voltage | 4.5 VDC via 3 AAA batteries |

| Description of Equipment Under Test |
|-------------------------------------|
| Wireless smoke detector. |

Operating modes of the EUT:

| No. | Descriptions of EUT Exercising |
|-----|-------------------------------------|
| 1 | Idle, transmitting every 65 minutes |
| 2 | Continuously transmitting |

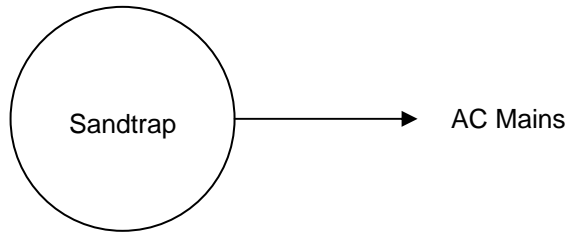
3.1 Photographs of Test Sample



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

The sample was set up in its normal operating mode. A small antenna connected to an oscilloscope was placed in close proximity to the sample. The scope was configured to trigger when the sample transmitted data. Condition 3 above was used to evaluate compliance.

4.2 Test Equipment Used:

| Description | Serial Number | Manufacturer | Model | Cal. Date | Cal. Due |
|-------------------|---------------|-----------------|-------|-----------|-----------|
| EMI Test Receiver | 10887490.26 | Rohde & Schwarz | ESU40 | 9/19/2016 | 9/19/2017 |

4.3 Transmission Timing Results

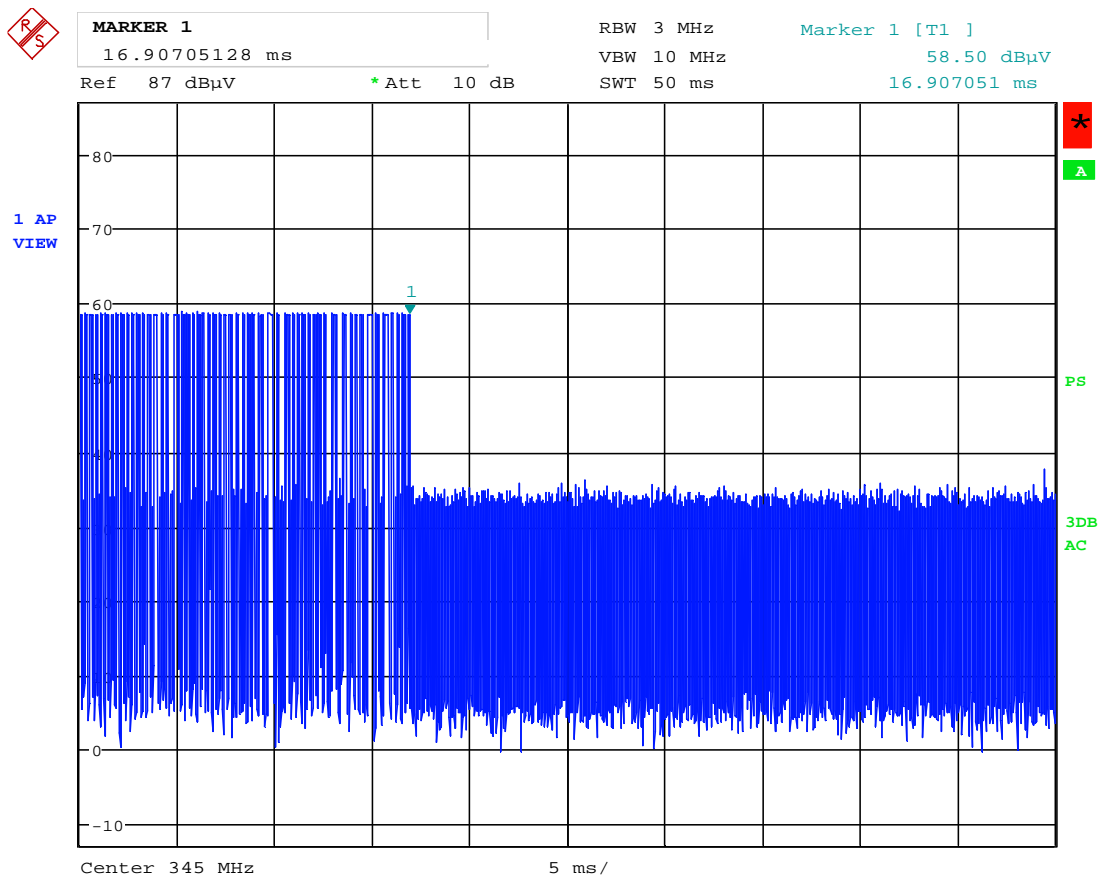
- (1) The device is not manually operated
- (2) The device is a safety device that is allowed continuous transmission during an alarm
- (3) See below
- (4) The device is a smoke alarm that is employed for safety of life
- (5) The device is not manually triggered and is a safety of life device.

