

Emissions Testing  
Performed  
On the Wireless Smoke Detector

**Model: SA400**

To FCC Part 15, Subpart C

Date of Test: July 12 and 13, 2000

JOB # J20019208

DOT: July 12 and 13, 2000  
Contact: Harry Pashkoff

Total No. of Pages Contained in this Report: 25 Including this cover.

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TO: Mr. Harry Pashkoff

FROM: Andy Bellezza

DATE: July 13, 2000

JOB #: J20019208

RE: Emissions Testing Performed On The Wireless Smoke Detector, Model: SA400

On July 12 and 13, 2000 we tested the Wireless Smoke Detector, Model: SA400 to determine if it was in compliance with the FCC Part 15 requirements, Subpart C, Section §15.231. A production version of the sample was received in good condition on July 12, 2000. We found that the unit met the Part 15 requirements when tested as received.

Fundamental output power is regulated under §15.231.

Harmonic emissions, which lie in the forbidden bands of §15.205, are required to meet the General Radiated Emission Limits of §15.209.

Table 1 shows the maximum level of the fundamental signal at 312.00 MHz was 70.0 dB $\mu$ V/m, which is 5.4 dB below the FCC limit. The worst case harmonic emission was 10.8 dB below the FCC limit. Please note that an average factor was applied to the level of the fundamental emission for comparison to the FCC limits. A duty cycle of 32.2 % was measured, and the corresponding average factor of – 9.8 dB was determined (see table 1, page 15).

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The maximum occupied bandwidth is determined by the operating frequency. The bandwidth must be less than 0.25% of the operating frequency. For a device operating at 312.0 MHz, the bandwidth limit of 780.0 kHz applies. The measured bandwidth of this signal was 355.0 kHz, which is significantly less than the FCC requirement. A bandwidth plot can be shown in the Bandwidth section of the report (see plot 1, page 16).

In summary, this report confirms that the SA400 is compliant with the FCC Part 15, Subpart C requirements when production units conform to the initial sample. Please address all questions and comments concerning this report to Scott M. Lambert, Telco Team Leader.

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**LABORATORY MEASUREMENTS**

**Pursuant To  
Part 15, Subpart C  
For  
Intentional Radiators**

**Manufacturer  
(Name and Address):**

**Ademco-Alarm Device Mfg. Co.**  
165 Eileen Way  
Syosset, NY 11791      USA

**Attention:**

**Mr. Harry Pashkoff**

**Model Number:**

**SA400**

**Serial Number:**

**14162H**

**Certification**

We attest to the accuracy of this report:



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Signature

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Andrew J. Bellezza

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Engineer

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Sr. Project Engineer

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Title

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Signature

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Reviewer

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Title

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### Introduction

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C, General Requirements.

- A. **Test Set-Up:** The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4 (1992).
1. The test site is a fiberglass structure with a groundplane. The site has attenuation characteristics which meet the requirements of ANSI C63.4 (1992). Information on the site has been filed with the FCC as required by Rule §2.948. The address of the site is 70 Codman Hill Road, Boxborough, MA 01719.
  2. Power to the site is nominal line voltage of 117 V<sub>AC</sub> and 230 V<sub>AC</sub>, 60 Hz.
  3. The equipment under test (EUT) is placed on a wooden turntable, ½ meter by 1 meter and is 0.80 meters in height above the groundplane. During the radiated emissions test, the turntable is rotated to find the configuration resulting in maximum emissions. The antenna height and polarization are also varied during the search for maximum signal levels. The height of the antenna is varied from one meter to four meters.
  4. Detector function for radiated emissions is in peak or quasi-peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings according to the following formula:

$$\text{Averaging Factor in dB} = 20 \text{ LOG (duty cycle)}$$

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### A. Test Set Up (cont'd)

The time period over which the duty cycle is measured is 100 msec. The worst-case (highest percentage on) duty cycle is used and described specifically in the data section. The duty cycle is measured by placing the spectrum analyzer in zero scan (receiver mode) and linear mode at maximum bandwidth (3 MHz at 3 dB down) and viewing the resulting time domain signal output from the analyzer on a Tektronix 380 TDS Oscilloscope. The oscilloscope is used because of its superior time base and triggering facilities. A drawing or photograph of the worst-case duty cycle as detected in this manner is included as an attached page.

