frequency and a second signal at a second frequency, and a mixing element to mix the first and second signals, to generate a third signal at a third frequency, and the energy coupler to transmit the third signal to an EAS detection system.

The invention may also be embodied in a method comprising the steps of receiving a first and second signal at a first and second frequency at an RFID module; mixing the first and second signals at the RFID module; generating a third signal at a third frequency; and transmitting the third signal to an EAS detection system.

In accordance with a first aspect of the present disclosure, there is provided a system comprising: an RFID module comprising a memory storing identification information and an energy coupler to receive transmitted energy comprising a first signal at a first frequency and a second signal at a second frequency, and a mixing element to mix said first and second signals, to generate a third signal at a third frequency, and said energy coupler to transmit said third signal to an EAS detection system, wherein said first signal is a signal of an electromagnetic field and said second signal is a signal of a magnetic field.

In accordance with a second aspect of the present disclosure, there is provided a method comprising: receiving a first signal at a first frequency and a second signal at a second frequency at an RFID module comprising a memory storing identification information and an energy coupler; mixing said first and second signals at said RFID module with a mixing element; generating a third signal at a third frequency; and transmitting said third signal to an EAS detection system, wherein said first signal is a signal of an electromagnetic field and said second signal is a signal of a magnetic field.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of various embodiments of the invention, reference should be made to the following detailed description which should be read in conjunction with the following figures wherein like numerals represent like parts.

FIG. 1 illustrates a block diagram of a system in accordance with one embodiment.

FIG. 2 illustrates a block diagram of a wireless communication module in accordance with one embodiment.

FIG. 3 illustrates a schematic diagram of a module in accordance with one embodiment.

FIG. 4 illustrates a schematic diagram of a module in accordance with one embodiment.

FIG. 5 illustrates a system in accordance with one embodiment.

FIG. 6 illustrates a system in accordance with one embodiment.

FIG. 7 graphically illustrates a difference frequency component in accordance with one embodiment.

FIG. 8 graphically illustrates a difference frequency component in accordance with one embodiment.

FIG. 9 graphically illustrates a plot in accordance with one embodiment.

FIG. 10 illustrates a programming logic in accordance with one embodiment.

DETAILED DESCRIPTION

For simplicity and ease of explanation, the invention will be described herein in connection with various exemplary embodiments thereof. Those skilled in the art will recognize, however, that the features and advantages of the invention may be

CLAIMS

What is claimed is:

1. A system, comprising:

an RFID module (122, 214, 300, 400, 540, 602) comprising a memory (208) storing identification information and an energy coupler (124) to receive transmitted energy comprising a first signal (130, 514, 616) at a first frequency and a second signal (140, 524, 622) at a second frequency, and a mixing element to mix said first and second signals (130, 514, 616; 140, 524, 622), to generate a third signal (150, 544, 618) at a third frequency, and said energy coupler (124) to transmit said third signal (150, 544, 618) to an EAS detection system,

characterized in that

said first signal (130, 514, 616) is a signal of an electromagnetic field and said second signal (140, 524, 622) is a signal of a magnetic field.

2. The system of claim 1, wherein said RFID module (122, 124, 300, 400, 540, 602) is configured to receive and mix said first and second signals (130, 514, 616; 140, 524, 622), and to generate and transmit said third signal (150, 544, 618) to said EAS detection system irrespective of power supply voltage to said RFID module (122, 124, 300, 400, 540, 602).

3. The system of claim 1, further comprising:

a first transmitter (112, 510, 612) to transmit said energy comprising said first signal (130, 514, 616) at said first frequency in a controlled area; and

a second transmitter (114, 520, 630) to transmit said energy comprising said second signal (140, 524, 622) at said second frequency in said coverage area,

wherein said first and second signals (130, 514, 616; 140, 524, 622) form overlapping fields in said controlled area.

4. The system of claim 1, further comprising a receiver (116, 530, 614) to receive said third signal (150, 544, 618) and to detect a presence of said RFID module (122, 214, 300, 400, 540, 602) in said controlled area.

5. The system of claim 1, wherein said energy coupler (124) comprises an inductor and a capacitor.

6. The system of claim 1, wherein said first frequency is greater than said second frequency.

7. The system of claim 1, wherein said first frequency is selected from the group consisting of about 13.56 MHz and about 915 MHz.

8. The system of claim 1, wherein said second frequency is selected from the group consisting of about 8.2 MHz, about 111.5 kHz, and about 58 kHz.

9. The system of claim 1, wherein said third frequency is selected from the group consisting of about 5.36 MHz and 13.502 MHz.

10. The system of claim 1, wherein said mixer comprises a non-linear element.

11. The system of claim 10, wherein said non-linear element is selected from the group consisting of modulation impedance, tuning capacitor, varactor, metal oxide semiconductor (MOS) capacitor, complementary MOS capacitor, varactor diode capacitor, AC/DC converter, rectifier, diode, bipolar junction transistors, field effect transistor, magnetic element, and non-linear resonator.

12. The system of claim 1, wherein said energy coupler (124) comprises a dipole antenna (412) and a matching network (420).

13. The system of claim 1, wherein said second frequency is FSK modulated with a signal at a frequency ranging from 650-950 Hz.

14. A method, comprising:

receiving a first signal (130, 514, 616) at a first frequency and a second signal (140; 524; 622) at a second frequency at an RFID module (122, 214, 300, 400, 540, 602) comprising a memory (208) storing identification information and an energy coupler (124);

mixing said first and second signals (130, 514, 616; 140, 524, 622) at said RFID module with a mixing element;

generating a third signal (150, 544, 618) at a third frequency; and

transmitting said third signal (150, 544, 618) to an EAS detection system,

characterized in that

said first signal (130, 514, 616) is a signal of an electromagnetic field and said second signal (140, 524, 622) is a signal of a magnetic field.

15. The method of claim 14, wherein said receiving and mixing of said first and second signals (130, 514, 616; 140, 524, 622), and said generating and transmitting of said third signal (150, 544, 618) are performed irrespective of power supply voltage to said RFID module (122, 214, 300, 400, 540, 602).

16. The method of claim 14, further comprising:

transmitting said first signal (130, 514, 616) at said first frequency; and

transmitting said second signal (140, 524, 622) at said second frequency.

17. The method of claim 16, further comprising:

receiving said third signal (150, 544, 618) at said third frequency; and

detecting a presence of said RFID module (122, 214, 300, 400, 540, 602).

18. The method of claim 14, wherein receiving said first signal (130, 514, 616) at said first frequency comprises receiving said first signal (130, 514, 616) at a frequency selected from the group consisting of about 13.56 MHz and about 915 MHz.

19. The method of claim 14, wherein receiving said second signal (140, 524, 622) at said second frequency comprises receiving said second signal (140, 524, 622) at a frequency selected from the group consisting of about 8.2 MHz, about 111.5 kHz, and about 58 kHz.

20. The method of claim 16, wherein receiving said third signal at said third frequency comprises receiving said third signal at a frequency selected from the group consisting of about 5.36 MHz and about 13.502 MHz.

21. The method of claim 14, further comprising FSK modulating said second frequency.