The sample is a smoke detector that transmits a burst of 64 134 μ s pulses once every 65 minutes in its normal operating mode, as shown in the scope capture below. The total “on” time in one hour is:

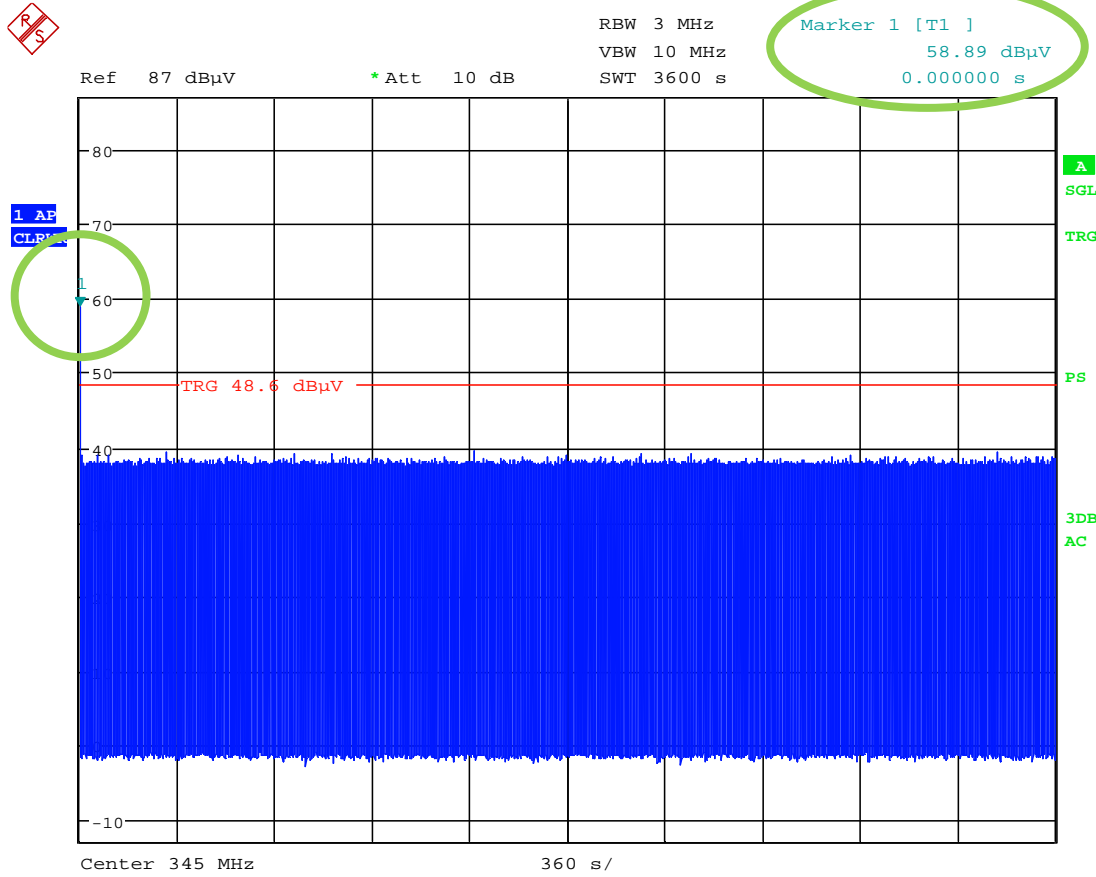
$$64 \cdot (134 \mu\text{s}) = 8.576 \text{ ms}$$

which is less than two seconds per hour.