5. If required, antennas used below 1000 MHz were Compliance Design, Inc. Roberts B-1000 Biconical Antennas. For measurements between 1000 MHz and 18000 MHz, where required, an Emco Double-Ridge Guide Horn Antenna was used. Alternately, for measurements above 1 GHz, an EMCO M/N 3115 Horn Antenna may have been used.

6. The field strength measuring equipment used included:

|                                   |                        |
|-----------------------------------|------------------------|
| EMI Receiver:                     | Hewlett Packard 8542 E |
| Spectrum Analyzer:                | Tektronix 2784         |
| Preamplifier:                     | None                   |
| Additional equipment or comments: | Hewlett Packard 8593 E |

All equipment used for testing of the SA400 is calibrated at one-year intervals.

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### A. Test Set Up (cont'd)

7. The frequency range to be scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency, or 40 GHz, whichever is lower. For line-conducted emissions, the range scanned is 450 kHz to 30 MHz.
8. The EUT is warmed up for 15 minutes prior to the test. If battery powered, a new battery is used.
9. Conducted measurements were made as described in ANSI C63.4 (1992). An IF bandwidth of 10 kHz is used, and peak or quasi-peak detection is employed.
10. The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application No. 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report. Above 1000 MHz, a bandwidth of 1 MHz is generally used.
11. Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the forbidden bands and above 1 GHz (where no preamplifier is used), signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.

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### **A. Test Set Up (cont'd)**

12. For measurements made in the 9 kHz to 30 MHz range, a distance of 30 meters was used unless a good signal-to-noise ratio could not be obtained. In that case, a closer distance was used and that distance is so marked in the data table.

### **B. This transmitter was found to meet the requirements of Part 15, Subpart C, Section §15.209, General Requirements.**

1. The emissions of the transmitter will not exceed the levels defined in §15.209(b).
2. Line-conducted emissions will be below the requirements of Rule §15.207.
3. The device does not operate in any of the restricted bands listed in §15.205(a).

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### C. Miscellaneous Information

- |     |                                                              |                                   |
|-----|--------------------------------------------------------------|-----------------------------------|
| 1.  | <b>Manufacturer:</b>                                         | Ademco-Alarm Device Mfg. Co.      |
| 2.  | <b>Grantee:</b>                                              | Ademco-Alarm Device Mfg. Co.      |
| 3.  | <b>Model No.:</b>                                            | SA400                             |
| 4.  | <b>Trade Name:</b>                                           | Wireless Smoke Detector           |
| 5.  | <b>Serial No.:</b>                                           | 14162H                            |
| 6.  | <b>Date of Test:</b>                                         | July 12 and 13, 2000              |
| 7.  | <b>Frequencies to which device can be tuned:</b>             | 312.0 MHz only                    |
| 8.  | <b>Can customer tune device?</b>                             | No                                |
| 9.  | <b>Detailed description of operation pursuant to 15.209:</b> | Some restricted band frequencies. |
| 10. | <b>Applicable emissions limits:</b>                          | §15.205, §15.209 and §15.231      |
| 11. | <b>Additional Comments:</b>                                  | None.                             |

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### Measurements of Bandwidth

The plot on the following page shows the fundamental emission when modulated with a worst-case bit sequence. From the plot, the bandwidth is observed to be 355 kHz at 20 dBc. The bandwidth limit is 780 kHz. The unit meets the FCC bandwidth requirements. Please note the following:

|            |                   |
|------------|-------------------|
| Frequency: | <u>312.00 MHz</u> |
| Span:      | <u>2.0 MHz</u>    |
| RBW:       | <u>120 kHz</u>    |
| Bandwidth: | <u>355 kHz</u>    |

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### Derivation of Averaging Factor

The repetition cycle of the EUT is less than 100 ms. the averaging factor is determined as follows:

|                           |                   |
|---------------------------|-------------------|
| Word Cycle:               | <u>0.638</u> mSec |
| Effective Period of Word: | <u>1.050</u> mSec |
| Duty Cycle of Word:       | <u>60.8</u> %     |

|                                  |                   |
|----------------------------------|-------------------|
| Period of Single Bit:            | <u>20.75</u> mSec |
| Effective Period of Digital "1": | <u>41.0</u> mSec  |
| Duty cycle of a Digital "1":     | <u>53.5</u> %     |

|                   |               |   |                |
|-------------------|---------------|---|----------------|
| Total Duty Cycle: | 0.608 x 0.535 | = | <u>32.22</u> % |
|-------------------|---------------|---|----------------|

Average Factor = 20 Log (total duty cycle) - 9.8 dB

**Discussion of Pulse De-sensitivity**

The determination of pulse de-sensitivity was made in accordance with Hewlett Packard Application Note 150-2, *Spectrum Analysis ... Pulsed RF*.

