coefficient for the antenna, in accordance with the information to generate the modulated signal; and, a decoder coupled to the delta-sigma modulator for generating the impedance value from the information. The variable impedance has a parallel array of impedances that are switched on and off, the parallel array of impedances including filtering characteristics capable of removing out-of-band noise received by the parallel array of impedances. The delta-sigma modulator is coupled to the parallel array of impedances and includes an over-sampling clock to set an over-sampling rate to over-sample the information. The decoder is a backscattering decoder and the information is an N-bit digital waveform that is adjusted by the decoder and the delta-sigma modulator to compensate for errors in the parallel array of impedances.

According to another aspect of the invention, there is provided a transmission apparatus for a wireless device, comprising: an inductor for receiving an original signal and for transmitting by mutual inductance a modulated signal containing information from the wireless device; a variable impedance coupled to the inductor, the variable impedance having an impedance value; a delta-sigma modulator coupled to the variable impedance for modulating the impedance value, and thereby a value of the mutual inductance, in accordance with the information to generate the modulated signal; and, a decoder coupled to the delta-sigma modulator for generating the impedance value from the information, wherein the information is a complex modulation signal that alternates between an in-phase signal and a quadrature signal via a control signal, and the variable impedance switches between impedance values that are 90 degrees offset from each other depending on whether the complex modulation signal is the in-

phase signal or the quadrature signal, and wherein the delta-sigma modulator includes an over-sampling clock to set an over-sampling rate to over-sample the information.

According to yet another aspect of the invention, there is provided a method of transmitting a signal by a wireless device, comprising: receiving an original signal on an antenna of the wireless device; backscattering a modulated signal containing information from the wireless device; generating the modulated signal in accordance with the information by modulating an impedance value of a parallel array of variable impedances coupled to the antenna and thereby a backscattering coefficient for the antenna, wherein an over-sampling clock coupled to a delta-sigma modulator sets an over-sampling rate to over-sample the information; generating the impedance values from the information by a decoder coupled to the delta-sigma modulator, the decoder being a backscattering decoder, wherein the information is an N-bit digital waveform that is adjusted by the decoder and the delta-sigma modulator to compensate for errors in the parallel array of impedances.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Features and advantages of the embodiments of the present invention will become apparent from the following detailed description, taken in combination with the appended drawings, in which:

[0018] FIG. 1 is a block diagram illustrating a radio frequency identification (RFID) system in accordance with the prior art;

[0019] FIG. 2 is a block diagram illustrating transmission of energy and data between a reader and a tag in a RFID system in accordance with the prior art;

[0020] FIG. 3 is a block diagram illustrating communications

between a reader and multiple tags in an RFID system in accordance with the prior art;

[0021] FIG. 4 is a block diagram illustrating a transmission apparatus for a tag for backscattering ASK and/or on-off keying ("OOK") signals in accordance with the prior art;

[0022] FIG. 5 is a block diagram illustrating a transmission apparatus for a tag for backscattering PSK signals in accordance with the prior art;

[0023] FIG. 6 is a block diagram illustrating multiple tags communicating back to a reader using the same frequency spectrum in accordance with the prior art;

CLAIMS

1. A transmission apparatus for a wireless device, comprising:

an antenna for receiving an original signal and for backscattering a modulated signal containing information from the wireless device;

a variable impedance coupled to the antenna, the variable impedance having an impedance value, wherein the variable impedance has a parallel array of impedances that are switched on and off, the parallel array of impedances including filtering characteristics capable of removing out-of-band noise received by the parallel array of impedances;

a delta-sigma modulator coupled to the parallel array of impedances for modulating the impedance value, and thereby a backscattering coefficient for the antenna, in accordance with the information to generate the modulated signal, the delta-sigma modulator including an over-sampling clock to set an over-sampling rate to over-sample the information; and,

a decoder coupled to the delta-sigma modulator for generating the impedance value from the information, the decoder being a backscattering decoder,

wherein the information is an N-bit digital waveform that is adjusted by the decoder and the delta-sigma modulator to compensate for errors in the parallel array of impedances.

2. The transmission apparatus of claim 1 wherein the information is an N-bit digital waveform that is applied to the decoder and then to the delta-sigma modulator to produce a control signal for the variable impedance that is related to the N-bit digital waveform.