5ms Sweep



1 Hour Sweep



5 Duty Cycle Correction Factor

5.1 Test Procedure

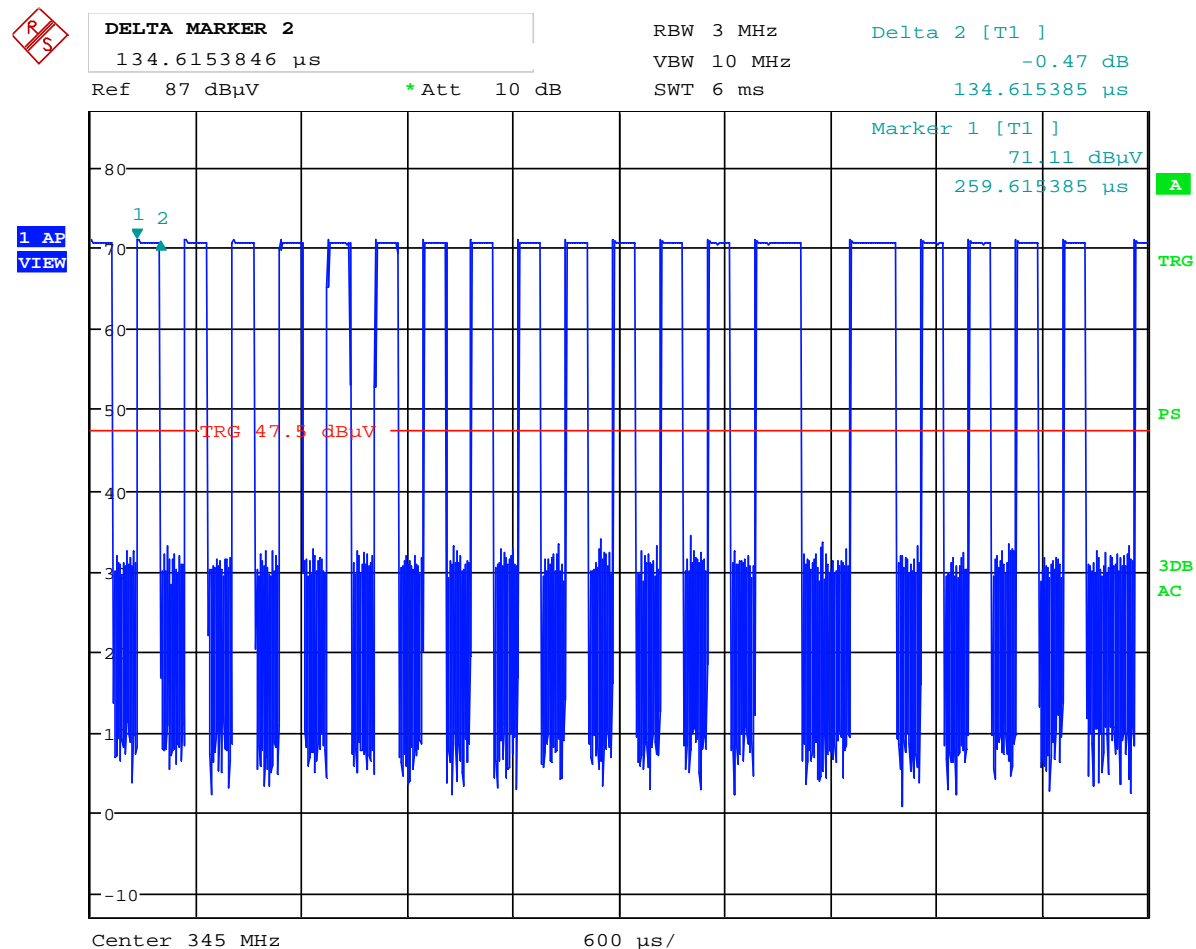
ANSI C63.10: 2013 Section 7.5 was followed for measuring the duty cycle and calculating the duty cycle correction factor. When necessary the duty cycle correction factor was used to compute the average value of pulsed emissions during the radiated testing.