Pulse de-sensitivity was not applicable for this device.

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### Configuration Information

|                              |                         |
|------------------------------|-------------------------|
| <b>Equipment Under Test:</b> | Wireless Smoke Detector |
| <b>Model:</b>                | SA400                   |
| <b>Serial No.:</b>           | 14126H                  |
| <b>FCC Identifier:</b>       | N/A                     |
| <b>Support Equipment:</b>    | None.                   |
| <br>                         |                         |
| <b>Cables:</b>               | None.                   |

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### Configuration Photographs

#### Worst-Case Radiated Emissions



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The following equipment was used to make measurements for emissions testing (the equipment abbreviation corresponds to a measuring device on the following calibration list):

| Description       | Manufacturer    | Model | Serial #   | Cal Due    |
|-------------------|-----------------|-------|------------|------------|
| RECEIVER          | HEWLETT PACKARD | 8542E | 3625A00188 | 01/19/2001 |
| ANTENNA           | EMCO            | 3142  | 9711-1223  | 10/12/2000 |
| HORN ANTENNA      | EMCO            | 3115  | 9610-4980  | 08/12/2001 |
| SPECTRUM ANALYZER | HEWLETT PACKARD | 8593E | 3829A03589 | 06/01/2001 |

**Test Data**

**Radiated Disturbance  
Radiated Emissions / Interference**

Table: 1

Company: **Ademco**  
 Model: **SA400**  
 Job No.: **J20019208**  
 Date: 07/13/00  
 Standard: FCC Part 15, Subpart C, Section 231  
 Class: None  
 Notes:

Tested by: Andy Bellezza  
 Location: Site 3C  
 Detector: HP8542E, HP8593E  
 Antenna: LOG3, Horn 3  
 PreAmp: None  
 Cable(s): CBL302S  
 Distance: **3** meters

| Ant. Pol. (V/H) | Frequency MHz   | Reading dB(uV) | Averaging Factor (dB) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | Distance Factor dB | Net dBuV/m | Limit dBuV/m | Margin dB |
|-----------------|-----------------|----------------|-----------------------|------------------------|---------------|-------------------|--------------------|------------|--------------|-----------|
| H               | 312.000         | 65.0           | -9.8                  | 13.6                   | 1.2           | 0.0               | 0.0                | 70.0       | 75.4         | -5.4      |
| H               | 624.000         | 24.2           | -9.8                  | 21.1                   | 2.7           | 0.0               | 0.0                | 38.1       | 55.4         | -17.3     |
| V               | 936.000         | 24.7           | -9.8                  | 24.3                   | 3.3           | 0.0               | 0.0                | 42.5       | 55.4         | -12.9     |
| H               | <b>1248.000</b> | 22.3           | -9.8                  | 26.4                   | 4.3           | 0.0               | 0.0                | 43.2       | 54.0         | -10.8     |

Measurements from the 4th harmonic to the 10th were at the noise floor of the measuring receiver. Frequencies shown in bold reside in the restricted band shown in FCC Part 15, Section 205.

| Derivation of Averaging Factor: |          |                                     |                 |
|---------------------------------|----------|-------------------------------------|-----------------|
| Length of Digital "1":          | 0.64 mS  | Averaging Factor = 20*Log(0.3223) = | <b>-9.83 dB</b> |
| Period of Digital "1":          | 1.05 mS  |                                     |                 |
| Length of Word:                 | 21.75 mS |                                     |                 |
| Period of Word:                 | 41.00 mS |                                     |                 |
| Total Duty Cycle:               | 32.23 %  |                                     |                 |

