GE Security, Inc.
900MHz Smoke Detector
B4Z-844-SMOKE
Certification

GE Security, Inc

900MHz Smoke Detector
B4Z-844-SMOKE

9/2/2004

GE Security, Inc.
1275 Red Fox Road
Arden Hills, MN 55112
(651) 777-2690

GE Security, Inc

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1. Introduction

This device is a smoke detector. The RF transmitter portion of the circuit resides on a daughterboard. It connects to a larger circuit board (the motherboard) via a 6-pin ribbon cable. The motherboard provides signals that cause the daughterboard to transmit. It transmits data via a 902 - 928MHz Frequency Hopping Spread Spectrum (FHSS) link to a base station receiver. The base station receiver may in turn be connected to a personal computer or security panel via a hardwired connection.

Power is supplied over the header connection by two standard CR123 LiMNO2 3V batteries connected in parallel on the smoke detector motherboard. The enclosure measures approximately 5.5″ diameter by 2.5″ high. The unit weighs approximately 5 ounces. The antenna is soldered to the daughterboard and is internal to the enclosure.

The transmitter uses the 902-928MHz ISM band, operating as a FHSS device. We are requesting Certification under FCC Rules, Part 15, Subpart C, Paragraph 15.247.

Please send comments/suggestions on the report to paul.saldin@ge.com.

Grantee Code: B4Z

2. Statement of Compliance

§2.907 <u>Certification</u>
This is an application for certification

§2.911 <u>Application</u>
a)   This is an application and has been filed electronically with form
       731.
b)   All information required has been supplied.
c)   The applicant has signed the application (electronically).
d)   The technical data has been signed.
e)   Applicant signature block on electronic form 731 completed by officer of
       the company or authorized company personnel.
f)   The appropriate fee has been paid electronically with VISA on 9/2/2004.

§2.915 <u>Grant</u>
This application demonstrates that all applicable technical standards have been met and a grant of this application will serve the public interest.

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§2.925 <u>Label</u>
Each piece of equipment for which authorization will be granted will be uniquely identified with "FCC ID: B4Z-844-SMOKE." The required statement will appear with the FCC ID on the product. See Exhibit A, "*ID label.pdf*".

§2.947 <u>Measurement Procedure</u>
a) The scan of the restricted bands was made in a radiated manner. The radiated measurement procedure follows ANSI C63.4 procedure.
b) All other RF measurements were made in a conducted manner.
c) Procedural notes are contained in the laboratory report.
d) A list of test equipment used is contained in the laboratory report.

§2.948 <u>Description of Measurement Facilities</u>
Measurements were performed at TUV Testing Services Open Test Site. The FCC keeps a full description of the measurement facilities on file. TUV's acceptance and approval is dated as December 5, 1993 in a letter received from the FCC.

The address of the test facility is:
TUV Product Service
19035 Wild Mountain Road
Taylors Falls, MN 55084-1758

Phone: 651-638-0297
Contact: Joel Schneider
                Test Engineer in Charge

See Exhibit B, "*test_pho.pdf*", for sketch of radiated measurement setup.

§2.1033 <u>Application for Certification</u>
a) Form 731 has been electronically filed on 9/2/2004. Items that did not apply were left blank.
b) This technical report contains the following information where applicable.
    1) Full name and mailing address of manufacturer and applicant for certification:
        GE Security, Inc.
        1275 Red Fox Road
        Arden Hills, MN 55112
    2) FCC Identifier:
        B4Z-844-SMOKE
    3) Copy of installation instructions:

See Exhibit C, "*install_man.pdf*"

4) Brief Description of circuit functions and device operation:
    See Exhibit D, "*op_desc.pdf*" for operational description.
    See Exhibit E, "*schematic.pdf*" for schematic.
    See Exhibit F, "*ppd1.pdf*" and "*ppd2.pdf*" for parts placement diagrams.

5) Block Diagram
    See Exhibit G, "*block.pdf*".