5.2 Test Equipment Used:

| Description | Serial Number | Manufacturer | Model | Cal. Date | Cal. Due |
|-------------------|---------------|-----------------|-------|-----------|-----------|
| EMI Test Receiver | 10887490.26 | Rohde & Schwarz | ESU40 | 9/19/2016 | 9/19/2017 |

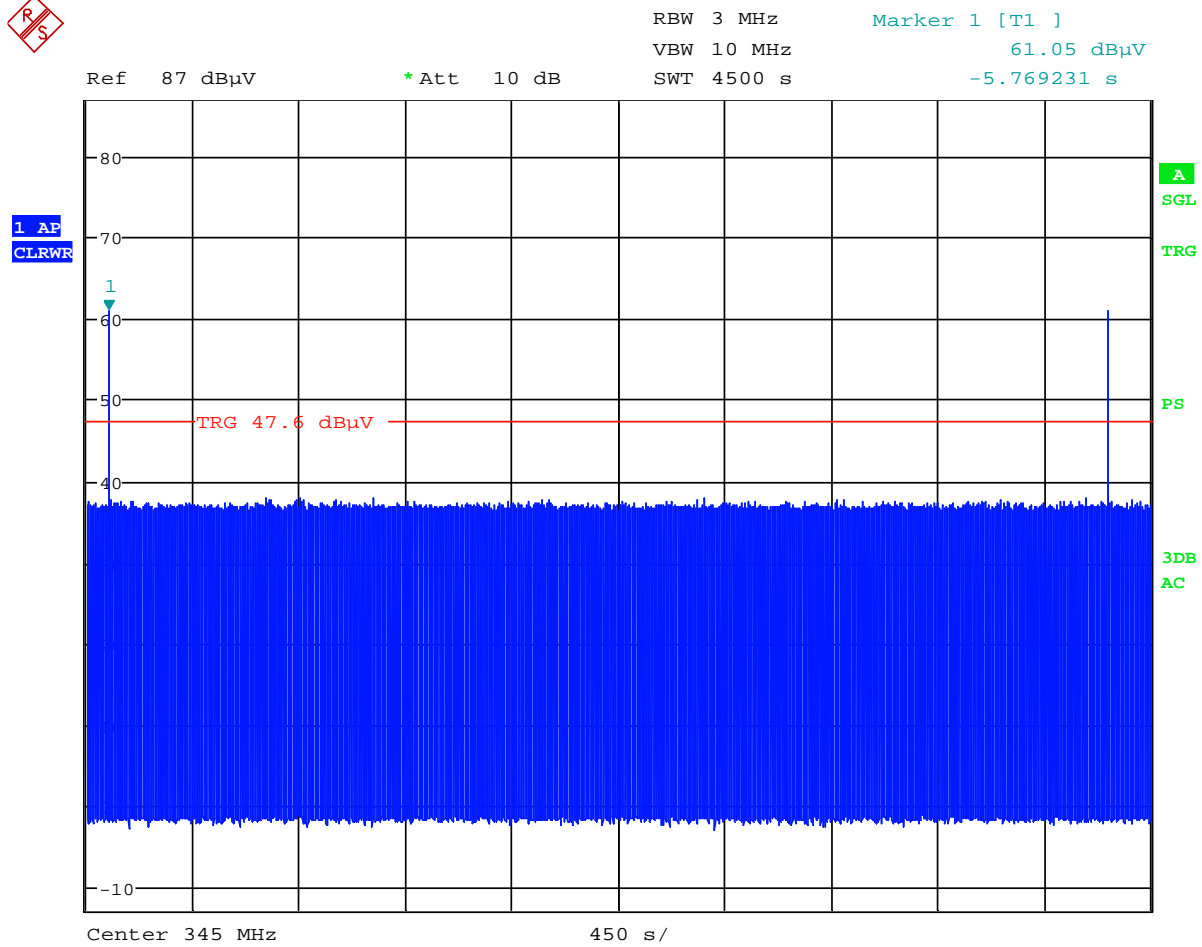
5.3 Duty Cycle Correction Factor Results (345MHz):