**END**

Test Data

Bandwidth Plot

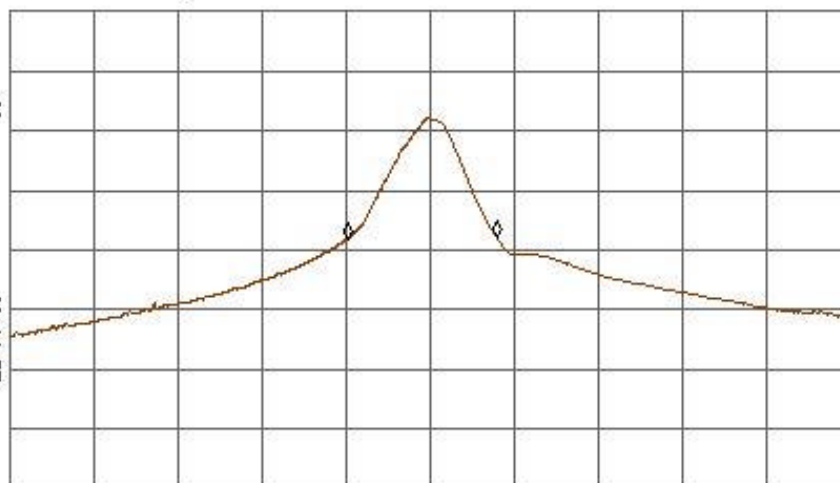
10:08:19 JUL 12, 2000  
A

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR  $\Delta$  355 kHz  
.16 dB

LOG REF B2.0 dB $\mu$ V

10  
dB/  
ATN  
10 dB

MA SB  
SC FC  
CORR



CENTER 312.000 MHz SPAN 2.000 MHz  
#IF BW 120 kHz AVG BW 300 kHz #SWP 50.0 msec

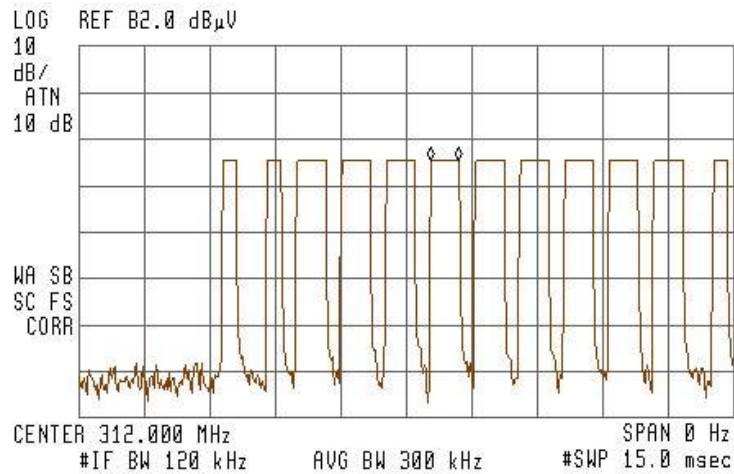
Plot 1: Bandwidth Plot

Test Data

Duty Cycle Plots

11:07:25 JUL 12, 2000  
A

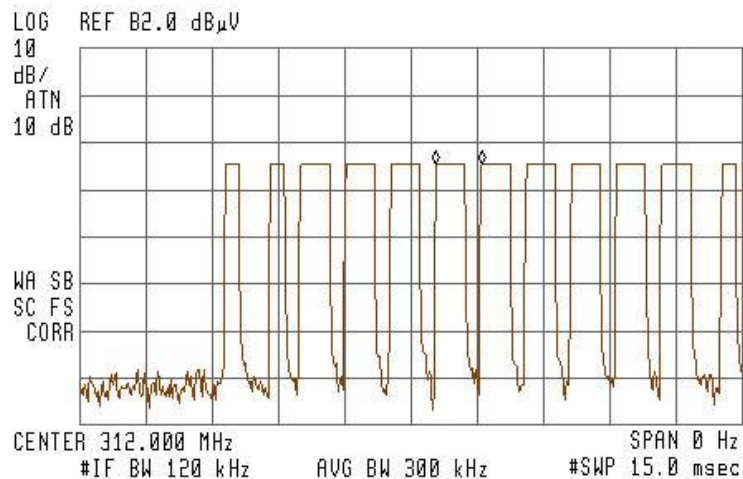
ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKRΔ 638.00 μsec  
.10 dB