6) Report of the measurements of radiated and conducted emissions:
    Exhibits P through Z show data and plots, and are discussed later in this report.

7) Photographs
    External:
        See Exhibit H, "*extern.pdf*".
    Internal:
        See Exhibit I, "*intern.pdf*".

8) Peripheral or Accessory devices:
    There are no peripheral or accessory devices designed to operate with this product.

9) Transition Rules
    This application is not pursuant to the transition rules of §15.37.

10) Application for scanning receivers:
    Not applicable to this device.

11) Application for operation within the 59 – 64GHz band:
    Not applicable to this device.

c) Composite Systems
Not applicable to this device.

3. Lab Measurements Discussion / Test Notes

3.1 Frequencies to be Examined [§15.31(m)]

In accordance with the guidelines of §15.31(m), all conducted and radiated measurements were performed at the lower, middle, and upper frequencies of the 902-928MHz band.

3.2 Antenna Requirement [§15.203]

The transmitter antenna is permanently soldered to the circuit board, and therefore complies with the requirement that no other antenna shall be used with the device.

3.3 Antenna Characteristics [§15.204]

There is only one antenna proposed for use with this device. This antenna has the following characteristics:

3.3.1 Antenna Type

The antenna is approximately a ¼ wave monopole at 900MHz.

3.3.2 Antenna Manufacturer

None; the antenna is a simple metal rod soldered to the circuit board.

3.3.3 Antenna Gain

The ¼ wave monopole is a well known antenna type. The theoretical gain of an ideal ¼ wave monopole is 5.15dBi. The antenna on this transmitter has some non-ideal characteristics, finite ground plane being the most significant. Therefore, the antenna gain will be somewhat lower than the ideal number of 5.15dBi.

3.4 Public Utility Power Line Measurements [§15.207]

This device does not connect to the AC power lines.

3.5 Frequency Hopping System Description[§15.247(a)]

This system meets the definition of a frequency hopping spread spectrum system as follows:

3.5.1 Carrier Frequency Separation

Carrier frequency separation is 524kHz. This meets the requirement that it be greater than the 20dB bandwidth, which is 105kHz. See Exhibit P, *"channel separation.pdf"* and Exhibit Q, "*20dB bandwidth.pdf*".

3.5.2 Randomization of Hopping Frequencies

A pseudorandomly ordered list of 50 hopping frequencies is used for carrier frequency selection. This list resides in non-volatile memory within the microcontroller. On each new hop, the software selects the next frequency in the list, resulting in a pseudorandom

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distribution and an equal use of each frequency on average. See Exhibit J, "*random freq list.pdf*".

3.5.3 System Receiver Description
See Exhibit D, "*op_desc.pdf*" for a description of the system receiver.

3.5.4 Number of Hopping Frequencies
The system uses 50 hopping frequencies as required. See Exhibit J, "*random freq list.pdf*" for the list of the frequencies. See Exhibit R, "*number of hopping frequencies.pdf*" for a plot showing usage of 50 frequencies. This plot was made by setting the spectrum analyzer to peak hold and presenting the transmitter with a continuous data stream.

3.5.5 Time of Occupancy
The dwell time on each frequency is 55.5msec. See Exhibit S, "*dwell time.pdf*" for a plot of the packet length. The software enforces a minimum interpacket delay of 46msec. This minimum delay between hops, in conjunction with the provision that all 50 hopping frequencies are used equally on average, guarantees that the transmitter shall not occupy any frequency for more than 0.4 seconds in a 20 second period.

3.5.6 20dB Bandwidth
The 20dB bandwidth of the modulated transmission is 105kHz. This complies with the requirement that the bandwidth be less than 500kHz. See Exhibit R, "*20dB Bandwidth.pdf*".

3.6 Output Power [*§15.247(b)*]

3.6.1 Peak Output Power
The peak output power of the transmitter is in compliance with the 1W limit for the low, middle and high channels. This data was taken with the unit operating in a continuous (non-modulated) manner. See Exhibit T, "*conducted emissions.pdf*" for the conducted test data.