Short Pulse 0.134ms

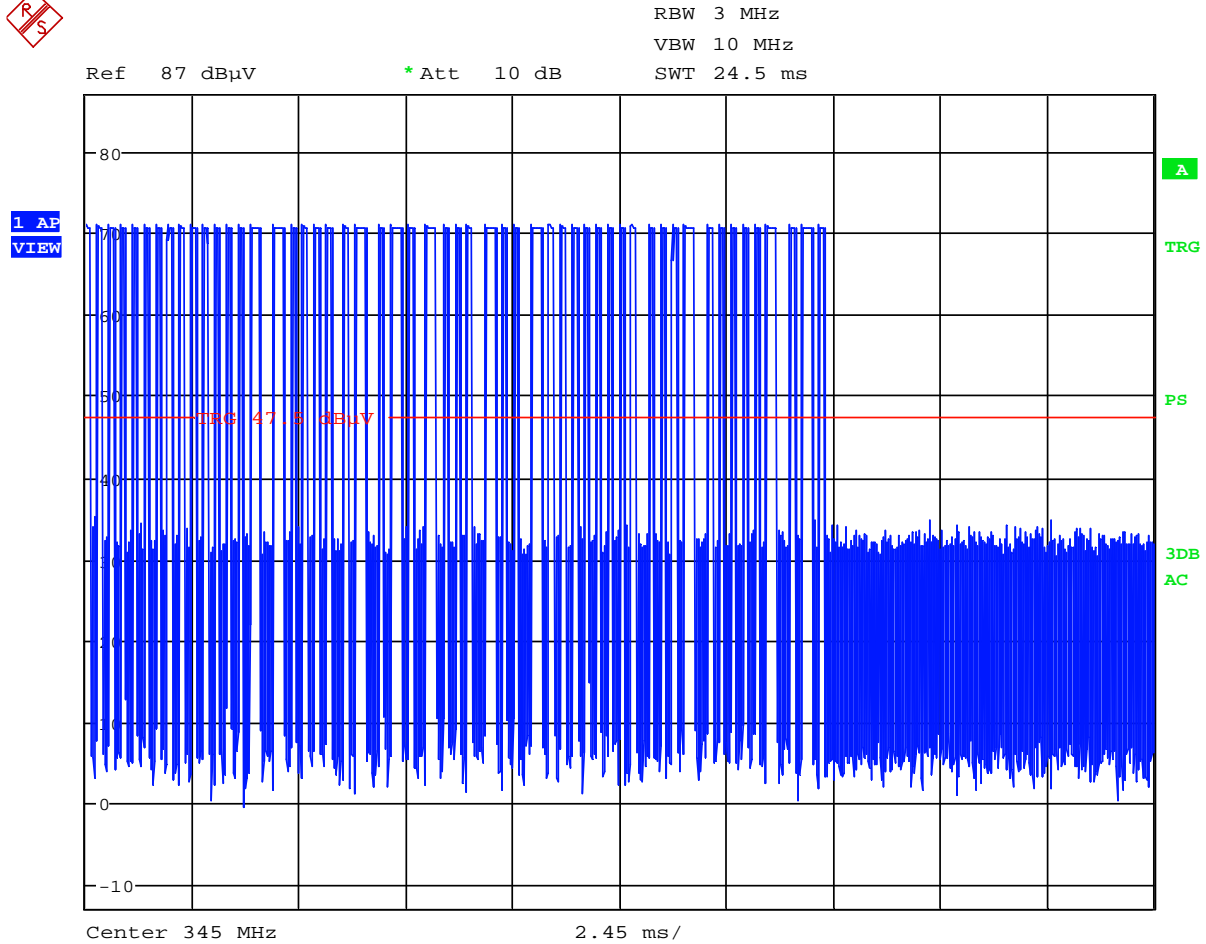


269.230769 μ s

Pulse Period



The pulse has a period of 70 minutes, as this is greater than 100ms, the duty cycle correctino factor was calculated over a period of 100ms.



345MHz Pulse On Time = (44 * 0.134 ms) + (10 * 0.269 ms)
Duty Cycle Correction Factor (at 345MHz) = 20 log (8.576ms / 100ms)= -21.33dB

Occupied Bandwidth**5.4 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.