Plot 2: Bit Length

11:21:44 JUL 12, 2000  
A

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKRΔ 1.0500 msec  
.03 dB



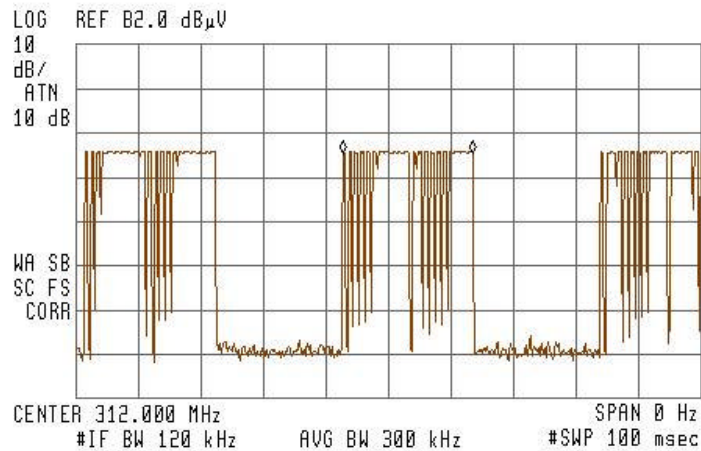
Plot 3: Bit Period

Test Data

Duty Cycle Plots Continued

10:34:04 JUL 12, 2000  
A

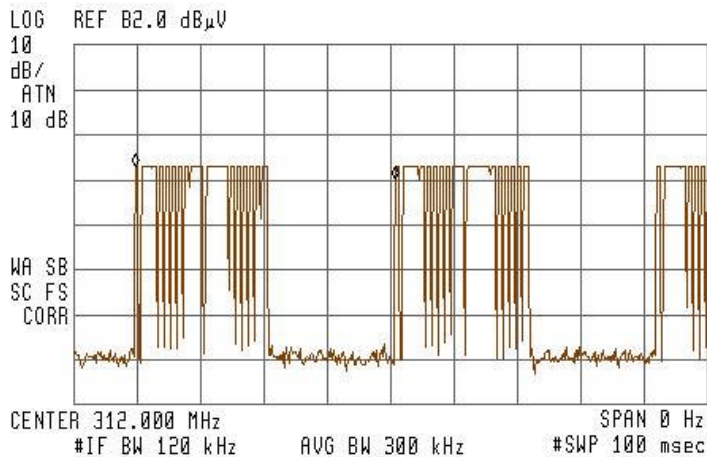
ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKRΔ 20.750 msec  
-.03 dB