3.6.2 De Facto EIRP Limit
The gain of the transmit antenna is given earlier in this report. Because the gain of the antenna is less than 6dBi, the peak output power need not be reduced to comply with this requirement.

3.6.3 RF Exposure Compliance Requirements
This device is not intended to operate within 20cm of a person's body.   Therefore, RF exposure requirements are not applicable to this application for certification.

3.7 Spurious Emissions [§15.247(c)]

3.7.1 Band-Edge Compliance

The transmitter was found to comply with the 20dB-down band-edge requirements with the hopping function both disabled and enabled.

In order to test with the hopping function disabled, the transmitter was put in a special mode in which it was locked on the low channel. Repeated data packets were then transmitted with the spectrum analyzer on peak hold at the low channel.   The same test was then repeated for the high channel. The results of these tests are shown in Exhibit V, "*lower band edge no hop.pdf*" and Exhibit W, "*upper band edge no hop.pdf*".

The hopping function was then enabled, and packets were transmitted until many had occurred at the low channel. The spectrum analyzer was once again on peak hold at the low channel. The same test was then repeated for the high channel. The results of these tests are shown in Exhibit X, "*lower band edge hop.pdf*" and Exhibit Y, "*upper band edge hop.pdf*".

3.7.2 Spurious RF Conducted Emissions

Spurious emissions not lying in restricted bands were tested in a conducted manner. These emissions were tested with the transmitter tuned to low, mid, and high channels and transmitting in a continuous manner.

The 2nd and 7th are the only harmonics that lie in non-restricted bands. The power conducted at these harmonics was found to comply with the requirement that it be 20dB down from the fundamental. See Exhibit T, "*conducted emissions.pdf*" for the conducted test data.

3.7.3 Spurious RF Radiated Emissions

A complete scan was performed to determine the radiated field strength of spurious emissions falling within the restricted bands defined in §15.205. These emissions were tested with the transmitter tuned to low, mid, and high channels and transmitting in a continuous manner.

3.7.3.1 Calculation of allowed limit

For spurs above 1000MHz, §15.205(b) allows duty cycle averaging per §15.35. The following is the derivation of the allowed duty cycle correction factor for this transmitter.

The transmitter employs amplitude modulation and transmits 208 bits. Each bit has an "ON" time of 122 µS. The total on time of a single packet is:

$$208 * 122 \, \mu S = 25.376 \text{ msec.}$$

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The interpacket delay time of at least 45mS, enforced by the software, ensures that only one packet is sent in any given 100mS window. The duty cycle correction factor is therefore:

$$20*LOG(25.376/100) = -11.91 \text{ dB}$$

The raw limit for spurs falling above 960MHz is given in §15.209 as 500 microvolts per meter, or 54 dBuV/m. After applying the duty cycle correction factor, the limit for this transmitter for spurs above 1000MHz in the restricted bands is:

$$54 – (-11.91) = 65.91 \text{ dBuV/m}$$

3.7.3.2 Radiated Emissions Results

Results of the radiated scan are shown in Exhibit Z, "*radiated spurious emissions.pdf*". These results show that all spurs lying in restricted bands above 1000MHz fall below the 65.91 dBuV/m limit. The highest spur was 6.05dB below the limit at 4.51GHz.

3.8 True Frequency Hopping Compliance [§15.247(g)]

The use of the pseudorandomly ordered frequency table, described previously in this report, guarantees that this system shall distribute its transmissions equally over 50 hopping channels should it be presented with a continuous data stream.

3.9 Coordination of Systems [§15.247(h)]

This device incorporates only a 900MHz transmitter. There are no other means of signaling to external devices. Since this device therefore has no means of communicating with other FHSS transmitters, it has no ability to coordinate its hopping in an effort to avoid simultaneous occupancy of individual hopping frequencies.