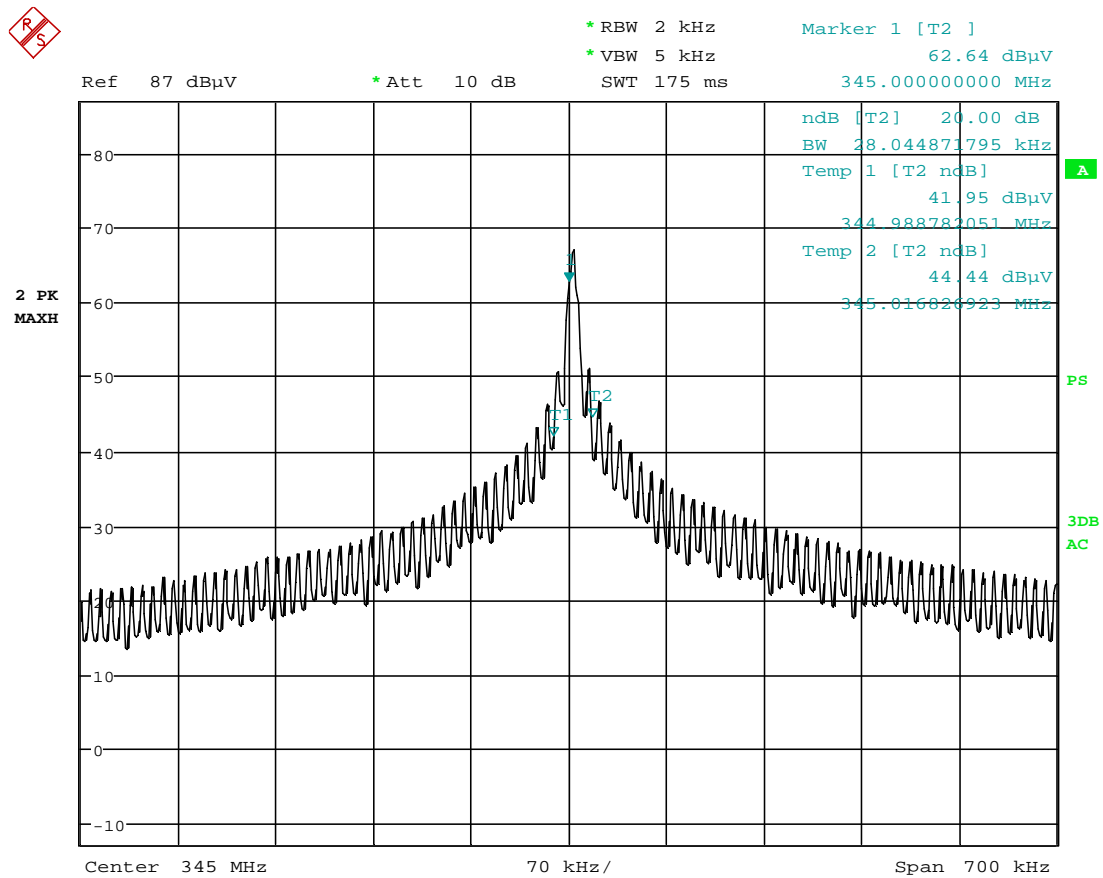
5.5 Test Procedure

ANSI C63.10: 2013

5.6 Test Equipment Used:

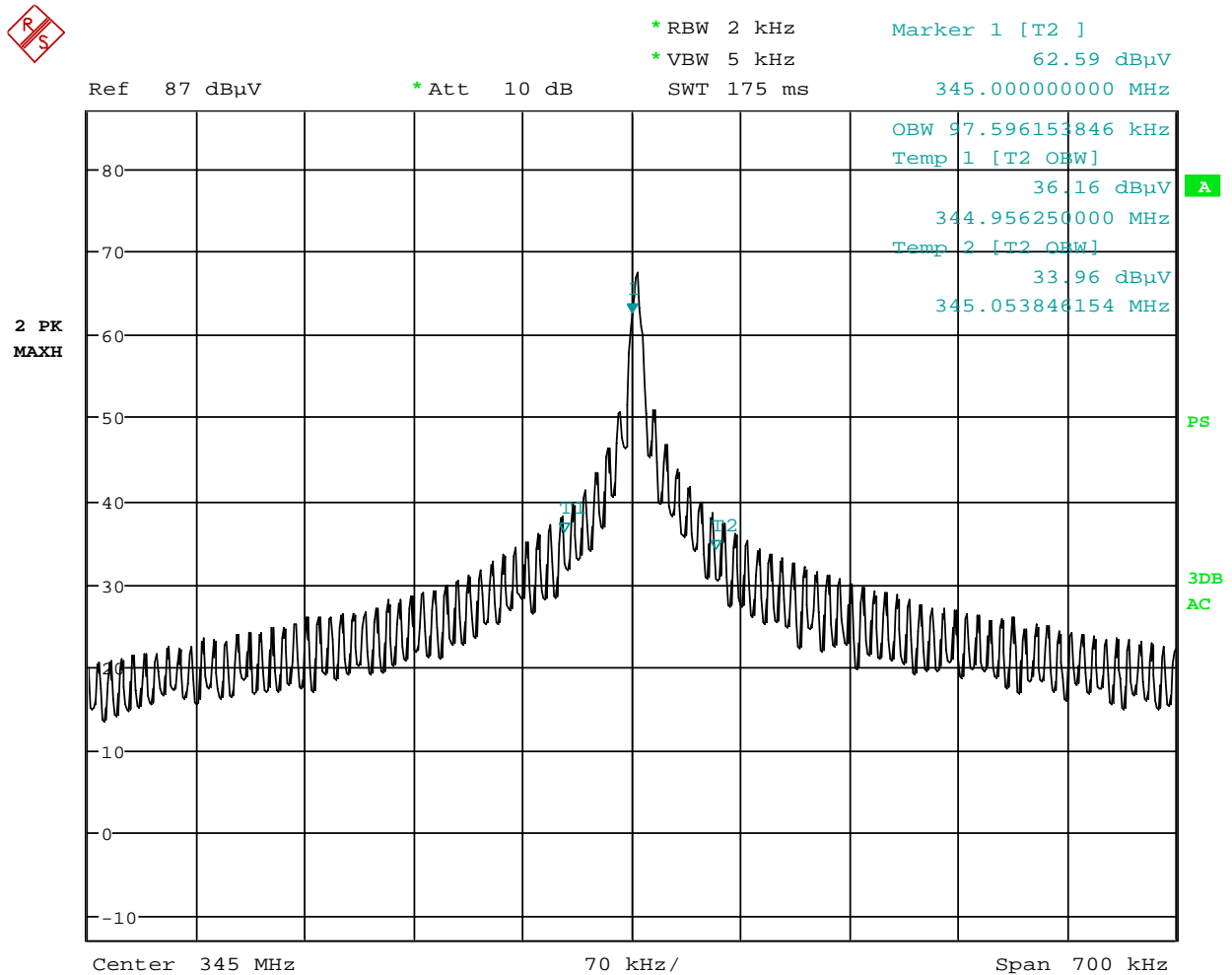
| Description | Serial Number | Manufacturer | Model | Cal. Date | Cal. Due |
|-------------------|---------------|-----------------|-------|-----------|-----------|
| EMI Test Receiver | 10887490.26 | Rohde & Schwarz | ESU40 | 9/19/2016 | 9/19/2017 |

5.7 Results: 20dB Bandwidth Measurement



(345MHz) 20dB Bandwidth = 28.05 kHz

5.8 Results: 99% Bandwidth Measurement



(345MHz) 99% Bandwidth= 97.60 kHz

6 Radiated Spurious Emissions (Transmitter)

6.1 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 |

¹Linear 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 |

6.2 Test Procedure

ANSI C63.10: 2013

6.3 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 dB μ V/m

RA = Receiver Amplitude in dB μ V

AF = Antenna Factor in dB

CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dB μ V

AF = 18.52 dB

CF = 0.78 dB

$$FS = 19.48 + 18.52 + 0.78 = 38.78 \text{ dB}\mu\text{V/m}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(38.78 \text{ dB}\mu\text{V/m})/20] = 86.89 \mu\text{V/m}$$