Plot 4: Word Length

11:41:55 JUL 12, 2000  
A

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKRΔ 41.000 msec  
-2.94 dB



Plot 5: Word Period

**Certification Photos**



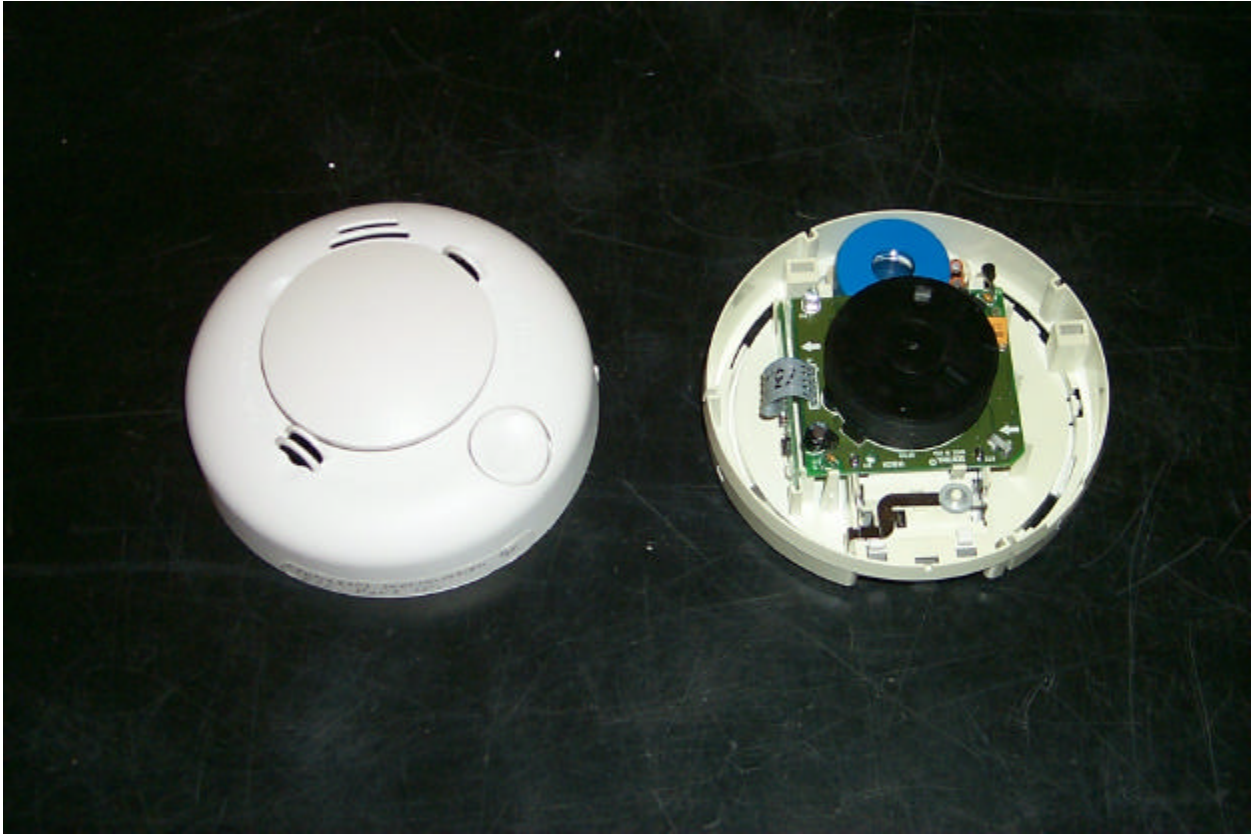
**Photo 1: Picture of EUT with covers on.**

Certification Photos Continued



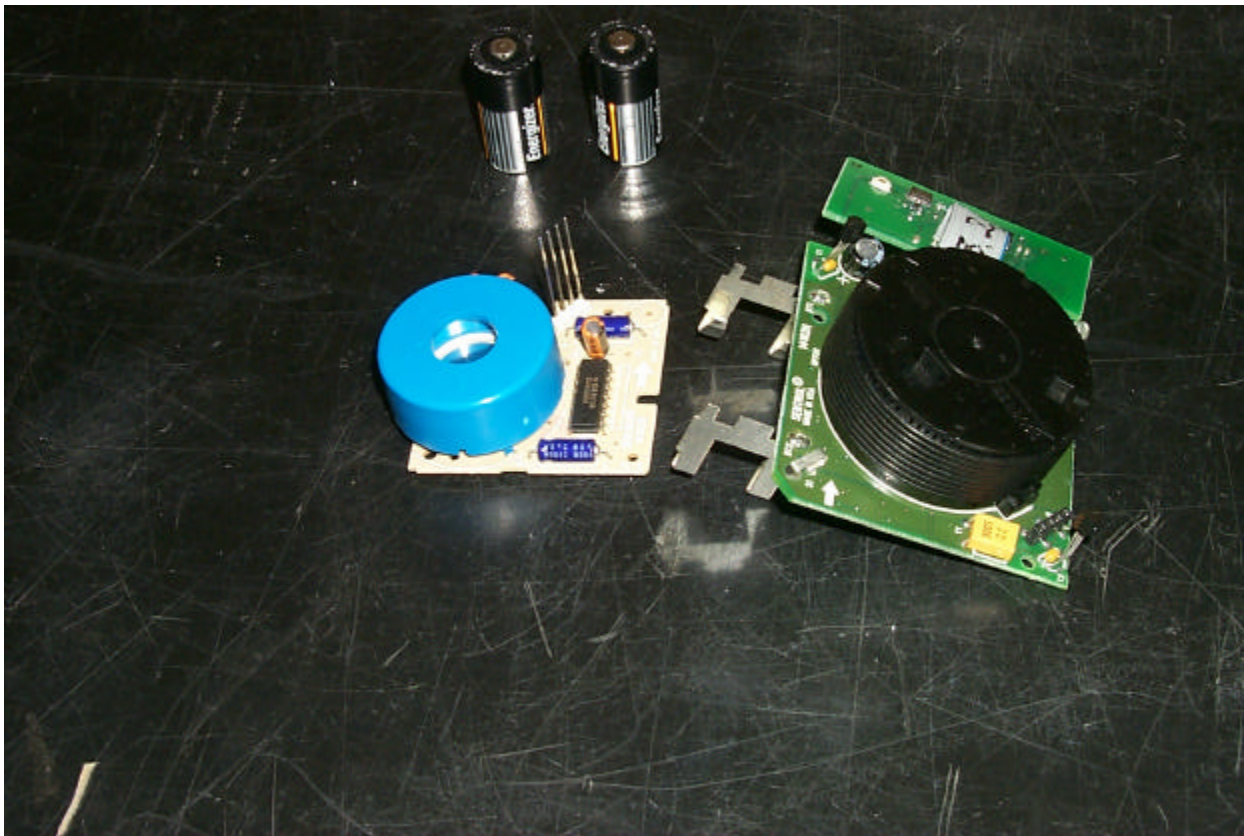
Photo 2: Picture showing side of EUT where device mounts to wall or ceiling.