3. The transmission apparatus of claim 1 wherein the information is a complex modulation signal that is offset in

frequency from the original signal.

4. The transmission apparatus of claim 1 wherein the information is a complex modulation signal that alternates between an in-phase signal and a quadrature signal via a control signal, and the variable impedance switches between backscattering coefficients that are 90 degrees offset from each other depending on whether the complex modulation signal is the in- phase signal or the quadrature signal.

5. The transmission apparatus of claim 1 wherein the variable impedance includes a filter for filtering noise generated by at least one of the decoder and the delta-sigma modulator.

6. The transmission apparatus of claim 1 wherein the original signal is received from an RFID reader that is configured to correct for errors in at least one of the decoder, the delta-sigma modulator, and the variable impedance.

7. A transmission apparatus for a wireless device, comprising:

an inductor for receiving an original signal and for transmitting by mutual inductance a modulated signal containing information from the wireless device;

a variable impedance coupled to the inductor, the variable impedance having an impedance value;

a delta-sigma modulator coupled to the variable impedance for modulating the impedance value, and thereby a value of the mutual inductance, in accordance with the information to generate the modulated signal; and,

a decoder coupled to the delta-sigma modulator for generating the impedance value from the information,

wherein the information is a complex modulation signal that alternates between an in-phase signal and a quadrature signal via a control signal, and the variable impedance switches between impedance values that are 90 degrees offset from each other depending on whether the complex modulation signal is the in-phase signal or the quadrature signal, and

wherein the delta-sigma modulator includes an over-sampling clock to set an over-sampling rate to over-sample the information.

8. The transmission apparatus of claim 7 wherein the information is an N-bit digital waveform that is applied to the decoder and then to the delta-sigma modulator to produce a control signal for the variable impedance that is related to the N-bit digital waveform.

9. The transmission apparatus of claim 7 wherein the information is a complex modulation signal that is offset in frequency from the original signal.

10. The transmission apparatus of claim 7 wherein the information is an N-bit digital waveform that is adjusted to compensate for errors in at least one of the decoder, the delta-sigma modulator, and the variable impedance.

11. The transmission apparatus of claim 7 wherein the variable impedance includes a filter for filtering noise generated by at least one of the decoder and the delta-sigma modulator.

12. The transmission apparatus of claim 7 wherein the original signal is received from an RFID reader is configured to correct for errors in at least one of the decoder, the delta-sigma modulator, and the variable impedance.

13. The transmission apparatus of claim 1 wherein the delta-sigma modulator is one of a low-pass delta-sigma modulator and a band-pass delta-sigma modulator.

14. The transmission apparatus of claim 1 wherein the delta-sigma modulator is a single bit delta-sigma modulator.

15. The transmission apparatus of claim 1 wherein the delta-sigma modulator switches the impedance value between at least two states.

16. The transmission apparatus of claim 7 wherein the delta-sigma modulator is one of a low-pass delta-sigma modulator and a band-pass delta-sigma modulator.

17. The transmission apparatus of claim 7 wherein the delta-sigma modulator is a single bit delta-sigma modulator.

18. The transmission apparatus of claim 7 wherein the delta-sigma modulator switches the impedance value between at least two states.

19. A method of transmitting a signal by a wireless device, comprising:

receiving an original signal on an antenna of the wireless device;

backscattering a modulated signal containing information from the wireless device;

generating the modulated signal in accordance with the information by modulating an impedance value of a parallel array of variable impedances coupled to the antenna and thereby a backscattering coefficient for the antenna,

wherein an over-sampling clock coupled to a delta-sigma

modulator sets an over-sampling rate to over-sample the information;

generating the impedance values from the information by a decoder coupled to the delta-sigma modulator, the decoder being a backscattering decoder,

wherein the information is an N-bit digital waveform that is adjusted by the decoder and the delta-sigma modulator to compensate for errors in the parallel array of impedances.

20. The method of claim 19, wherein the information further is a complex modulation signal that alternates between an in-phase signal and a quadrature signal via a control signal, and the variable impedance switches between impedance values that are 90 degrees offset from each other depending on whether the complex modulation signal is the in-phase signal or the quadrature signal.