6.4 Test Equipment Used:

| Description | Serial Number | Manufacturer | Model | Cal. Date | Cal. Due |
|--------------------|-----------------|-----------------|--------------------------------|-------------|-------------|
| EMI Test Receiver | 10887490.26 | Rohde & Schwarz | ESU40 | 9/19/2016 | 9/19/2017 |
| Preamplifier | 122005 | Rohde&Schwarz | TS-PR18 | 11/17/2016 | 11/17/2017 |
| Biconnilog Antenna | 00051864 | ETS | 3142C | 2/4/2016 | 2/4/2017 |
| Horn Antenna | 00154521 | ETS | 3117 | 11/14/2016 | 11/14/2017 |
| 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 |

6.5 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.

Worst Case Spurious Measurements (345MHz)**Fundamental**

| Frequency (MHz) | Final Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Height (cm) | Pol | Azimuth (deg) | Measured (dBµV/m) | Duty Cycle Correction Factor (dB) | Measurement Detector |
|-----------------|-----------------------|----------------|-------------|-------------|-----|---------------|-------------------|-----------------------------------|----------------------|
| 345.02 | 95.41 | 97.26 | 1.85 | 104.4 | H | 319 | 95.41 | 0 | MaxPeak |
| 345.02 | 74.08 | 77.26 | 3.18 | 104.4 | H | 319 | 95.41 | -21.33 | Average |

Spurious Emissions

| Frequency (MHz) | Final Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Height (cm) | Pol | Azimuth (deg) | Measured (dBµV/m) | Duty Cycle Correction Factor (dB) | Detector |
|-----------------|-----------------------|----------------|-------------|-------------|-----|---------------|-------------------|-----------------------------------|-----------|
| 690.03 | 24.64 | 57.26 | 32.62 | 104.2 | H | 18 | 45.97 | -21.33 | QuasiPeak |
| 1035.0059 | 26.19 | 57.26 | 31.07 | 129 | V | 146 | 47.52 | -21.33 | MaxPeak |
| 1380.0045 | 24.74 | 57.26 | 32.52 | 182 | H | 0 | 46.07 | -21.33 | MaxPeak |
| 1725.0115 | 32.26 | 57.26 | 25.00 | 192 | H | 8 | 53.59 | -21.33 | MaxPeak |
| 2069.9646 | 26.32 | 57.26 | 30.94 | 200 | H | 10 | 47.65 | -21.33 | MaxPeak |
| 2415.0083 | 35.88 | 57.26 | 21.38 | 161 | H | 4 | 57.21 | -21.33 | MaxPeak |
| 2759.9338 | 27.70 | 57.26 | 29.56 | 100 | H | 321 | 49.03 | -21.33 | MaxPeak |
| 3105.0213 | 28.60 | 57.26 | 28.66 | 127 | H | 315 | 49.93 | -21.33 | MaxPeak |
| 3450.0352 | 25.26 | 57.26 | 32.00 | 100 | H | 247 | 46.59 | -21.33 | MaxPeak |
| 3794.9995 | 31.67 | 57.26 | 25.59 | 142 | H | 323 | 53.00 | -21.33 | MaxPeak |
| 4139.9162 | 25.57 | 57.26 | 31.69 | 134 | H | 188 | 46.90 | -21.33 | MaxPeak |
| 4485.0422 | 30.62 | 57.26 | 26.64 | 134 | H | 250 | 51.95 | -21.33 | MaxPeak |
| 4830.0752 | 33.55 | 57.26 | 23.71 | 100 | H | 204 | 54.88 | -21.33 | MaxPeak |
| 5174.9720 | 30.40 | 57.26 | 26.86 | 100 | H | 154 | 51.73 | -21.33 | MaxPeak |
| 5519.9240 | 31.80 | 57.26 | 25.46 | 138 | H | 270 | 53.13 | -21.33 | MaxPeak |

7 Antenna Requirement per FCC Part 15.203

7.1 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.

7.2 Results:

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

8 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 | |

9 Revision History

| Revision Level | Date | Report Number | Notes |
|----------------|-----------|------------------|----------------|
| 0 | 1/16/2017 | 102839440LEX-001 | Original Issue |
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