**Certification Photos Continued**



**Photo 3: Cover removed showing internal circuitry.**

Certification Photos Continued



**Photo 4: Circuit boards removed, speaker board on left, detector and transmitter on right. Two lithium power cells in the background.**

Certification Photos Continued

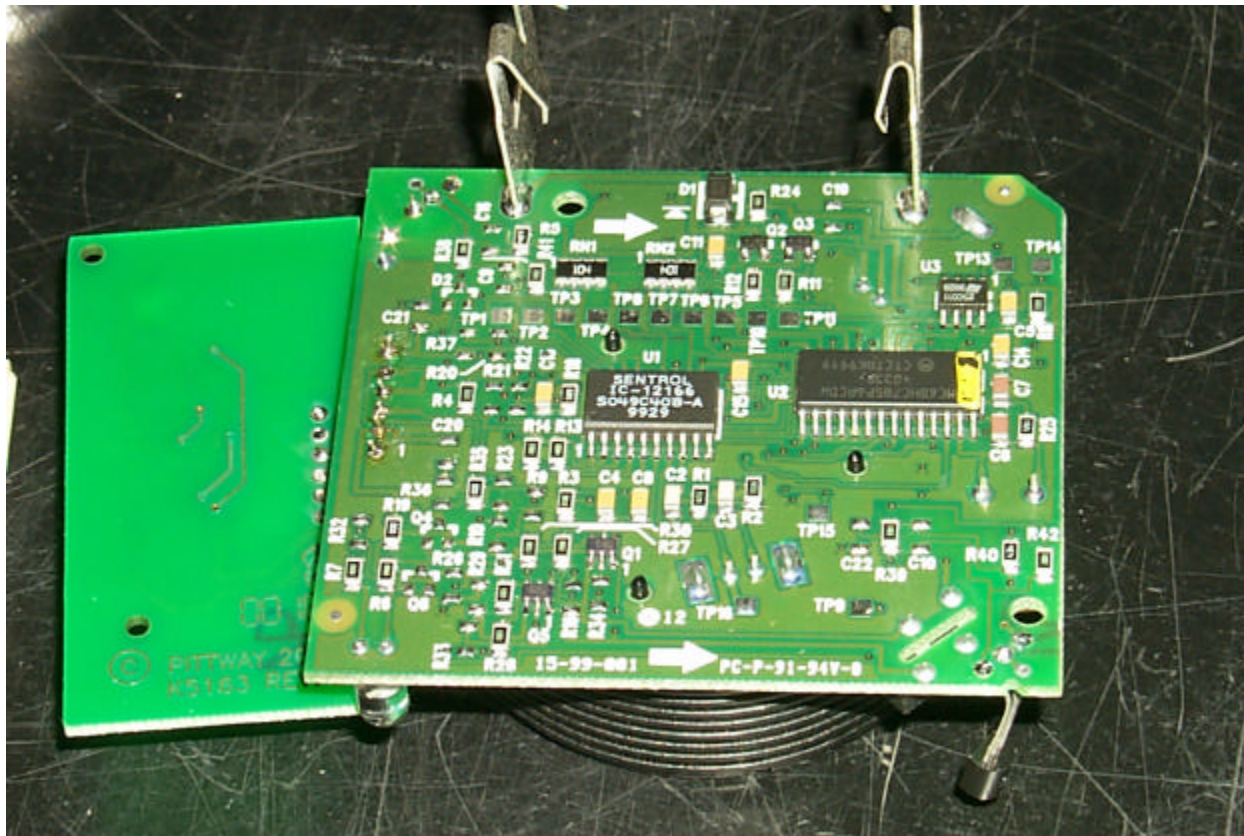
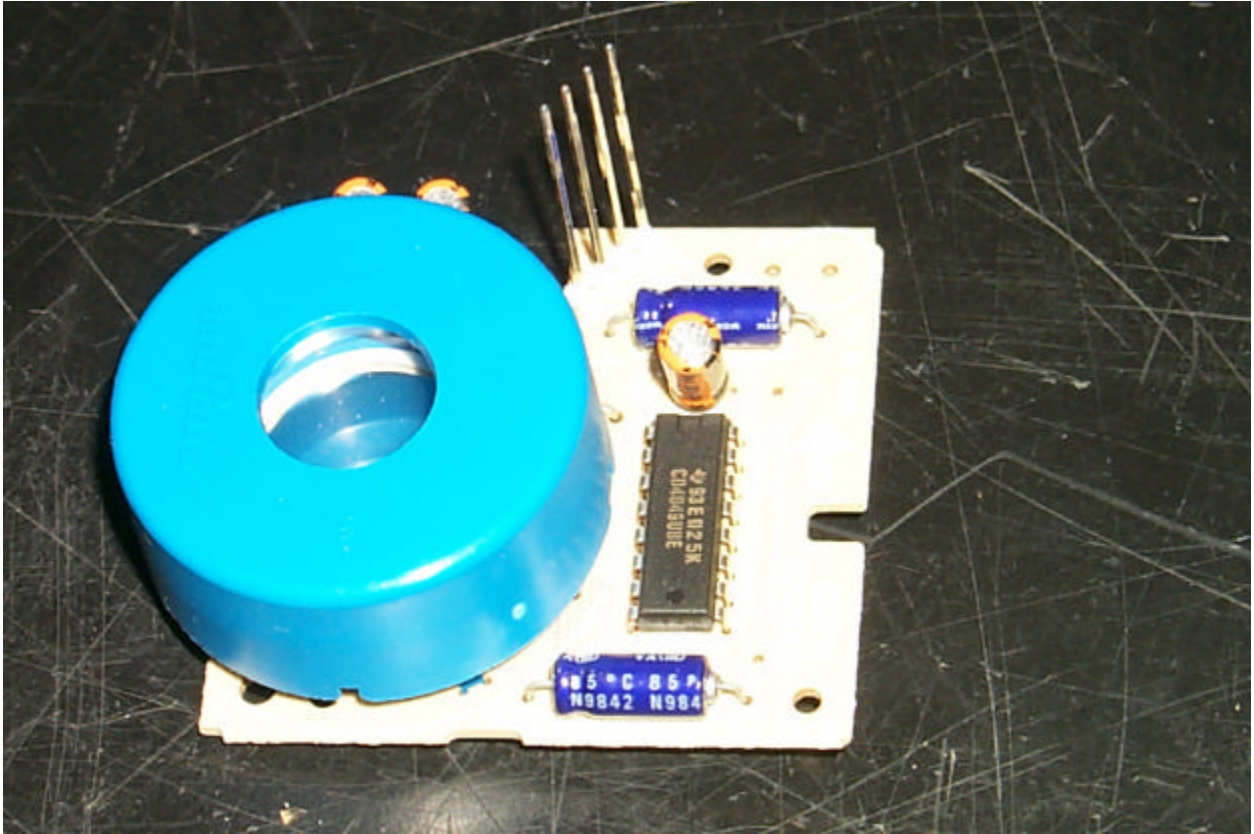


Photo 5: Close up of bottom of detector/transmitter board.

Certification Photos Continued



**Photo 6: Close up of top of speaker board.**